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Public Sector, Not for Profit & Healthcare Management

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Student Papers

Elizabeth Rasnick……Georgia Southern University

Supply Chain Management and Logistics

Rebecca Scott……University of North Carolina Wilmington

Table of Contents

Experience with and Advice for Teaching Statistics and Analytics with Excel, R and Python **541**
Dr. Robert Andrews[1], Prof. Leslie Hendrix[2], Prof. Joan Donohue[2], Dr. Zhixin Kang[3], Prof. Kellie Keeling[4]
1. Virginia Commonwealth University, 2. University of South Carolina, 3. UNC Pembroke, 4. University of Denver

Value of Software for Teaching Variable Reduction and Healthcare Quality **543**
Dr. Robert Andrews[1], Mr. Kevin Potcner[2], Dr. Rose Sebastianelli[3]
1. Virginia Commonwealth University, 2. JMP, 3. University of Scranton

Accounting, Economics and Finance

A SIMPLE MODEL OF INFLATION VOLATILITY

Regular Session

Dr. Barry Pfitzner [1]***, Dr. Sreven Lang*** [1]

1. *Randolph-Macon College*

This paper investigates the behavior of inflation, measured by the Consumer Price Index, over the recent past with primary focus on volatility, not the level of inflation. Over the past 70 years, the inflation rate has shown periods of tranquility as well as periods of volatility. Evidence from the early 2000s suggests that inflation, after a period tranquility during the 1990s, became more volatile early in the new century (perhaps even as early as 1999)—prior to the run-up in the energy and food sectors. Since the 2008-2009 rise in volatility, inflation has entered a more tranquil phase, but is still more volatile than during the Great Moderation of the 1990s. Evidence of the changes in volatility is presented, and the volatility is modeled with a relatively simple autoregressive conditional heteroskedasticity (ARCH) model.

A STUDY OF THE RELATIONSHIP BETWEEN NARCISCISTIC LEADERSHIP, LOCUS OF CONTROL, AND JOB SATISFACTION IN THE ACCOUNTING PROFESSION

Regular Session

Dr. Susan Shurden [1], ***Dr. Mike Shurden*** [1]

1. *Lander University*

Narcissistic leadership is often prevalent within the business environment. Narcissism is considered a personality disorder and may cause significant problems for those who work for such leaders. This purpose of this paper is to study the relationship between narcissistic leadership and job satisfaction within the accounting industry. Also, locus of control, which refers to the amount of control an individual believes they have over their circumstances or environment, will be examine with regard to narcissism and job satisfaction. These variables will be analyzed from data collected from 152 accountants throughout the country. The primary research question guiding this study was: Do locus of control (LOC), and narcissistic leadership affect employee job satisfaction in the accounting profession? The data were analyzed using SmartPLS data software, and the method of analysis was (PLS-SEM), partial least squares, structural equation modeling. Further analysis were conducted to determine if significant differences exist between female and male accountants in regard to narcissistic leadership, LOC, and job satisfaction.

BUSINESS LAW OUTCOME ASSESSMENT FOR ACCOUNTING MAJORS

Regular Session

Dr. Larry Menter [1], ***Mr. Dustin Grant*** [1], ***Dr. Greg Kordecki*** [1]

1. *Clayton State University*

Business schools pride themselves with knowledge of achievements of their graduates in the work force, and may attribute some of this success to the quality of assessment the individuals received during their time of academic preparation. External influences by accreditation associations such as the Association to Advance Collegiate Schools of Business (AACSB) and the Accreditation Council for Business Schools and Programs (ACBSP) are part of a trend to have common measures as part of the evaluation scheme. Accounting graduates wishing to achieve professional certification of the certified public accountant (CPA) must face the uniform CPA examination as an additional assessment beyond any academic or experience credentials imposed by their state jurisdiction. The CPA exam then becomes an excellent assessment measure as it is carefully developed and controlled internationally, and reveals results on components such as strength in business law and other areas in the curriculum which are not always tested heavily or given sufficient emphasis in the path to becoming a successful accounting graduate.

Impact of Capital Investment, Export, Education, and Growth of State Product: Evidence from ARDL, DOLS, and GMM Estimates

Regular Session

Dr. Muhammad Mustafa [1], ***Dr. Haile Selassie*** [1]

1. *South Carolina State University*

This paper investigates the impact of capital investment, export, and education on gross state product growth. Unlike previous studies, this study uses the autoregressive distributed lag (ARDL) bound testing approach, Dynamic OLS (DOLS) and GMM methodologies to explore the linkages among the variables. The long- run results show that capital investment and export have significant positive impact on the growth of gross state product. The short run dynamic results confirm that lagged gross state product, capital investment, education positive impact on growth. Also, GMM and Dynamic OLS estimates find capital investment and export have positive significant impact on growth. The results imply a commitment to education, export promotion and investment are important ingredients for successful state growth strategy.

Medical Tourism Brain Drain

Regular Session

Dr. James Frederick [1]

1. *UNC Pembroke*

Many third-world and emerging countries have promoted medical tourism into their countries as a way for them to earn foreign exchange income. The foreign patients clearly boost incomes in the host country's medical sector. Yet, there has been criticism in the popular press that as the local medical services sector grows to accommodate medical tourism, paradoxically, there has been a decline in the medical care received by the host country's citizens. This paper adds to the economic literature on the effects of medical tourism on the host country. Specifically, this paper develops a model to examine the "brain drain" issue. In the absence of medical tourism, well trained medical practitioners tend to emigrate from the host country in search of high paying patients. With medical tourism, those practitioners can stay in the host country, but their mix of medical tourists and local patients depends on their preferences and the incentives imposed on them by the host country's government. Thus, whether the local patients benefit from medical tourism is indeterminate as it depends on these same factors. The conditions under which the local patients benefit from medical tourism are examined.

Neural Networks Highlight Pricing Differences as Regimes Shift

Regular Session

Dr. Mary Malliaris [1], ***Dr. Anastasios Malliaris*** [1]

1. *Loyola University Chicago*

In this paper we consider five variables describing the microeconomics of supply of and demand for oil and evaluate their importance in different time periods. We consider five dissimilar regimes from January 1986 through 2017:two regimes prior to the global financial crisis, the regime during the crisis and two regimes after the crisis. This analysis shows that, while the inputs into an accurate neural network can remain the same, the impact of each variable can change considerably during different regimes. We find that the shifts in impacts of the various inputs are great enough to support the hypothesis that there are important structural breaks among periods.

A SIMPLE TIME-SERIES MODEL OF INFLATION VOLATILITY

C. Barry Pfitzner and Steven D. Lang, Department of Economics/Business and Accounting, Randolph-Macon College, Ashland, VA, bpfitzne@rmc.edu; slang@rmc.edu

ABSTRACT

This paper investigates the behavior of inflation, measured by the Consumer Price Index, over the recent past with primary focus on volatility, not the level of inflation. Over the past 70 years, the inflation rate has shown periods of tranquility as well as periods of volatility. Evidence from the early 2000s suggests that inflation, after a period tranquility during the 1990s, became more volatile early in the new century (perhaps even as early as 1999)—prior to the run-up in the energy and food sectors. Volatility increased significantly during the Great Recession. During the current recovery inflation has entered a more tranquil phase, but is still more volatile than during the Great Moderation of the 1990s. We present evidence of the changes in volatility, and model the series with a relatively simple autoregressive conditional heteroskedasticity (ARCH) model.

INTRODUCTION

The autoregressive conditional heteroskedasticity (ARCH) model was developed by Robert Engle to explain volatility "clustering," that is, periods in which the variance of a time series is tranquil and other periods in which the variance of the series is more volatile. The ARCH model and its extension, generalized ARCH (GARCH), have been applied to numerous economic and financial series. These models are important in identifying periods of volatility and they also aid in producing more realistic interval forecasts.

DATA, METHOD, PRELIMINARY RESULTS

We collected the monthly measure of the Consumer Price Index (CPI) for the period January 1947 to September 2018. The measure of inflation is the monthly log difference in the CPI at annual rates. That series is shown in Figure 1.

Casual observation of Figure 1 suggests that inflation was quite volatile in the late 1940s and early 1950s, again in the 1970s, yet again starting around the turn of the century, and during the *Great Recession*. Periods of tranquility were evident in the late 1950s through most of the 1960s, in the 1990s, and in the current recovery. It is well known that simple inspection of the variance of a series can be misleading when the series is autocorrelated. To correct for this, we fit an autoregressive model to the inflation rate. The lags are chosen using standard penalized likelihood model selection criteria. The form of the autoregressive model can be represented as follows:

$$INFL_t = a_0 + \sum_{i=1}^{p} b_i INFL_{t-i} + e_t \quad (1)$$

where *INFL* is annualized monthly inflation, *t* indexes time, e_t is a white noise disturbance term and the $b_i\ (i = 1,..., p)$ are the lag coefficients, and *p* indicates the order of the lags. The two standard penalized likelihood selection criteria are the Akaike information criterion *(AIC)* and the Schwarz information criterion *(SIC)* represented as follows:

$$AIC = (2k / T) + \log(\sigma) \tag{2}$$

$$SIC = [k \log(T) / T] + \log(\sigma), \tag{3}$$

where *k* is the total number of estimated coefficients in the VAR, T is the number of usable observations, and σ is the scalar estimate of the variance of the equation's disturbance term. If the *AIC* and the *SIC* differ on the number of lags, each indicated model was estimated, with evidence presented here for the most parsimonious model. The *SIC* chooses *p* = 12, and we present additional evidence based on that model.

Figure 1: Monthly "Headline" Inflation at Annualized Rates

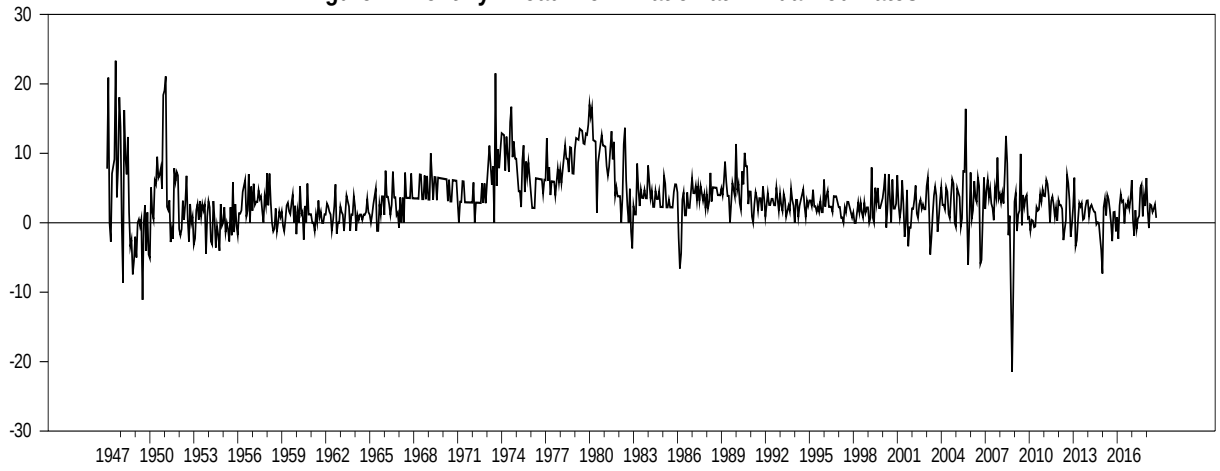


Figure 2: Residuals From the AR Model

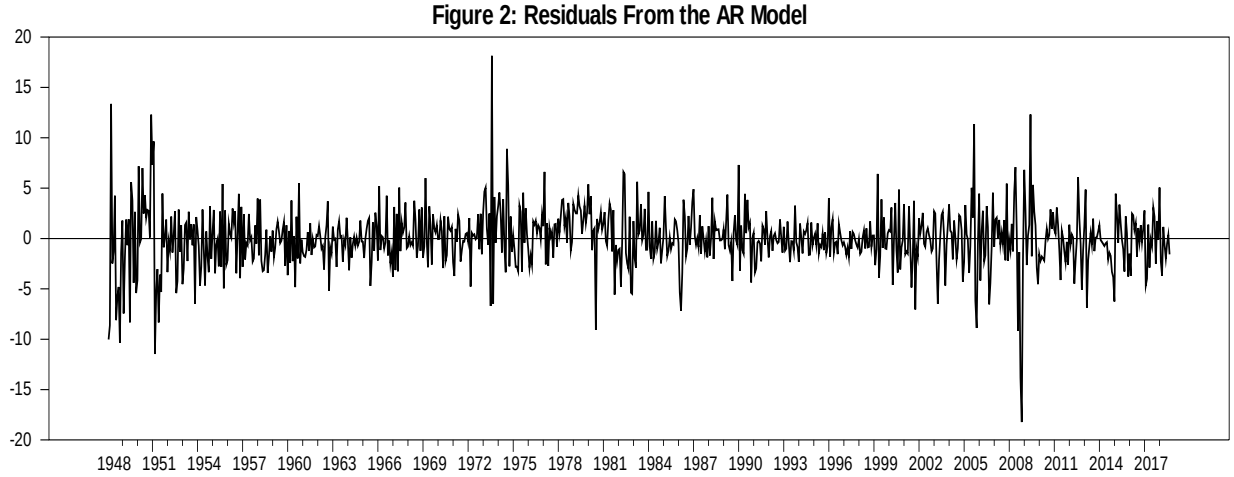


Figure 2 depicts the residuals from the autoregressive model for inflation, with the same periods of volatility and tranquility evident.

Testing for volatility is usually accomplished by analysis of the squared residuals from an autoregressive model, such as depicted in Figure 3. The reasoning for testing the squared residuals is simple. The residuals from the autoregressive model (see Figure 2) will be serially uncorrelated as a result of the autoregressive lag fit. Those residuals are, however, not independent. Small (in absolute value) residuals are likely to be followed by additional small residuals, and large residuals are likely followed by other large residuals—that is the meaning of volatility clustering.

Figure 3: Squared Residuals From the AR Model

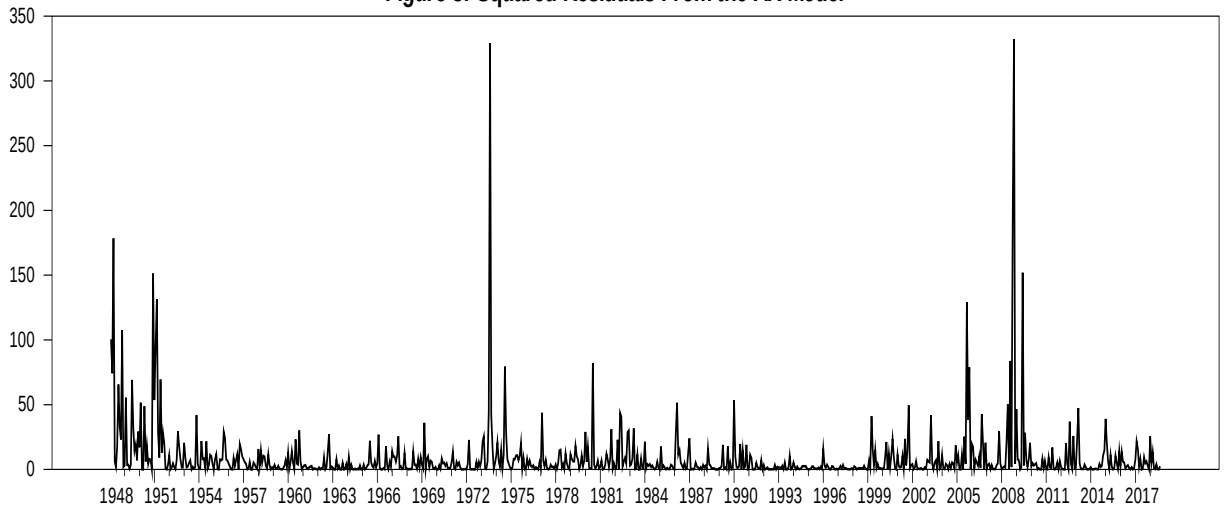


Figure 3 shows the same clustering effect for the squared residuals. To test for ARCH errors, a second regression is run:

$$e_t^2 = c_0 + \sum_{i=1}^{p} d_i e_{t-i}^2 + v_t \quad (4)$$

Where e_t^2 represents the squared residuals from equation 1, and the $d_i\,(i = 1,..., p)$ are lag coefficients and p again indicates the order of the lags. If there are no *ARCH* effects, then equation 4 will have little explanatory power, i.e., R^2 will be very low. The existence of *ARCH* effects can be tested in two ways. First with a sample of T residuals, $T \cdot R^2$ is distributed as χ^2 with p degrees of freedom. Alternatively, an F-test that all d_i coefficients are jointly zero will also indicate whether or not *ARCH* effects are present. The *SIC* chooses 3 lags for equation 4.

The estimated equation for (4) is:

$$\hat{e}_t^2 = 5.20 + 0.23\hat{e}_{t-1}^2 + 0.06\,\hat{e}_{t-2}^2 + 0.10\hat{e}_{t-3}^2 \quad (4')$$

$R^2 = 0.0881$
$T = 845$

The null hypothesis of no *ARCH* effects can be written:

H_0: $d_1 = d_2 = d_3 = 0$ (there are no *ARCH* effects)
H_1: some $d_i \neq 0$ (there are *ARCH* effects)

As expected, the null hypothesis is rejected resoundingly for either the χ^2 test (χ^2 = 74.41), p-value = 0.0000), or the F-test ($F_{(df = 3,841)}$ = 27.07, p-value = 0.0000). We conclude that the process of inflation is subject to *ARCH* effects. Thus we have confirming statistical and visual evidence that small squared residuals tend to be followed by small squared residuals, and large squared residuals are more often followed by other large squared residuals.

OTHER RESULTS

The *ARCH* errors model is typically estimated simultaneously with the autoregressive model of inflation by maximum likelihood methods. That estimation also yields an estimate of the variance of the series, typically known as the h series. Again choosing p = 12 for the autoregressive presentation for inflation, and p = 3, for the variance of the series, we present the portion of the equation that represents the variance (here, h) of the inflation series (here we are less interested in the autoregressive parameters of the estimate of inflation, since many, many, alternative inflation forecasting models are possible):

$$h_t = 2.57 + 0.31\hat{e}_{t-1}^2 + 0.23\hat{e}_{t-2}^2 + 0.30\hat{e}_{t-3}^2 \quad (5)$$
$$(6.86) \quad (4.04) \quad (3.99)$$

Where h is the estimated conditional variance in inflation and the numbers in parentheses are t-statistics.

Figure 4 represents the conditional variance of inflation since 1978 based on the *ARCH* model estimated by maximum likelihood methods. In that figure recessions are shaded. Several things from Figure 4 are striking for the behavior of inflation. First, consistent with prior results, there was a marked period of tranquility, beginning near 1991 and lasting through 1998. Second, the beginnings of the early 2000s increase in volatility began earlier than we would have anticipated, even as early as 1999. In 2008, there was a marked increase in volatility due, in part, to three consecutive months of declines in the CPI. At annualized rates, the declines were 10% in October, 21% in November, and another 10% in December. Since 2010, the recovery phase has seen a period of relative tranquility. Not surprisingly, all of this is consistent with the visual analysis of Figure 3.

As a final visual for the effects on forecasting of the increase in volatility, we offer Figure 5, an estimate of 95% error bands for inflation forecasts. In the graph, we limit the time period to the 1990s until the end of the dataset and, for simplicity, we assume a 2.0% forecast of inflation.

In the graph, it is once again clear that the variance in inflation, and hence the 95% confidence interval around inflation forecasts was relatively narrow for most on the 1990s and began to widen in 1999, and continues on a wider path through the most recent data.

Figure 4: Estimated Variance of Inflation from the ARCH Model

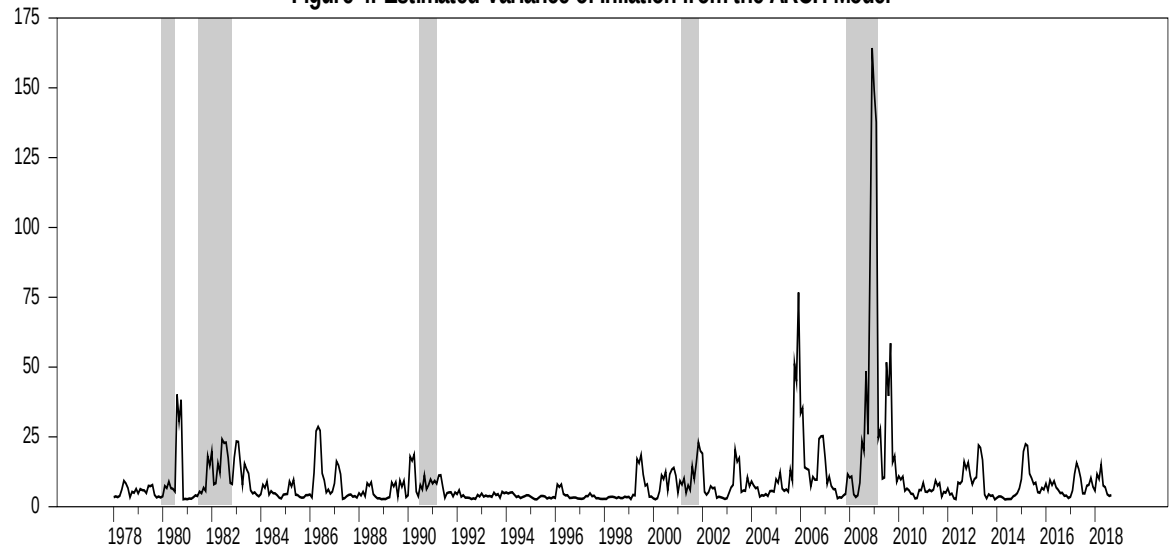
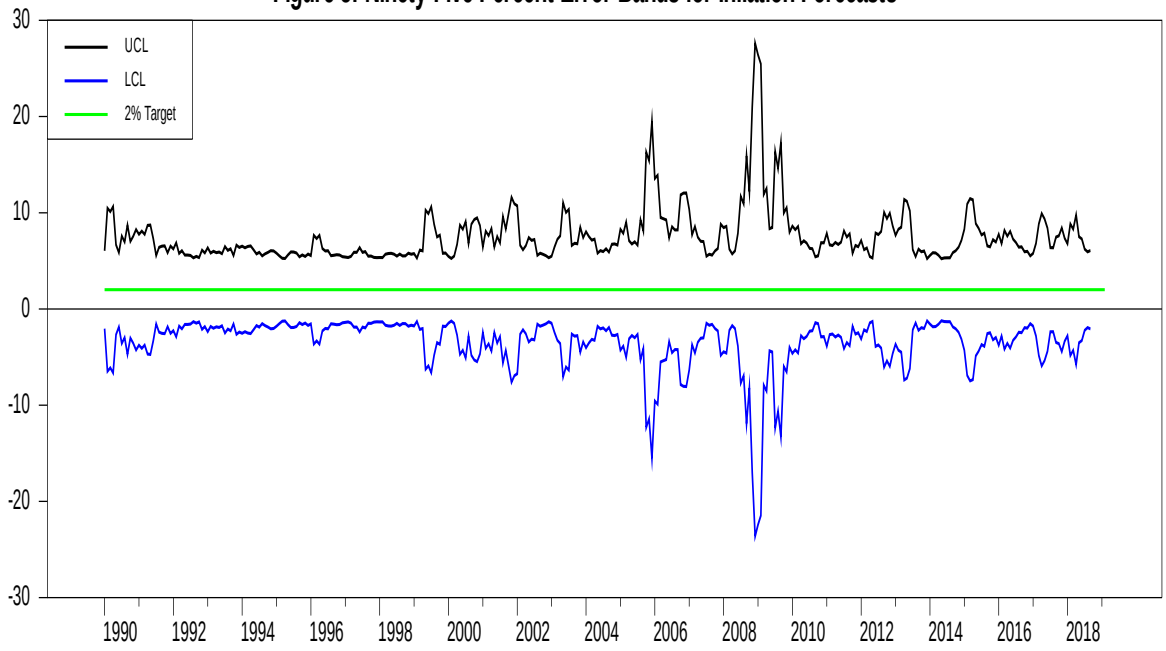


Figure 5: Ninety-Five Percent Error Bands for Inflation Forecasts



To summarize the results of this section, we find in favor of *ARCH* effects for the inflation series. The statistical and visual evidence are (we think) very clear. That result is interesting, but not particularly surprising. We do not find surprising the extremely tranquil period through most of the 1990s. That inflation in the middle to late 2000s is also more volatile is also unsurprising. That the genesis of that increased volatility seems to have begun as early as 1999 is (at least to us) a surprise. The increase in volatility in 2008, during the *Great Recession*, can be traced primarily to a tremendous fall (70%) in energy prices during the credit crunch. Energy prices had risen to near record levels by summer of 2008. Since the volatile phase during the *Great Recession*, headline inflation has returned to a more tranquil period in the recovery period.

MONETARY POLICY AND VOLATILITY

The Federal Reserve System's dual mandate calls for "stable" prices. Current monetary policy makers in the US and elsewhere have adopted specific inflation targets—for the US the target is 2% (see Figure 5), measured by the Personal Consumption Expenditure (CPE) index excluding food and energy prices. Measures excluding those volatile sectors are commonly referred to as "core" inflation. *Stable* prices would then imply moderate fluctuations relative to the 2% target. Moreover, it has long been a central tenet of monetary policy that the FED should provide a stable background so that decision making on the part of economic agents is not impaired by volatile inflation. The level of inflation and its volatility are important considerations for monetary policy in the US.

Recall that the data series employed in this work is the monthly Consumer Price Index (CPI) including food and energy. Though not the primary inflation target of monetary policy, it is nonetheless a measure that is closely watched by policymakers and the public alike.

ECONOMIC EVENTS AND INFLATION

Why would inflation have been less volatile in the 1990s, and more so in the early 2000s, very volatile during the *Great Recession*, and more tranquil during the current recovery? Here we present some economic events that may be associated with those effects.

The tranquil period of the 1990s can be considered a part of *The Great Moderation*. This term, coined by Stock and Watson (2003), refers to the simultaneous reduction in the volatility of inflation and real output that began in 1984. Bernanke (2004) popularized this moniker and explained that economists attribute its occurrence to structural changes in the economy, improved monetary policy, and good luck. Structural changes include the smaller share of output attributed to durable goods production, improvements in inventory management, and increased openness in international trade and capital flows. The change in monetary policy refers to the increased emphasis on fighting inflation that began in 1979. Good luck took the form of fewer exogenous shocks, such as oil and other commodity price increases and financial crises. The empirical evidence on the relative importance of these three classes of causes of decreased economic volatility is decidedly mixed and it remains an important area of research.

As noted above, the increased volatility of inflation in the early 2000s not surprising. Perhaps the good luck of the 1990s simply ran out. The terrorist attacks on New York and Washington, wars in Afghanistan and Iraq, oil and food price shocks, and the bursting of two speculative bubbles can all be classified as exogenous shocks. The fact that the earliest of these shocks, namely the precipitous decline in stock prices in 2000, occurred in the year *after* the period of inflation volatility began is surprising and interesting to us.

The recession of 2001 and the *Great Recession* clearly indicated resounding end to period of the *Great Moderation*. However, there has been a recent return since 2010 (see, again Figure 4) to a more tranquil period for volatility, though clearly not as tranquil as the 1990s. It may not be surprising that the ongoing (for now, at least) low inflation environment might also imply less volatility—though that is not a foregone conclusion.

CONCLUSIONS

This research finds in favor of modeling inflation as an *ARCH* process, consistent with much other research on inflation. Our primary findings in this paper include the following three conclusions. First, for much of the 1990s, the variance in inflation was very low in comparison with prior and succeeding periods. Second, the increased variance in inflation that followed the period of tranquility began earlier than expected—as early as 1999. Third, following the pronounced increase in volatility during and shortly after the Great Recession, the CPI inflation

measure has entered a new more tranquil phase. The current level of volatility is, however, much greater that that of the 1990s *Great Moderation*.

Since the measure of inflation we use in this paper includes food and energy prices, a future paper based on core inflation (excluding the more volatile food and energy sectors) is an obvious extension. Such an investigation could determine whether the results of this paper are driven by the more volatile CPI components.

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A STUDY OF THE RELATIONSHIP BETWEEN NARCISCISTIC LEADERSHIP, LOCUS OF CONTROL, AND JOB SATISFICTION IN THE ACCOUNTING PROFESSION

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ABSTRACT

Narcissistic leadership is often prevalent within the business environment. Narcissism is considered a personality disorder and may cause significant problems for those who work for such leaders. The purpose of this paper is to study the relationship between narcissistic leadership and job satisfaction within the accounting profession. Also, locus of control, which refers to the amount of control an individual believes they have over their circumstances or environment, will be examined to determine if there is a mediating effect between narcissistic leadership and job satisfaction. These variables will be analyzed from data collected from 152 accountants throughout the United States. The primary research question guiding this study was: Do locus of control (LOC), and narcissistic leadership affect employee job satisfaction in the accounting profession? The data were analyzed using SmartPLS data software, and the method of analysis was (PLS-SEM), partial least squares, structural equation modeling. Further analysis was conducted to determine if significant differences exist between female and male accountants in regard to their perception of narcissistic leadership, LOC, and job satisfaction.

LITERATURE REVIEW

The American Psychiatric Association classifies narcissism as one of ten personality disorders and is diagnosed by an individual having five of the following nine traits:

1) Has a grandiose sense of self-importance.
2) Is preoccupied with fantasies of unlimited success, power, brilliance and beauty.
3) Believes that he or she is special and unique.
4) Requests excessive admiration.
5) Has a sense of entitlement to especially favorable treatment.
6) Is interpersonally exploitative.
7) Lacks empathy with the feelings and needs of others.
8) Is envious of others or believes that others are envious of him or her.
9) Shows arrogant, haughty behaviors and attitudes. (Amernic & Craig, 2010, p. 83).

The APA identifies a personality disorder as a "deviation" from the behavior one normally expects from an individual. These disorders often begin in childhood and continue through adolescence. According to the APA's *Diagnostic and Statistical Manual of Mental Disorders* (fourth edition, text revision version), often abbreviated as DSM-IV-TR, the definition of the

personality disorder of narcissism that is most widely accepted is that it is "a pervasive pattern of grandiosity (in fantasy or behavior), need for admiration and lack of empathy…" (Amernic & Craig, 2010, p. 83).

The word "narcissism" is from Greek mythology where a very handsome young man named Narcissus (son of a nymph and river god) discovered how handsome he was when gazing into a pool of water. He refused to leave the edge of the pool because he had fallen in love with his own reflection. He ultimately died either by suicide or an outright refusal to be separated from his reflection. Regardless of the method of his death, the end result was the same, a short life because of his self-love (Bullfinch, 2012).

Narcissism is also one of three personality disorders characterized as the "dark triad". The other two are Machiavellianism and psychopathy. Machiavellianism is a disorder in which an individual will do anything to accomplish their goal, while psychopathy is characterized by a total lack of empathy and a cold personality. Individuals possessing any of the three personality disorders have an increased desire for power and dominance and will often resort to aggressive tactics to achieve them (Black, 2011).

Narcissists can either be characterized as having a destructive personality or a constructive personality (Grier, 2008). Destructive narcissists are generally arrogant, unprofessional and often unethical. They can be critical and untrustworthy. Destructive narcissists do not work well with others, cannot accept criticism and generally will not listen to others. If a destructive narcissist is in a leadership position, the employees feel undervalued and unappreciated (Lubit, 2002).

However, some narcissists can be constructive (Amernic & Craig, 2010; Craig & Amernic, 2011) and still possess common traits of the destructive narcissist such as ambition, manipulation, and a sensitivity to criticism, yet their general disposition can be positive, and they can have a healthy self-esteem (Kets de Vries & Miller, 1985). An example of a constructive narcissist is Oprah Winfrey. Oprah possesses traits of "healthy adult narcissism" which are empathy, engaging, leadership, self-possessed but not selfish, determined, confrontational, wisely fearful and recognition seeking. (Behary, 2008, pp. 28-29). This study will not investigate the constructive aspect of narcissism but will focus on the destructive characteristics of the disorder.

Grier (2008) says that "The narcissist has one world, and he resides in the middle of it" (p. 21). The "destructive" narcissist is not willing or capable of taking the suggestions of others or of even listening to their opinions. They will generally take actions and make decisions to accomplish their own agenda rather than what is best for the organization. A narcissistic individual is "like an old codger who takes the wrong highway onramp in the dead of night and starts driving against the traffic…. he wonders where all the idiots are coming from" (Grier, 2008, p. 48).

The actions of the destructive narcissist may also be unethical and/or harm company performance. Likewise, the effects of working with a narcissist can be damaging and uncomfortable for others which results in a less than satisfying existence for employees, both

professionally and personally, resulting in little job satisfaction (Grier, 2008). Narcissistic behavior often has a negative impact not only in the work force, but in social and family situations. This disorder affects approximately one percent of all adults in the United States and is more prevalent in men than women (Cherry, 2012).

The theory on which this paper will focus is Locus of Control. The word itself means "place", and an individual can have an internal or external locus of control. If an individual possesses an "internal" locus of control, they believe that their behavior controls the outcome of their situation. If the individual has an "external" locus of control, they believe they personally have little control over the outcome of their situation, but someone or something else externally controls the outcome (Neill, 2004). In other words, Zimbardo (1985) states that the internal locus of control theory means "outcomes of our actions are contingent on what we do" while external locus of controls means "events outside our personal control" influence our actions (Zimbardo, 1985, p. 275).

Generally, it is more desirable to possess an internal locus of control, which also is called self-determination (Neill, 2006). Mamlin, Harris, and Case (2001) observed that males tend to have a higher internal locus of control than females, and males often go higher in the organization. They also contend that older individuals develop a higher internal locus of control. This observation is in contrast with McNulty and Borgen (1988) who believes that individuals between 14-16 have a higher internal locus of control which becomes more external by age 18.

Additionally, an individual's well-being, level of happiness, and job satisfaction are more affected by locus of control (April, Dharani, & Peters, 2012). Maccoby (2003) has identified successful leaders Steve Jobs, Martha Stewart, Bill Gates, Donald Trump as having narcissistic tendencies. Successful leaders such as those listed have also been known to have a higher level of internal locus of control (Hiers & Hecken, 1977), in addition to narcissism. Both combined make them successful (Kets de Vries, 2004). Therefore, this research wants to identify whether job satisfaction is affected by narcissism, and if and to what extent, locus of control intervenes or mediates that relationship.

METHODOLOGY

This purpose of this paper is to study the relationship between narcissistic leadership, internal locus of control (LOC), and job satisfaction within the accounting industry. The research question this study will answer is:

Do locus of control (LOC), and narcissistic leadership affect employee job satisfaction in the accounting profession?

The following are the hypotheses for this study:

Hypothesis 1: Narcissistic leadership has a negative causal impact on employee job satisfaction within the accounting profession.

Hypothesis 2: Narcissistic Leadership has a negative effect on internal locus of control (LOC) within the accounting profession.

Hypothesis 3: Locus of control has a significant positive effect on employee job satisfaction.

Hypothesis 4: Internal locus of control (LOC) has a significant mediating effect between narcissistic leadership and job satisfaction within the accounting profession.

A nation-wide sample of approximately 4,914 accountants were surveyed via email. The overall response rate was 3.3%. The total useable number of surveys were 152. The voluntary nature of participating and the purpose of the study were communicated to the participants. Table 1 reflects the demographics of those who responded to the survey.

The data were analyzed using a software package called SmartPLS. The causal modeling technique called Partial Least Square/Structural Equation Modeling (PLS-SEM) was applied through the software package.

Table 1
Demographic Data

Description	Gender	Age	Degree	CPA	Race
Male	62%				
Female	37%				
No response	1%				
18-30		2%			
31-40		9%			
41-50		18%			
51-60		46%			
Over 60		24%			
No response		1%			
Undergraduate		63%			
Masters			29%		
PhD			7%		
No response			1%		
CPA				91%	
Non-CPA				9%	

White	92.0%
Black	1.3%
Hispanic	2.0%
Asian	.7%
Other	3.0%
No response	1.0%

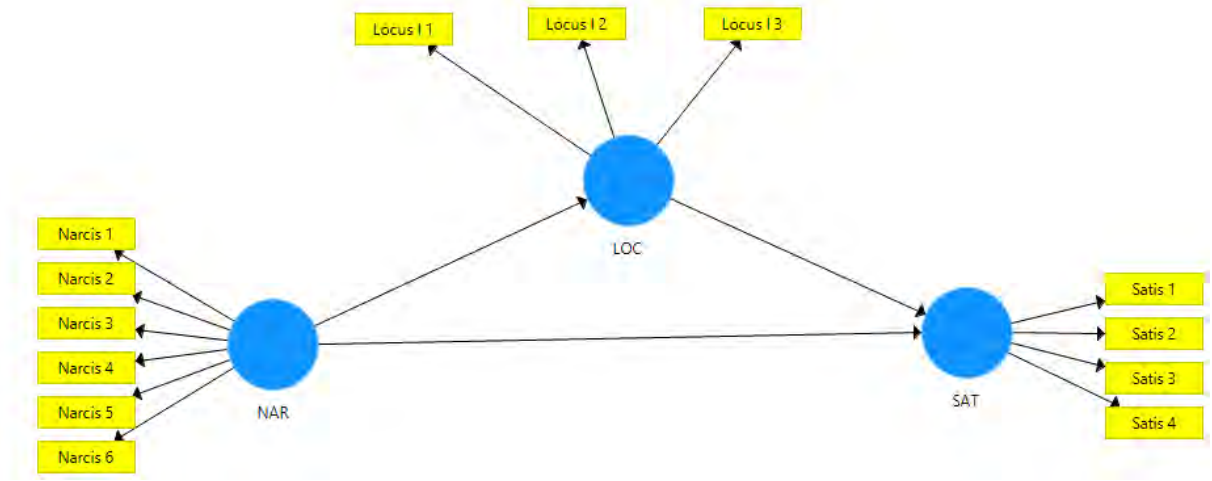
Shurden, 2014.

ANALYSIS

Using Partial Least Squares, Structural Equation Modeling (PLS SEM), the first model produced is shown in Figure 1 and indicates the latent variable and the paths under investigation. As can be seen in Figure 1, the circles represent the three latent variables (Narcissistic Leadership, Internal Locus of Control (LOC) and Job Satisfaction), while the rectangles represent the survey questions associated with each latent variable. Three survey questions were associated with LOC; six questions were associated with the latent variable Narcissistic Leadership; and four questions were associated with Job Satisfaction.

The latent variable Narcissistic Leadership (NAR) is the exogenous (Independent) variable while internal locus of control (LOC) and Job Satisfaction (SAT) are endogenous (Dependent or both) variables. NAR is an exclusively independent variable while SAT is an exclusively dependent variable. LOC can be both independent and dependent.

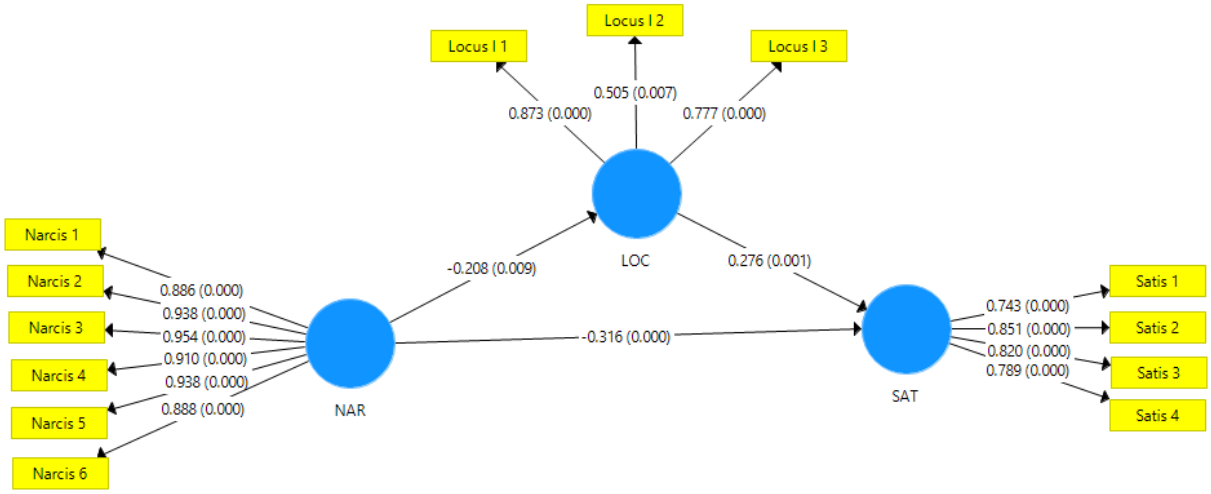
Figure 1
Introductory model showing the latent and indicator variables.



The assumption was made that the latent variables (blue circles) explain the indicator variables (yellow rectangles). Therefore, the indicator variables were classified as reflective rather than formative, meaning the arrows are shown pointing toward the indicator variables (yellow rectangles) as can be seen in Figure 1. Formative relationships suggest the indicator variables

(rectangles) explain the latent variables (circles), and the arrows would be pointing toward the latent variables (circles) had this been the situation.

Figure 2
Bootstrapping Results with SmartPLS



Assessment of Reflective Indicators

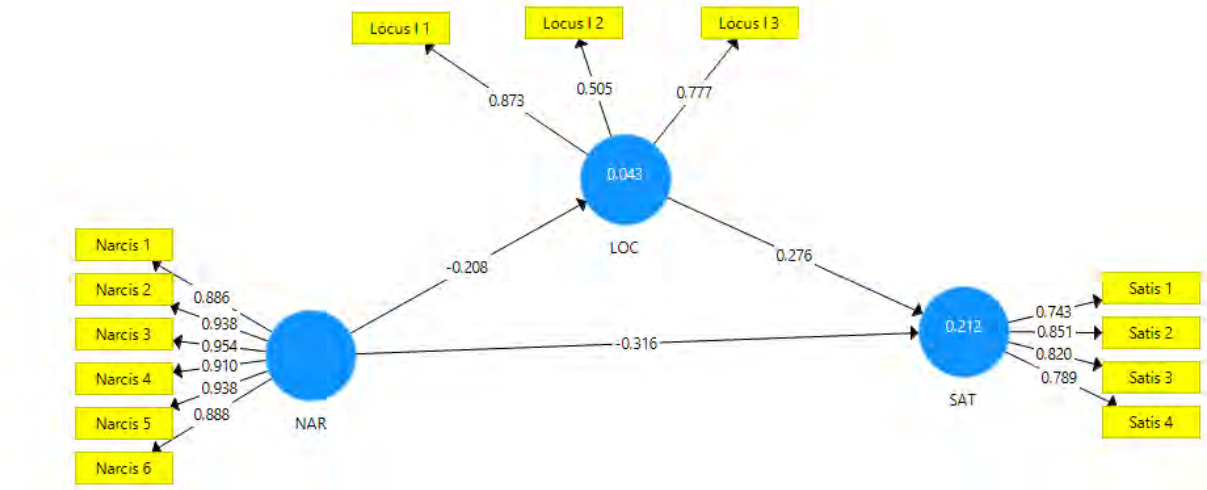
A bootstrapping procedure is a resampling technique that draws samples from the original data and is used to assess statistical significance (Hair, et al. 2017) Using the Bootstrapping procedure in SmartPLS, the p-values of the indicator variables along with the correlation and p-value for each latent variable are presented in Figure 2. All of the reflective indicator variables showed significant p-values as well as the latent variables.

The reflective measurement models (narcissism, internal locus of control, and job satisfaction) were also assessed with regard to their reliability and validity. All indicator reflective variables met the assessment qualifications and were included in the final model.

Final Structural Model Analysis

The final structural model (blue circles) met all the assessment criteria and is now useful for interpretation. The numbers on the line indicate the coefficient which measures the relationship between the two variables. The final structural model is presented in Figure 3.

Figure 3
Final Model



Hypotheses Results and Analysis

In regard to the responses on these hypothesis, it must be acknowledged that these responses are based on the perception of the surveyed respondents only.

Hypothesis 1: Narcissistic leadership has a negative causal impact on employee job satisfaction

In regard to hypothesis 1, there is a significant negative relationship between the "perception" of narcissistic leadership and employee job satisfaction in the accounting profession.

Hypothesis 2: Narcissistic Leadership has a significant negative effect on internal locus of control.

In regard to hypothesis 2, there is a significant negative relationship between the "perception" of narcissistic leadership and internal locus of control in the accounting profession.

Hypothesis 3: Locus of control has a significant positive effect on employee job satisfaction.

In regard to hypothesis 2, there is a positive significant relationship between internal locus of control and its "perceived" effect on employee job satisfaction in the accounting profession.

Hypothesis 4: Internal locus of control (LOC) has a significant mediating effect between narcissistic leadership and job satisfaction.

In regard to hypothesis 4, since hypothesis 2 and 3 were significant; therefore, internal locus of control has a significant mediating effect between narcissistic leadership and its "perceived" effect on job satisfaction within the accounting profession.

SUMMARY AND CONCLUSION

The results of this research indicate that locus of control and narcissistic leadership do affect employee job satisfaction in the accounting profession. In fact, narcissistic leadership has a direct negative effect on job satisfaction. The analysis also indicates that internal locus of control in a leader will have a positive effect on employee job satisfaction. Likewise, narcissism in a leader will have a negative effect on that leader's internal locus of control, meaning their ability to control their situation; and therefore, internal locus of control has a mediating effect between narcissism and job satisfaction.

In previous research of a similar nature, Shurden, (2018) introduced an additional latent variable, Leader Member Exchange (LMX), which is based on the theory of either a positive or negative relationship between employer and employee. When this variable was introduced, locus of control had neither a direct or an indirect effect on employee job satisfaction. Also, the addition of LMX caused the now negative direct relationship between narcissistic leadership and job satisfaction to no longer exist. In that study, LMX had a mediating effect between narcissistic leadership and job satisfaction. The study by Shurden, (2018) also found a positive direct relationship between LMX and LOC indicating that the relationship between leader and employee does have an effect on the individual's "feelings" of control. However, that study did not indicate if that LOC was internal or external. It could be assumed that by the nature of the relationship being positive, the LOC was internal. Otherwise, an individual might feel as if the leader had control rather than themselves.

However, while an internal locus of control "feels" satisfying to the individual possessing it (Neill, 2006), the effects on others may be adverse (April, et al., 2012). And keep in mind that that internal locus of control by the employer becomes the external locus of control of the employee. Therefore, comments from some interviewees experiencing external locus of control were, "I am consistently externally affected by 'powerful others'…my Dad and other influential people has [sic] often led to me feeling inadequate. Even if I know that I have performed brilliantly. I often do not get any satisfaction…" (April et al, 2012, p. 130). They go on to say that "…external locus of control, of powerful others affecting me, was so entrenched in me that I even became dissatisfied in my job" (April et. al, 2012, p. 130).

Likewise, Neil (2006) believes that those in leadership possessing that internal locus of control have an unhealthy and unstable mental attitude which causes neurosis, anxiety and depression. He believes that one can still have personal success and maintain personal control and become competent, thereby offsetting the maladjustment that could form from the psychological

adversity. Research has proven that the more successful leaders have a much higher internal locus of control (Hiers and Heckel, 1977; Anderson & Schneier, 1978; McCullough, Ashbridge & Pegg, 1994), and that the connection between leadership and internal locus of control is because these leaders have faith that they can achieve their dreams/objectives through their own abilities (Klein and Wasserstein-Warnet, 1999). The nagging question is, can these leaders still be successful and maintain healthy, happy relationships with employees? After all, in the long run, it is often the individuals behind the throne that make the king look regal!

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NEURAL NETWORKS HIGHLIGHT PRICING DIFFERENCES AS REGIMES SHIFT

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ABSTRACT

In this paper we consider five variables describing the microeconomics of supply of and demand for oil and evaluate their importance in different time periods. We consider five dissimilar regimes from January 1986 through 2017: two regimes prior to the global financial crisis, the regime during the crisis and two regimes after the crisis. This analysis shows that, while the inputs into an accurate neural network can remain the same, the impact of each variable can change considerably during different regimes. We find that the shifts in impacts of the various inputs are great enough to support the hypothesis that there are important structural breaks among periods.

INTRODUCTION

Global oil markets are complex and the price of oil exhibits significant volatility. During the past four decades, the price of oil was as low as about $20 in the late 1990s and as high as $150 before the global financial crisis. An excellent overview of the behavior of oil prices over the past forty years with a special focus on the fluctuations of these prices is given in [4]. These authors emphasize that fluctuations of such magnitude contain a large component of surprise in the sense that ordinary economic foresight could not penetrate the dynamic succession of regime shifting in oil markets. For example, events such as the 1973/74 oil crisis with the deliberate cuts in oil production in Arab OPEC countries were followed by the unexpected Great Moderation during the mid-1980s.

The moderation of inflation and the reduction of real GDP fluctuations created conditions for increased risk-taking and the housing bubble of 2002 to 2007 with its associated global boom in emerging markets like China, India and Brazil that fueled big increases in the price of oil. Then we experienced the unforeseen global financial crisis and the ushering of unconventional monetary policies around the world that brought oil prices from about $150 down to $40, and finally, the post crisis period with the quick recovery of China but also the eventual fracking technology that brought a huge decline in oil prices. A comprehensive analysis of this period is given in [2], [3], and [4] while other authors examine specific topics and periods, such as [8], [5], [12] and [10].

The focus of this paper is the pricing of oil and its determinants. We consider five variables describing the microeconomics of supply of, and demand for, oil motivated by a similar approach proposed by [11]. We evaluate their importance of oil determinants and their variability before, during and after the global financial crisis. We consider five dissimilar regimes during the period of January 1986 to the end of 2017: two regimes prior to the global financial crisis, the regime during the crisis and two regimes after the crisis.

The classic paper on regime changes is [1] that instructs us about the methodology used. Economists are familiar with two regime methodologies from the analysis of business cycles. One regime contains period of economic growth and the next regime includes periods of decline. The fundamental assumption is that all regimes of growth are similar in all other respects; similarly for regimes of decline. However, regimes need not repeat themselves between just 2 states: growth and decline. Most techniques consider two regimes and in the case of oil have been applied extensively in papers such as [6] or [16]. Related papers are [13], [14], and [17]. In our case we identify 5 regimes described in section 2 and assume that each such regime is distinctive.

The main hypothesis tested is that oil fundamentals of supply and demand remain important even as the five regimes are dissimilar. We build five boosted and over-fitted neural networks to capture the exact relationships between spot oil prices and oil data related to those prices. This analysis shows that, while the inputs into an accurate neural network can remain the same, the impact of each variable can change considerably during different regimes. We find that the shifts in impacts of the various inputs are great enough to support the hypothesis that there are important structural breaks between periods.

There are many reasons to avoid overfitting a neural network, particularly because it destroys any chance of building a generalized model that will be good over time. But in this paper, we use the downsides of overfitting to our benefit. By overfitting models on five different time periods, we are able to highlight why generalization is difficult over the entire period. By building, then comparing, five bespoke networks, we can identify the specific areas where general models will need to improve in order to forecast well. Although we do not perform any forecasting, the neural network methodology applied in this paper, the microeconomic data of independent inputs used and the results obtained provide an excellent opportunity for further work in this area along the lines of [7], [9] and [15].

In this paper, we build five neural network models and overfit them in order to capture the relationships among the inputs in the ways that most perfectly match their configuration in a specific period. As indicated, it is not our purpose to build forecasting models with validation sets. Rather, we want to create descriptive models that encapsulate existing relationships on different regimes of the data set. This will help us to understand the shift in variable impact over the various regimes.

DATA

The data for this study comprises inputs related to oil and supply and demand for oil. There are five variables, the spot price of oil, and the stored stocks of oil except for the part held out by the government for the strategic petroleum reserves, net imports of oil, oil production and product supplied. The EIA uses product supplied as a representation for the amount of petroleum products consumed. All data are monthly and were downloaded from the US Energy Information Administration (EIA). They cover the time period from January 1986 through the end of 2017. Table 1 gives the source of the data for each of these variables, and the abbreviated name used in the models.

The spot price of oil is the price of a single transaction for delivery of a determined quantity of oil to a specified place. Demand for oil does not change rapidly, but is seasonal. As demand varies, we see the effect on production, on imports, and on the amount of oil in storage. The stock of oil, excluding the strategic petroleum reserves, includes the inventories stored for future use and is reported in thousands of barrels on the last day of the week. The strategic petroleum reserve is an amount of stock maintained by the government for use during any period where there is a major disruption in supply. The values of net imports are recorded in thousands of barrels imported and include oil from the 50 states, the District of Columbia and U.S. possessions and territories.

TABLE 1. VARIABLES AND THEIR SOURCES

Variable	Data Source	Short Name	Source URL
Production of Oil in the U.S.	MCRFPUS1 from EIA	Prod	https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm
Net Imports of Oil in the U.S.	MTTNTUS2 from EIA	NetImp	https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MTTNTUS2&f=M
Oil Stocks excluding the Strategic Petroleum Reserve	MTESTUS1 from EIA	Stks	https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MTESTUS1&f=M
Product Supplied (Consumption) of Oil	MTTUPUS1 from EIA	Con	https://www.eia.gov/dnav/pet/pet_cons_psup_dc_nus_mbbl_m.htm
Spot Price of Cushing Oil	RWTC from EIA	SpotPr	https://www.eia.gov/dnav/pet/pet_pri_spt_s1_m.htm
Month of the year	Derived from data above	Month	

Net imports is the amount of imports minus the amount of exports. Production is in thousands of barrels. Production covers the volume of oil produced from U.S. oil reservoirs. It includes the volume from the point of custody transfer to trucks, pipelines, or other means with the intent to be transported to refineries. The quantities are estimated by state and summed to the PADD and then the U.S. level. The Product Supplied is used as a stand-in for the consumption of petroleum products since it calculated as the removal of petroleum products from principal origins. These 5 variables form the fundamentals of supply (production, plus net imports, plus oil stock (inventory) and oil demand, both determining the price of oil in the U.S. variables were then scaled to be between zero and one. This set of variables include the abbreviation of the original variable name followed by Scld. Scaling allows the model to treat the variables on a more equal basis, but all values are positive, as they refer to quantities and prices. Thus, for the model, scaled values allow direct comparison of variables. The target for each network was the scaled value of the spot price of oil.

The data set was split into five parts using the structural breaks created by the intervening economic crisis. These five time periods are shown in Table 2 along with the beginning and ending dates, and number of months. Our entire data set begins in January of 1986 and shows a sideways movement of spot prices until late 2001, followed by a steady growth of spot prices, with some noise, until late 2007. The crisis period is the one determined by the National Bureau of Economic Research and coincides with the Great Recession that began in December 2007 and ended in May/June 2009. During this period the bubble continued growing in late 2007 and early 2008 and then collapsed with the Lehman Brothers' bankruptcy. A small bounce at the bottom led eventually to the resumption of the steady growth of prices after mid-2009. After this time period, we see another sharp downward trend followed by a slight upward move. Thus the middle regime is chosen objectively since it describes the period of the Great Recession while the two regimes before it and the two after it are decided by subsets differing in terms of price volatility. Viewed together these 5 regimes are dissimilar in terms of economic conditions and the oil market.

TABLE 2. DATA SET TIME PERIODS

Regime	Begin	End	Number of Months
Pre-Bubble	Jan 1986	Dec 2001	180
Bubble Forming	Jan 2002	Nov 2007	83
Crisis	Dec 2007	May 2009	18
After Crisis	June 2009	May 2013	48
Recent	June 2013	Nov 2017	54

Figure 1 shows this graphically along with the five periods. In Figures 2, 3, 4, and 5, we see the graphical representation of each of the scaled input variables. Net imports shows a great amount of inter-week volatility and an underlying inverted parabola shape, increasing prior to the Crisis, and decreasing afterwards. Production moves in an upward parabolic shape with periodic seasonal drops where oil demand slows. Following the Crisis, production increased significantly then took a dip. Stocks also exhibit a seasonal pattern with a sharp increase in the recent time period. Consumption shows a seasonal increasing pattern that dropped during the Crisis and has been gradually increasing since then.

FIGURE 1. SPOT PRICES OVER FIVE REGIMES

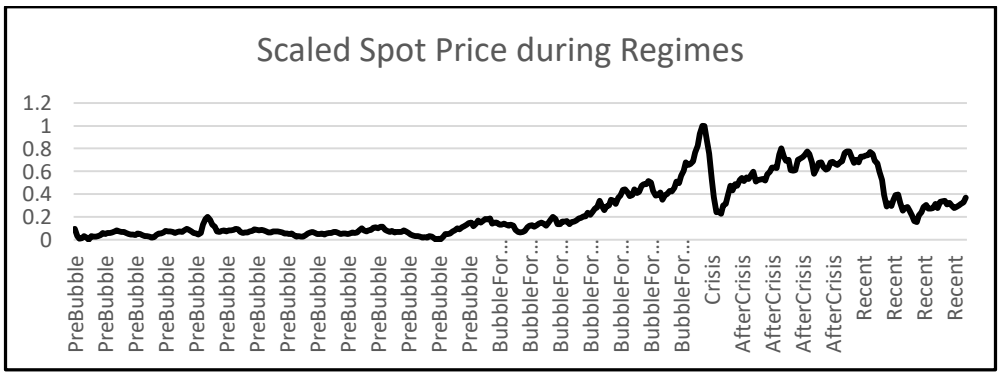


FIGURE 2. NET IMPORTS

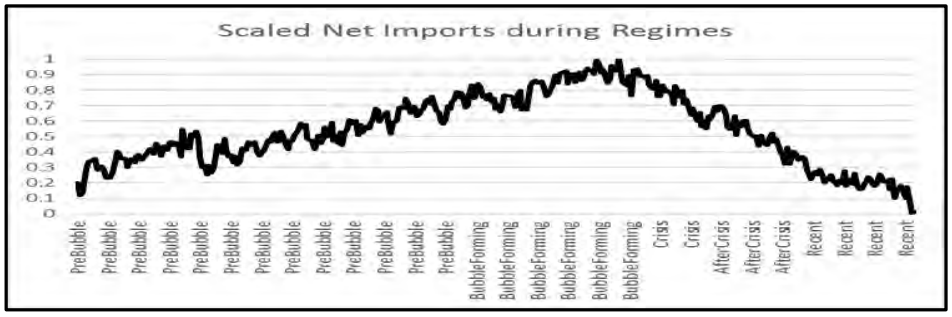


FIGURE 3. PRODUCTION

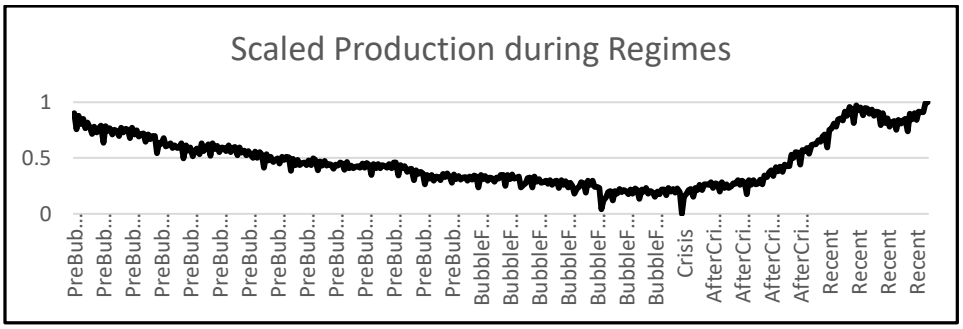


FIGURE 4. STOCKS

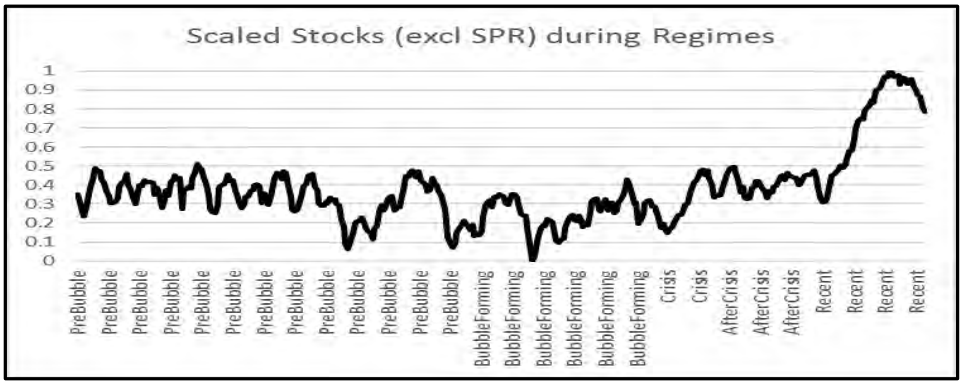
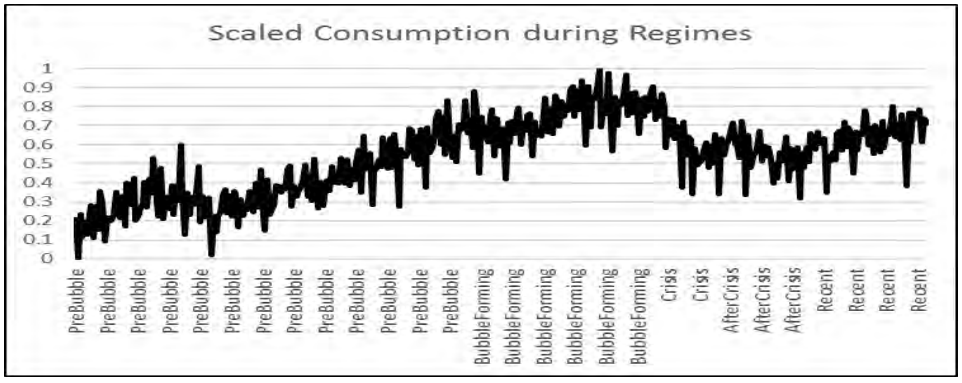


FIGURE 5. CONSUMPTION



In Table 3, we see the correlations of the input variables and the spot price during each of the time periods. Negative correlations are shown as shaded cells. As a first indication of the shifting relationships, we see that the set of negative correlations is not consistent from period to period. No input is always positive or negative. Production is negatively correlated with spot price, except in the period following the crisis. Consumption has a positive correlation with the spot price before and through the crisis period, then turns negative for both periods following the crisis. The amount of oil held in stocks has a negative correlation with the spot price except when the bubble was beginning to form. And net imports have a positive relationship to the spot price except during the period immediately after the crisis, where it turned sharply negative. These shifting correlation relationships are an indication that the importance of each of these variables to the spot price may within each of the neural network models.

TABLE 3. CORRELATIONS BETWEEN INPUT VARIABLES AND THE SPOT PRICE, PER PERIOD

	PreBubble	***BubbleForming***	***Crisis***	***AfterCrisis***	***Recent***
ProdScld	-0.291	-0.780	-0.107	0.437	-0.654
ConScld	0.252	0.488	0.427	-0.242	-0.387
StksScld	-0.444	0.276	-0.796	-0.487	-0.885
NetImpScld	0.228	0.682	0.406	-0.563	0.556

MODELS

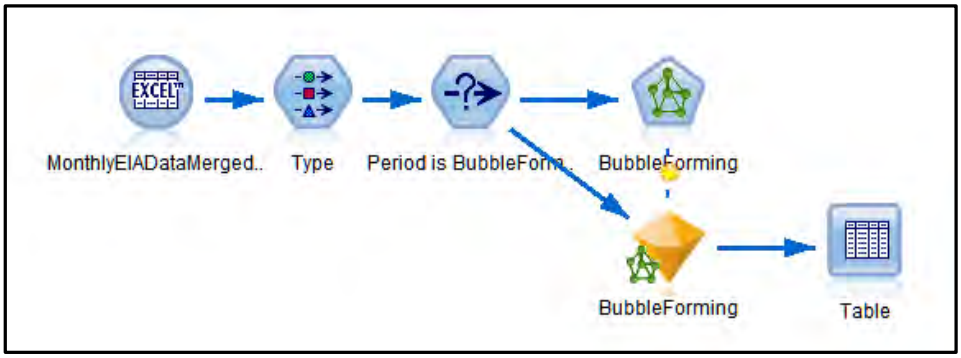
Each of the data sets was used to build a neural network with IBM's Modeler 17.0 data mining software. Each model had 5 input variables and 1 target. The multi- perceptron networks had one hidden layer. Since the objective was to build models that were as precise as possible on each data set, boosting was used to enhance the model accuracy. The same seed of 229176228 was used for each of the networks for replicability. Models were set to stop after a maximum of 15 minutes, though each trained in under a minute.

In Modeler, boosting is done by creating an ensemble model. That is, a sequence of ten models is built. In this group of component models, each one is built on the entire data set of the period. Before building the next successive component model, all the rows are weighted based on the residuals from the immediately previous component model. Rows with large residuals receive relatively higher analysis weights in order to force the following component model to forecast these particular records very well. The component models all together form the ensemble model. This ensemble model then scores records by using a combining rule. This combining rule assigns to the target the value that has the highest probability most often across the component models. This is done to help the network to most perfectly mirror the relationships within that financial regime of the data.

In Modeler, all development occurs through nodes and flows from the first node to the last. Nodes are added to the stream by dragging up into the stream the type of node you wish from the possible set at the bottom of the stream's screen area. Figure 6 illustrates one of the streams constructed

for this problem. It shows an Excel node connected to a Type node, then to a Select node followed by a neural network node. The network generates a trained node (shown as a gold nugget) through which it sends data. The last node, a table, is used to display the results.

FIGURE 6. MODELER STREAM



Settings within a node are easily accessed by right-clicking on the node and opening a submenu. The data is first read in using an Excel node which forms the connection to the specific data set. It then flows through a Type node where the role each field will play is specified. As Modeler reads the data, it also displays the largest/smallest values the variable takes on, the type of data it is assigning to each variable, and whether or not there is any missing or unreadable data in the set. The Type node, opened in its Edit screen, allows all these setting to be checked.

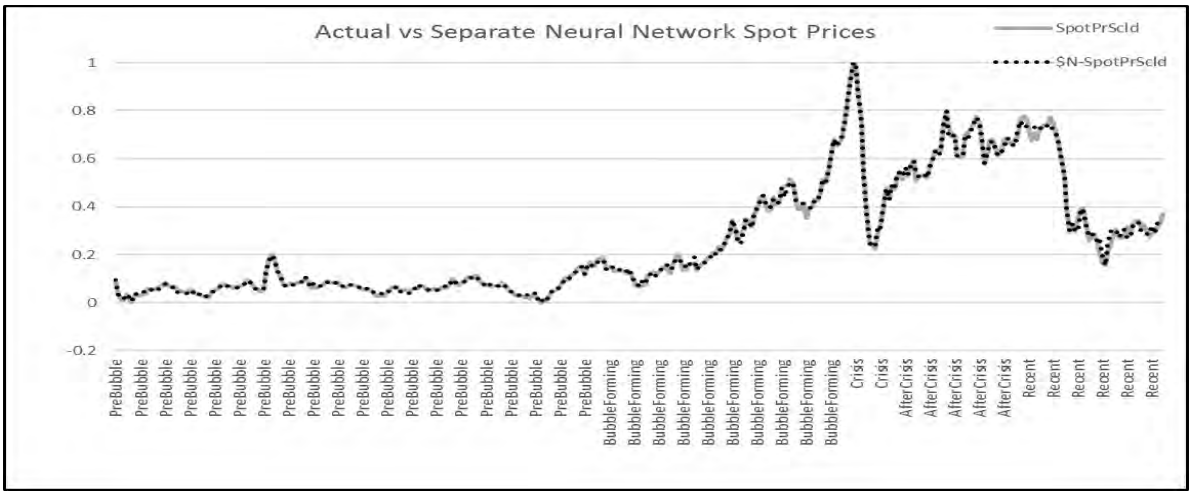
From the Type node, the data is fed through a Select node which allows you to narrow the data set to a specific time period. From this node the data flows to the neural network node. Within the neural network node, the settings for model size and purpose (boosting) are controlled. There are many possible settings within the Edit screen of this node. In Objectives, one can choose to build a standard model, to model for accuracy, or to model for stability. Stopping rule limits can be set for time, for number of cycles, or for accuracy. When using either boosting or bagging, settings under Ensembles allow the user to specify the type of combining rule that will be used for either continuous or category type targets. Under the Advanced menu, the user can specify the random seed for the network run in order to replicate results, and whether or not missing values will be imputed.

The neural network is then executed and this generates a trained model. The trained model can be browsed to view the sensitivity analysis and structure of the model. Once a trained model is generated, other data sets can be run through it to generate future forecasts or to compare accuracy on a validation set. The trained model's specific output can be viewed by attaching a table to the trained node and running the data through it. A network similar to the one shown was developed for each of the five data sets.

The accuracy of these networks can be seen in the next graph, Figure 7, which shows the actual spot price versus the spot price generated by the trained networks. To generate this graph, the

data from all five sets was recombined into a single set. The trained networks closely mimic the actual prices, with a mean absolute deviation of .007 across all periods.

FIGURE 7. ACTUAL VS NEURAL NETWORK SPOT PRICES

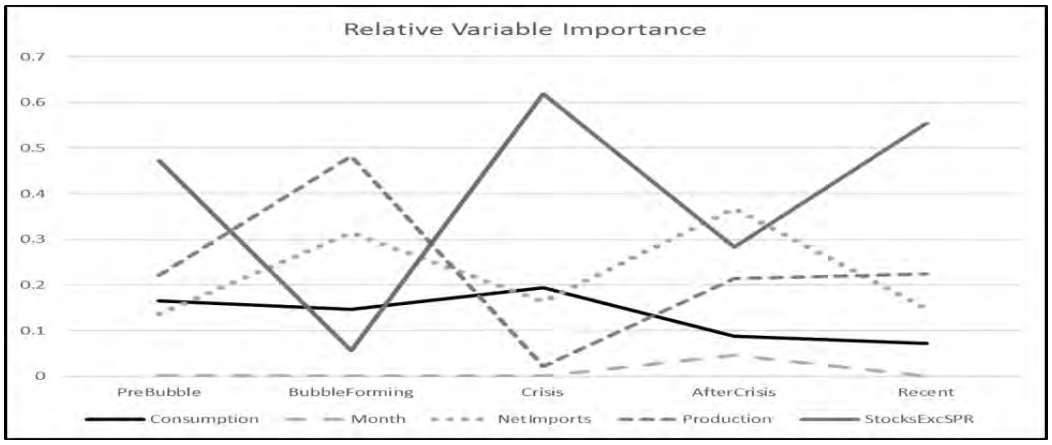


With this high level of accuracy, we now turn to the sensitivity analysis. The sensitivity analysis allows us to see the impact of each of the input variables on the neural network target value. The values of a sensitivity analysis are relative to each other and, within a single model, always sum up to one. While these values have no directly interpretable meaning in terms of determining the output value, they do show how the model ranks each input relative to the others in deciding the target's final value. A larger value indicates a greater impact on the target. Table 4 shows the sensitivity analysis (or, relative importance) of each variable on the spot price of oil during each period of time. The variable with the highest impact is highlighted. Figure 8 shows these values in a graph.

TABLE 4. RELATIVE IMPORTANCE OF VARIABLES PER DATA SET

Input Variable	PreBubble	BubbleForming	Crisis	AfterCrisis	Recent
Consumption	0.166	0.147	0.1936	0.0878	0.0727
Month	0.0026	0.0001	0.0009	0.0469	0.0000034
NetImports	0.1369	0.3141	0.1647	**0.3681**	0.149
Production	0.2215	**0.4828**	0.0219	0.2145	0.2239
StocksExcSPR	**0.473**	0.056	**0.6189**	0.2828	**0.5544**

FIGURE 8. GRAPH OF RELATIVE VARIABLE IMPORTANCE OVER THE FIVE PERIODS.



The stored stock of oil had the greatest role in determining the spot price during the pre-bubble, the crisis, and the recent periods. However, in the periods between those, its impact dropped greatly. During the bubble-forming period, production had the greatest impact, and during the period immediately after the crisis, net imports had the most influence of the spot price.

A SOLITARY MODEL

Suppose, rather than developing individual neural network models for each period, we instead developed one model using all the data. How well would it do, and what variables would be the most important? The results from doing this are shown in Figure 9, and in Table 5. The overall network spot prices have a mean absolute deviation from the actual prices of 0.03. This is compared to the mean absolute deviation of 0.007 across the networks developed on individual periods.

FIGURE 9. ONE NETWORK COMPARISON

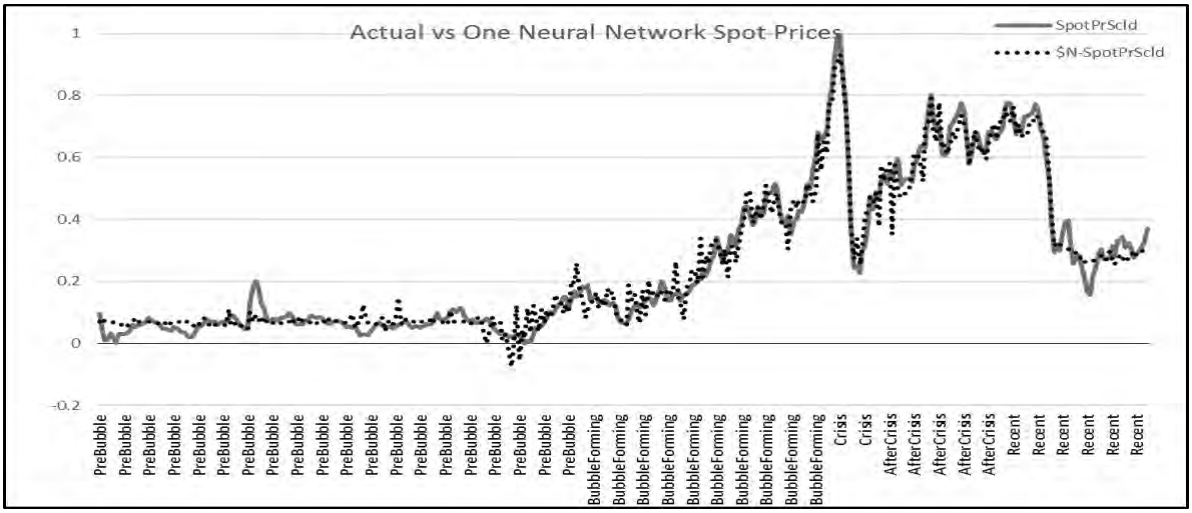


TABLE 5. RELATIVE VARIABLE IMPORTANCE OVER ONE NETWORK

Variables	Importance
Consumption	**0.7138**
Month	2.14E-07
NetImports	0.0421
Production	0.1934
StocksExcSPR	0.0508

This combined variable importance, generated by one network over all the data, hides from us the changing impact of variables over time. For example, we see in Table 5 that Consumption has a variable importance of .71, much higher than in any individual period. If we were to average the effect of consumption over separate periods, we would get about .13. This is about one fourth of the value it has in the single network. Inspection of the other inputs shows a similar story. By not developing networks on individual regimes, our picture of the variables' impacts is distorted.

CONCLUSIONS

This paper considers the spot price of oil, net imports of oil, production of oil, the stored supply of oil, and petroleum supplied (a proxy for petroleum consumption) to focus on the microeconomic fundamentals of oil in the U.S. markets. Each of these variables was scaled to be between zero and one. In addition, the month of the year was also employed as an input to account for seasonality in the demand for oil. The data was divided into five periods, or regimes, from 1986 through 2017, two before, one during, and two after the financial crisis of 2008. Using these inputs, we built boosted neural networks to explain the spot price of oil, advancing the hypothesis that different inputs receive fundamental importance along dissimilar economic regimes. Put differently, these networks were built with the intent of analyzing the variable impact across time periods to see whether or not the variable importance remained the same through these very different periods. If we found that a set of variables stayed the same in impact across the financial structural breaks, then we could look for a single network that could be used to successfully forecast across widely varying time periods.

Our methodology shows that, while the inputs into an accurate neural network can remain the same, the impact of each variable can change considerably during different regimes. We find that the shifts in impacts of the various inputs are great enough to support the hypothesis that there are important structural breaks between periods. We conclude that, in the presence of structural breaks, there is a shift in the way the neural network uses and values the inputs. One approach to forecasting is often a rolling time period for training followed by a short validation set. When structural breaks occur, it is unlikely that this methodology would be successful. A structural break indicates a clear-cut shift in market movement and relationships. Even with frequent re-training, the shift across these breaks is significant enough that the time period for training and that for validation will be different enough that the network will not be successful on the future set. With an indication of a structural break, we might need to shift to very short training sets in order to mirror the current relationships. Our methodological conclusion concurs

with Baumeister and Kilian (2016) who give a rich and informative narrative of the oil market during the past forty years to conclude that oil prices have continued to surprise us and may continue to do so in the future, both because of the complex fundamentals of this global market and the sequence of unexpected shifts in economic and financial regimes.

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Analytics, Business Intelligence, Data Mining and Statistics

Distribution of p-Values in JMIS and MISQ

Oral

Dr. Kellie Keeling [1], ***Dr. Robert Pavur*** [2]

1. *University of Denver,* ***2.*** *University of North Texas*

Most research studies, regardless of design or purpose, report p-values. Previous studies have begun to examine p-values from disciplines such as marketing research, medical research, and biomedical science, but there has been no systematic study in the reliability of conclusions provided by p-values. Because of this, the p-values that are published may be misleading. This paper explores if it is possible to obtain an approximation to the relative frequencies of null and alternative hypotheses in research studies specifically looking at the information systems field. A survey of reported *p*-values from two leading Information Systems journals is compiled to seek insight into possible selective reporting. This study examines an aggregate population of published p-values in JMIS and MISQ from 2017 to reveal how researchers address the "*p*-value" problem, if at all, and how findings may hamper meaningful interpretations. Based on this, we try to identify possible over-enthusiastic significant result(s) in publication conclusions.

Reduced Size Generalized Assignment Problems—Still Hard to Solve?

Oral

Dr. ROBERT NAUSS [1], ***Dr. Jeremy North*** [2]

1. *U of Missouri-St. Louis,* ***2.*** *Murray State University*

"Off the shelf" solver software packages, such as GUROBI and CPLEX, have improved markedly in being able to solve general integer linear programs (ILP) to optimality. However, certain classes of ILPs remain difficult to solve in a reasonable amount of time. Some instances of the Generalized Assignment Problem (GAP) exhibit this behavior. GAP may be described as finding a minimum-cost assignment of tasks to agents such that each task is assigned to exactly one agent and such that each agent's resource capacity is not violated. Hard GAP instances are defined as taking more than one hour of CPU time to prove optimality.

Initial global lower and upper bounds on the GAP are obtained from a column generation approach that utilizes a sophisticated "triple" dual stabilization technique in combination with a diversified diving heuristic due to Sadykov, Vanderbeck, Pessoa (2015). These lower and upper bounds are then used to generate a parametric list of penalties for the problem variables as a function of values between the global lower and upper bound. We also generate a parametric list of lower bounds for the resource usage of each agent as a function of values between the global lower and upper bound. These penalties allow variables to be fixed to 0(1) whenever the corresponding penalty to 1(0) equals or exceeds the current upper bound. This approach enables us to reduce the size of the GAP by eliminating variables set to 0 and 1. Some problems experience a reduction of over half of the original binary variables. CPU time for this analysis is under 5 minutes for problems in our data set.
Interestingly, this variable reduction does not necessarily mean that GUROBI or CPLEX are able to prove optimality in less than 60 minutes. GUROBI and CPLEX both use linear programming (LP) as their relaxation solver. Variable selection for branching is from the set of variables that are fractionally valued in the LP relaxation. In our algorithm we utilize a Lagrangean relaxation where all solution variables assume an integer value, but where the multiple-choice constraints for the tasks may be violated. Branching selection focuses on the violated multiple-choice constraints. The Lagrangean relaxation devolves into a set of independent 0-1 knapsack problems solved with the *minknap*solver of Pisinger (1997).
We utilize a test set of 140 GAP problems ranging in size from 2250 to 8000 binary variables. A "plain vanilla" implementation of GUROBI 7.5.1 is unable to solve 139 of the problems to optimality with an individual CPU time limit of 75 minutes. Computational algorithmic results are presented.

Using Machine Learning Techniques to Predict First Generation College Students' Academic Success

Oral

Dr. Zhixin Kang [1]

1. *University of North Carolina at Pembroke*

First-generation students are the integral constituents in the Higher Education institutions in the United States. It is well known that this group of students faces more challenges in achieving their academic goal. Understanding the predicting factors of academic success for this group of students is very important to students, educators, and policy makers in the Higher Education field. A key measure of student success in Higher Education is graduation. In this study, we apply machine learning models to the data collected at one regional master level university, which has a high percentage of first-generation students on its campus, to investigate the determining factors of the first-generation and full time undergraduate students' six-year graduation. Furthermore, we compare the performance of these machine learning techniques in forecasting the first-generation students' six-year graduation at this university. Specifically, we employ logistic regression model, artificial neural networks, decision tree, and support machine vectors to conduct this quantitative research.

REDUCED SIZE GENERALIZE ASSIGNMENT PROBLEMS---

STILL HARD TO SOLVE?

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ABSTRACT

"Off the shelf" solver software packages, such as GUROBI and CPLEX, have improved markedly in being able to solve general integer linear programs (ILP) to optimality. However, certain classes of ILPs remain difficult to solve in a reasonable amount of time. Some instances of the Generalized Assignment Problem (GAP) exhibit this behavior. GAP may be described as finding a minimum-cost assignment of tasks to agents such that each task is assigned to exactly one agent and such that each agent's resource capacity is not violated. Hard GAP instances are defined as taking more than one hour of CPU time to prove optimality.

Initial global lower and upper bounds on the GAP are obtained from a column generation approach that utilizes a sophisticated "triple" dual stabilization technique in combination with a diversified diving heuristic due to Sadykov, Vanderbeck, Pessoa (2015). These lower and upper bounds are then used to generate a parametric list of penalties for the problem variables as a function of values between the global lower and upper bound. We also generate a parametric list of lower bounds for the resource usage of each agent as a function of values between the global lower and upper bound. These penalties allow variables to be fixed to 0(1) whenever the corresponding penalty to 1(0) equals or exceeds the current upper bound. This approach enables us to reduce the size of the GAP by eliminating variables set to 0 and 1. Some problems experience a reduction of over half of the original binary variables. CPU time for this analysis is under 5 minutes for problems in our data set.

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Innovative Education, Teaching, and Pedagogy

Academic Motivation in Introductory Business Analytics Courses

Oral

Mrs. Stacey Vaziri [1]***, Dr. Baback Vaziri*** [2]***, Dr. Elham Torabi*** [2]***, Dr. Luis Novoa*** [2]

1. *Virginia Tech,* ***2.*** *James Madison University*

The main objective of this research effort is to examine relationships among student perceptions of their learning experience, including levels of motivation and effort, and their performance in introductory Business Analytics courses using the MUSIC Model of Motivation. We implement a statistical inference framework aiming at the identification of research-based motivation strategies that can be used to improve instruction and suggest techniques to improve student learning experiences. Specifically, we intend to answer the following research questions:

1. How highly do students rate each of the components of the MUSIC model?
2. What motivation strategies can be used to increase student perceptions of the MUSIC model components?
3. To what extent can students' scores on the MUSIC model components predict or explain their effort and academic performance in an introductory business analytics course?

An Exploratory Framework for the Scholarship of Teaching and Learning

Oral

Dr. Christie Chen [1], ***Dr. Kevin Hammond*** [1], ***Dr. Taeuk Kang*** [1], ***Dr. Bonnie Daniel*** [1]

1. *University of Tennessee at Martin*

For the Scholarship of Teaching and Learning (SoTL) to be recognized as crucial intellectual work, faculty must connect theory-based classroom teaching to experience-based learning by continually developing instructional design, pedagogy, and the broader curriculum (Felton, 2013). Moreover, some observers have questioned whether institutions of higher education are preparing students in developing employability skills. Among business schools, efforts are being made to improve curriculum by integrating traditional classroom learning and workplace experiential learning. Meanwhile, some concerns have been raised whether traditional assessments actually reflect students' knowledge and skill development (Azevdo et al., 2012). Williams and Williams (2011) identified five key elements which impact students' motivation by improving student learning outcomes. Specifically, challenging assignments (e.g. problem-solving activities or realistic business scenarios) enrich and build students' competency in the content learning aspects. Likewise, learners can be motivated through hands-on techniques such as simulation, casework, group projects/presentation and guided discussions. The purpose of this study is to provide a framework for evaluating various classroom practices and the effects on student learning outcomes. For this present study, we surveyed graduating seniors at our institution regarding the types of classroom practices and teaching methods which they had experienced over the previous twelve months, such as group presentations, computer assignment(s), textbook-based lectures, lecture from other sources, class discussion/debate, "real-world speaker(s), brief in-class group projects, practical application of knowledge in a lab setting, service learning, etc. Based on Exploratory Factor Analysis of the data, three components were extracted to provide three dimensions of teaching and learning elements. Next, Confirmatory Factor Analysis was used to validate the three components.

An Honors Adaptation of a Live Case Srategic Management Project

Panel

Dr. Janice Black [1]***, Dr. J. Kay Keels*** [1]***, Ms. Alexandra Legut*** [1]

1. *Coastal Carolina University*

Most public institutions of higher education have a wide range of student skills present among their student body. Many respond to this by having an honors program for the more advanced student. Some honors programs are fully developed with separate honors classes and even degrees; others use their regular degree program and require students to take a number of "honors' courses. This may mean an honors version of an existing class. Having such a provision with an existing core class that has a number of disciplinary specific concepts to pass on to the students can be a challenge. The goal being to convey the skills and definitions while still stretching the honors student and meeting them at their higher level of critical thinking.

Taking a philosophy of teaching differently and not just more, the capstone faculty designed a project that required the student to "edit" an older form of the class assignment and to then turn that into a series of "answers" to a series of case problems. This session describes their process of transforming an intensive team project into an individualized honors project where more advanced skills are expected beyond the analytical, synthesis and implication skills normally required. The adaptation and the personal reflections of an honors student are included. The session finishes with a discussion on how this process may be used in other classes/colleges.

Attendees leave with several handouts. One summarizes the learning goals and processes involved in the honor student's adaptation and with the experience of directly asking the honors student questions about the adaptation and the personal learning beyond class expected learning.

DEVELOPING AN EFFECTIVE BUSINESS SPEAKER SERIES

Oral

Dr. Suzie Smith [1]

1. *Presbyterian College*

This presentation will highlight several college and university business speaker series and discuss the infrastructure needed to make the series work successfully. Topics will include budgets, endowed programs and grants, types of speakers that resonate best with students, best practices in marketing to students, managing student behavior and cell phone use, coaching students on asking good questions, and following up after the fact.

Schools with big budgets and endowed speaker programs can invite prominent business leaders with speaker fees ranging from $1000 to $100,000. How much value do they add to students' understanding of business? Successful alumni will usually speak for free as a way to give back to their school and connect personally with current students. Sometimes they may use the visit as a chance to screen top students as potential employees. They can also build credibility on LinkedIn through the experience if the school promotes them on the platform.

To motivate student attendance for a speaker without a big name, faculty can offer bonus points, include future test questions on the speaker's content, and invite hand-picked students to dine with the speaker.

The goal of the presentation is to review the current state of college and university business speaker programs and invite participants to share their good and bad experiences with speaker series on their campuses so that all participants can learn from each other.

Evaluating the Feasibility of Virtual Reality for High School Students with Autism Spectrum Disabilities

Oral

Dr. James Lawler [1]

1. *Pace University*

Cognitive disabilities are characterized by deficits in attention skills that adversely affect development in data processing and in learning progression.

The preliminary findings of this paper highlight the feasibility of a foundation for fertile learning possibilities of virtual reality for high school students with Autism Spectrum Disorders (ASD).

This paper can be helpful for special education instructors considering instructional interventions of virtual reality systems.

Financial Literacy Initiative at a Liberal Arts College: What student's want (& need)!

Oral

Dr. Michelle Hagadorn [1]***, Ms. Marissa Lahousse*** [2]

1. *Roanoke College,* ***2.*** *Virginia Tech*

The college years are an important time in the life of young adults as they gain increased independence and responsibility. In addition, to managing their schedules, student are often faced for the first time with important personal financial decisions. For example many students encounter real-world debt related issues, such as credit cards or students loan. Since they have reached the legal age to enter into these binding contracts, these financial decisions can have potential long-term negative consequences such as damage to their credit history. The purpose of this paper was to evaluate the need and interest in a financial literacy program at a small liberal arts college in Virginia.

Improving Information System Instructions

Panel

Dr. Ping Wang [1]***, Mr. Carey Cole*** [1]***, Ms. Laura Atkins*** [1]***, Mr. Shawn Lough*** [1]***, Mr. Laurent Tchommo*** [1]

1. *James Madison University*

1. BizLab – Developing Business and Connecting Students with Community, One Client at a Time
Laura Atkins
EXECUTIVE SUMMARY
A key to success for new entrepreneurs and small businesses is “to be found” by having an up-to-date, engaging Web presence paired with targeted branding. These marketing tools, while recognized as essential, can be a challenging budget issue for new businesses. With project, the Small Business Development Center (an outreach of JMU College of Business), will utilize the creative talents of JMU students across multiple disciplines to provide Web, graphic, and communication services to local businesses and non-profit agencies.

2. Online Classes: My goal and journey to make mine successful
Carey Cole

This Computer Information Systems class in eight weeks during summer includes a course interview, Canvas use, synchronous WebEx sessions, asynchronous Discussion board postings, online quizzes, and a final exam requiring a Web-Cam.
3. Content Leadership: Bringing the student into the role of teacher, not just the learner.

Shawn Lough
In working with International Students, using traditional lecture and activity based learning does not always translates into a productive learning environment due to the language challenges and the interpretation of specific vocabulary related to the CIS field, especially using examples confined within United States. In order to encourage active discussions between the student and the instructor about the content, a “train the trainer approach” can be used to develop Content Leaders, in which students have to opportunity to present content material to their peers where examples that are more relevant from their experience and culture can be included within the discussion and in a fashion, that as a student, would see as interesting or engaging.
4. Engaging students through simulation for operations management class

Laurent Tchommo
A simulation game is used to engage students and teach many concepts and processes in operations The game consists of a production line for paper planes. The production consists of six steps process. The product must pass through each of the six work stations in the order from one to six. One operation is completed at each station. The operation consists of folding the paper sheet.

Interactivity and Student Learning Experience in Online Learning

Oral

Dr. ChongWoo Park [1], ***Dr. Dong-gook Kim*** [2]

1. *Augusta University,* ***2.*** *Dalton State College*

According to WCET Distance Education Enrollment Report 2016, the number of students who enrolled in at least one online course increased from 1.6 to 5.8 million between 2002 and 2014. Despite the growth and benefits of online learning, there have been questions about the effectiveness of online learning. According to a report on online education (Bettinger & Loeb, 2017), with current design, online courses are difficult, especially for the students who are least prepared. The report found that such students' learning performance is worse (e.g., higher dropout rates and lower grades) when they take online courses than it would have been if these same students had taken in-person courses. It also argues that the major difference between online and in-person courses is student-faculty interaction. Thus, student learning experience in online learning is quite different from that in the face-to-face learning, especially for student-instructor interactions and engagement.

While prior research has identified student-instructor interactions and engagement as critical factors on student learning experience and performance in online learning, there has been little discussion on how to promote such interactions and engagement in the online learning context. This study attempts to address how we can make online learning more effective by promoting the interactions between students and instructors, and ultimately improve student engagement and satisfaction in online learning. Thus, we pose the following research questions.

Research Question 1: Can an interactive communication tool facilitate students' online learning by promoting their perceptions on instructor presence and engagement?

Research Question 2: Do instructor presence and student engagement contribute to student satisfaction in online learning?

In answering the questions, we draw on theories of constructivism, social presence, and engagement, and propose and empirically test a research model including four constructors of interactivity, instructor presence, student engagement, and student satisfaction in online learning.

We believe that the findings in this paper would help us better understand the student learning experience mechanism in online learning where the use of interactive tool for communication contributes to students' perception on instructor presence, promotes student engagement, and eventually leads to student satisfaction. To test the research model, we collected data from a sophomore level business statistics course, using Microsoft Teams, as the medium of the classroom communication, which was designed for workplace communication and collaboration by combining chat, meetings, notes, and attachments. Survey method was used to collect data and test the hypotheses in this study. Preliminary data analysis with PLS shows that all hypotheses are supported, except for the hypothesized path between interactivity and student engagement.

Map Your Class Project to Critical Thinking Criteria

Panel

Dr. Janice Black [1], ***Dr. Darlene Booth-Bell*** [1], ***Dr. Olajumoke Awe*** [1], ***Mr. David Doerring*** [1], ***Dr. J. Kay Keels*** [1]

1. *Coastal Carolina University*

This panel session/workshop presents an operationalized form of bloom's revised taxonomy and Paul & Elder's mature critical thinking cycle that can enable faculty to demonstrate how their projects and assignments further the college's goal of developing graduate who are critical thinkers. The faculty panel shares what those projects and assignments are and how they can be mapped. The pros and cons of making the links between common critical thinking concepts and the project's attributes include audience contributions. A final by-product is the use of such a composite document as evidence of a series of exposures for accreditation purposes.

Accreditation is a fact of life in higher education circles. Whether it is a regional accreditation body looking for evidence of continuous improvement (e.g. HLC, NCA, SACS) or a disciplinary accreditation body looking for explicit evidence of classroom support of college goals (e.g. AACSB, ACBSP or IACBE) , providing such evidence with a minimal amount of additional time is a personal goal of many faculty. This panel will provide the tool, an example spreadsheet, and personal descriptions of processes along with the amount of time spent providing the evidence.

Critical thinking is often a stated learning objective of business programs. It then becomes a component of their program assessment processes. However, there are a number of critical thinking models ranging from Bloom's Revised Taxonomy (Anderson, et al., 2001). to Paul and Elder's critical thinking model (Paul & Elder, 2010). Some have suggested that for business students an appropriate critical thinking model might simply be systems thinking (Black & Twigg, 2012). On a pragmatic level research-based reports from university classes have been shown to correlate with Bloom's revised taxonomy (Rains & Sechrest, 2018). However, as assignments have become customized to current student needs, gaps in the students' ability to engage in higher level thinking dimensions have been identified (Rains & Sechrest, 2018). This deficit often requires faculty to provide very detailed and explicit instruction since the students find applying or extending concepts learned in other classes into many business courses. Furthermore, students often need multiple opportunities to apply their understanding before it becomes second nature.

This panel demonstrates a mapping process that enables assignments across courses to build and culminate in a full research project that demonstrably meets the criteria of advanced critical thinking. This same process can be used by other schools either as a demonstration of the critical thinking thread in their curriculum or to justify the use of a particular project as an assessment for the critical thinking portion of their curriculum.

MESSAGING APPS AND THE DARK SIDE OF COURSE SOCIAL CLIMATE: ARE ONLINE COMMUNICATION TOOLS HELPING OR HURTING STUDENT LEARNING AND ETHICAL BEHAVIOR?

Oral

Dr. Belinda Shipps [1]

1. *North Carolina A&T State University*

There has been a growing interest in the value of course climate considerations in the learning environment. Course climate addresses matters such as: social interaction and the use of online, social and interactive tools and methods for learning, collaboration and communication with instructors and students. Previous research supports the importance of social interaction for cognitive development in the course environment (Price, 2011; Brown, Collins, & Duguid, 1989). Social interaction/Social climate has also been associated with: lower dropout rates, higher levels of student involvement and lower levels of risky behaviors (Ambrose, 2010).

Ambrose et al, 2010 defines course climate as “the intellectual, social, emotional, and physical environments in which our students learn. The social climate includes a combination of factors that interact together which includes: online communication and presentation tools, student-student interaction, faculty-student interaction and the presentation of course materials and content.

However, in recent years, there is increasing attention on a darker side of social interaction and online communication tools that are used for academic courses. There have been increasing reports of academic dishonesty associated with mass cheating among student members who are using group messaging applications (apps) such as GroupMe. The messaging apps allow students to communicate through group chats instead of texting or emailing.

Cheating is becoming more common in the classroom. Wilson (2008) suggests that students are cheating more because of pressure from parents who are more focused on obtaining the degree within a certain time frame and not as much on the learning. Mcabe & Butterfield, 2012) state that academic dishonesty is widespread throughout college campuses because everyone thinks its ok because “everyone does it” and because there are no consequences.

Messaging applications for academic purposes create opportunities that can be beneficial but also detrimental. For example, messaging applications can be very useful when used for legitimate purposes such as forming a study group or communicating with project members or sharing upcoming due dates for assignments. However, if they are being used to share answers to a test or to copy and turn in duplicate work this is harmful to the students receiving it as well as to those giving the work.

This research seeks to understand the following: what factors contribute to mass cheating through messaging applications; if mass cheating is more prevalent in online versus traditional classrooms and what steps can be taken to decrease academic cheating. This research will examine students’ perceptions of online messaging applications and the ethical implications associated with being a member of a messaging application. Initial research will focus on interviews which will be used to develop a questionnaire. The questionnaire will be distributed to students who have taken both online and traditional co

Publishing in the Decision Sciences Journal of Innovative Education

Workshop

Dr. Matthew Drake [1]

1. *Duquesne University*

This workshop is designed for authors who are interested in publishing pedagogical research or teaching materials in the *Decision Sciences Journal of Innovative Education* (DSJIE). It will be facilitated by the editor-in-chief of the journal, who will discuss the journal's mission and submission criteria along with some tips for drafting a successful manuscript. Attendees are encouraged to bring ideas for manuscripts or drafts of manuscripts to obtain feedback from the editor to improve their likelihood of acceptance for publication in the journal.

STUDENT ASSESSMENT IN A CAPSTONE COMPUTING COURSE

Oral

Dr. Charles Tappert [1], ***Prof. Avery Leider*** [1], ***Ms. Sukun Li*** [1]

1. *Pace University*

The capstone computing course at our university provides students with experience working on real-world computing and information systems projects. Students have the opportunity to develop both the hard and soft skills that are sought after by industry. The structure of the course has evolved from a traditional face-to-face format to a web-assisted format with only three face-to-face class meetings. With the current essentially online nature of the course, student assessment has required development of improved assessment tools. Both the project work team-level assessment and the peer evaluation individual-level assessment methods have been extensively revised, while maintaining student satisfaction and quality of project deliverables at a high level.

Student Learning in Quantitative Courses and its Impact on Critical Thinking Skills

Oral

Dr. Burcu Adivar [1], ***Dr. Li Chen*** [1], ***Dr. Carin Lightner-laws*** [2]

1. *Fayetteville State University,* ***2.*** *Clayton State University*

In this study, the authors focus on the relationship between student learning experience in selected core courses (specifically business statistics and operations management), and critical thinking skills. Critical thinking skill is quantified by three variables: scientific / quantitative reasoning, critical reading and evaluation, and critiquing an argument. Data has been collected from learning management systems, instructors' email records and the Banner system. By using multiple regression models, a comparative analysis is performed between key factors such as the amount of time spent online, number of late submissions, number of missed assignment, communication with students and instructor, participation, time spent in tutorial sessions, etc. Authors also assess student learning outcomes in an online vs. traditional statistics course taught in different institutions. Results indicate significant correlation between quantitative courses and scientific / quantitative reasoning as well as critical thinking skill development. Based on our findings, we suggest a predictive model to estimate student success in Collegiate Learning Assessment (CLA) Exam and early detection strategies to identify students that need additional support or tutoring.

KEYWORDS: Critical Thinking, Scientific/quantitative reasoning, Business statistics, Operations management, Online teaching, Traditional teaching, Predictive model

The Impact of Electronic Textbooks on Student Academic Success in Accounting Courses: A Proposal

Oral

Dr. Cathy Staples [1]

1. *Randolph-Macon College*

For many college students, the price of textbooks has become exorbitant, resulting in the search for alternative means of gaining access to a book. Many choose to rent or borrow while some even choose to complete the course without ever acquiring the required materials. One option available only in the last few years, electronic textbooks, has become much more popular among students. (Mulholland & Bates, 2014; Brown, 2013) While much research has focused on electronic books, most of it has concentrated on why students often choose that format over traditional hard-copy texts. Others have looked at how students use e-books in comparison to hard-copies. However, very little research has studied the impact of e-books on student academic success. This study proposes to evaluate student performance in four accounting classes (three Accounting 1 and one Intermediate Accounting I), comparing final course grades of students utilizing e-books to the final grades of students using the more traditional hard-copy book.

The Rules of Student Engagement: A Test of Instructor Inputs and Student Learning Outcomes in Active vs. Passive Classroom Learning Environments

Oral

Prof. DeShannon McDonald [1], ***Dr. Yvette Holmes*** [2], ***Dr. Tammy Prater*** [3]

1. *Alabama A&M University,* ***2.*** *Florida Gulf Coastal University,* ***3.*** *Alabama State university*

Asa guide or moderator in the classroom, professors more actively engage students in the learning process and capture their interest. Students' performance expectations of themselves are also impacted based on the learning environment created by instructors and the classification of the student. Instructors will learn the best way to complement the learning experiences of traditional vs. non-traditional students and graduate vs. undergraduate students. The importance of the study centers on how the current tech-savvy student learns best and what teaching methods instructors should consider in order to be optimally effective.

TINELOK BUSINESS CASE

Oral

Dr. Mario Zaino [1], ***Dr. Sara Kiser*** [1]

1. *Alabama State university*

The TineLok Case deals with a one product company that has a “cutting edge” product with seemly unlimited target markets, not just in the United States, but also throughout the world. Yet, what appears to be a simple enough product and company has evolved into a never ending change of corporate structures and ownerships. A brief history of the development of the product and then a longer history of the company’s formation, development, changes, and current situation are provided. There are strategic management, target markets issues, corporate structure changes and potential growth that forms the basics of the major issue, “where do we go from here?”

Workshop on Academic Dishonesty in Higher Education, Best Practices adopted by Major Universities Regarding Prevention and Dealing with Violations.

Workshop

Dr. Peggy Johnson [1], ***Dr. Joseph Krupka*** [2]

1. *Lander University,* ***2.*** *Savannah State University*

Cheating is omnipresent in higher education in the United States. A recent article in the Atlantic pointed out that in 2015, Dartmouth College suspended 64 students suspected of cheating in—irony of ironies—an ethics class in the fall term. Stanford University, New York State's Upstate Medical University, Duke University, Indiana University, the University of Central Florida and even the famously honor code-bound University of Virginia have all faced cheating scandals in recent memory. At Lander and Savannah State Universities, we completed research recently that indicates that the ubiquitous problem persists. In our examination of the issue, we gathered information pertaining to the prevention of academic dishonesty and have compiled a list of best practices we wish to share in a workshop for SEDSI in 2019.

AN EXPLORATORY FRAMEWORK FOR THE SCHOLARSHIP OF TEACHING AND LEARNING

Hui-chuan Chen, Kevin Hammond, Taeuk Kang, and Bonnie Daniel
University of Tennessee at Martin

ABSTRACT

For the Scholarship of Teaching and Learning (SoTL) to be recognized as crucial intellectual work, faculty must connect theory-based classroom teaching to experience-based learning by continually developing instructional design, pedagogy, and the broader curriculum (Felton, 2013). Moreover, some observers have questioned whether institutions of higher education are preparing students in developing employability skills. Among business schools, efforts are being made to improve curriculum by integrating traditional classroom learning and workplace experiential learning. Meanwhile, some concerns have been raised whether traditional assessments actually reflect students' knowledge and skill development (Azevdo et al., 2012). Williams and Williams (2011) identified five key elements which impact students' motivation by improving student learning outcomes. Specifically, challenging assignments (e.g. problem-solving activities or realistic business scenarios) enrich and build students' competency in the content learning aspects. Likewise, learners can be motivated through hands-on techniques such as simulation, casework, group projects/presentation and guided discussions. The purpose of this study is to provide a framework for evaluating various classroom practices and the effects on student learning outcomes. For this present study, we surveyed graduating seniors at our institution regarding the types of classroom practices and teaching methods which they had experienced over the previous twelve months, such as group presentations, computer assignment(s), textbook-based lectures, lecture from other sources, class discussion/debate, "real-world speaker(s), brief in-class group projects, practical application of knowledge in a lab setting, service learning, etc. Based on Exploratory Factor Analysis of the data, three components were extracted to provide three dimensions of teaching and learning elements. Next, Confirmatory Factor Analysis was used to validate the three components.

DEVELOPING AN EFFECTIVE BUSINESS SPEAKER SERIES

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ABSTRACT

This presentation will highlight several college and university business speaker series and discuss the infrastructure needed to make the series work successfully. Topics will include budgets, endowed programs and grants, types of speakers that resonate best with students, best practices in marketing to students, managing student behavior and cell phone use, coaching students on asking good questions, and following up after the fact.

Schools with big budgets and endowed speaker programs can invite prominent business leaders with speaker fees ranging from $1000 to $100,000. How much value do they add to students' understanding of business? Successful alumni will usually speak for free as a way to give back to their school and connect personally with current students. Sometimes they may use the visit as a chance to screen top students as potential employees. They can also build credibility on LinkedIn through the experience if the school promotes them on the platform.

To motivate student attendance for a speaker without a big name, faculty can offer bonus points, include future test questions on the speaker's content, and invite hand-picked students to dine with the speaker.

The goal of the presentation is to review the current state of college and university business speaker programs and invite participants to share their good and bad experiences with speaker series on their campuses so that all participants can learn from each other.

EVALUATING THE FEASIBILITY OF VIRTUAL REALITY FOR HIGH SCHOOL STUDENTS WITH AUTISM SPECTRUM DISABILITIES (ASD)

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ABSTRACT

Cognitive disabilities are characterized by deficits in attention skills that adversely affect development in data processing and in learning progression. Computer systems are evolving however to help in the improvement of attention, information processing and memory promotion. In this paper, the authors are evaluating the comfortability of virtual reality applications to help high school students with Autism Spectrum Disorders (ASD) at mid-spectrum. The preliminary findings of this paper highlight the feasibility of a foundation for fertile learning possibilities for this population with virtual reality. This research-in-progress paper can be helpful for special education instructors considering instructional interventions of virtual reality systems.

Keywords: Assistive Devices, Autism Spectrum Disorders (ASD), Special Education, Students with Developmental and Intellectual Disabilities (IDD), Technology Tools for Students with Autism, Virtual Reality, Virtual Reality Applications (Apps)

BACKGROUND OF PAPER

Virtual reality is defined as an artificial "computer-generated digital [engagement] environment that can be experienced … as if [the] environment [is] real." (Jerald, 2016) The environment is experienced in an immersive, interactive and intuitive presence of "being there" in a physical but virtual reality (Ludlow, 2015). Examples of virtual reality applications (apps) are NYTimesVR

and Discovery VR, Web sites as 360cities.net, and the National Geographic YouTube Channel (Burns, 2018), and gaming systems as POKEMON Go. The frequent hardware of a virtual reality system includes desktop displays, displays held by the hand and displays hitched to the head, for navigating the systems. Virtual reality is considered a consumer mainstream market of technology (Ohanesian, 2014).

The expenditures by industry in virtual reality are estimated at $4.7 billion in 2016 and at $16.3 billion in 2020 (Rubin, 2018). The market of virtual reality is estimated at an exhilarating $60 billion in 2025 (Sakoui, 2017). The shipments of headset virtual reality systems, including augmented reality systems, are estimated for Google, HTC, Oculus, PlayStation and Samsung at 2.5 million in 2017 and are estimated further at 15 million systems in 2020 and 28 million systems in 2021 (Harvard Business Review, 2017); and those on virtual reality apps systems are estimated to be as high as 250-300 million in the 2020s (Bank of America Merrill Lynch, 2016, pp.1,11). The hype of the market is matched by investments by leading technology firms as Facebook and Google in new virtual reality systems (Kugler, 2017). The benefits of the technology are further however than the domain of elite technologists.

This paper evaluates the benefits of virtual reality spaces in an educational environment of learners with developmental and intellectual disabilities (IDD). Literature from practitioner sources (Light, 2018 and Diament, 2018) is indicating benefits in learning and in sociality; and literature from scholarly sources (Goodwin, 2008, Parsons, & Mitchell, 2002, and Trepagnier, 1999) is indicating the benefits similarly from the systems. Evolving in the literature are the findings of immersive interactive interventions in practicing learning skills and new skills in sociality in virtual reality, with notably students with Autism Spectrum Disorders (Lawther, 2016). Interventions in practicing the skills may even be therapeutic (Laufer, & Weiss, 2011), with Virtual Learning Environments (VLEs) of virtual reality. Therefore, this paper explores the apps of virtual reality systems for students with Autism Spectrum Disorders at a local non-profit organization.

INTRODUCTION TO PAPER

This paper evaluates the feasibility of virtual reality applications (apps) for high school students with Autism Spectrum Disorders (ASD) at a local non-profit organization involved on a project with the Seidenberg School of Computer Science and Information Systems of Pace University. The evident feasibility from the literature of apps on virtual reality systems to help the students in learning and in sociality justifies a paper for initial study that may highlight a foundation for further study of the systems. Literature in scholarly sources is indicating not hype but instances of Virtual Learning Environments of virtual reality systems, influencing not only learning skills but notably skills of sociality of students with Autism Spectrum Disorders (Cheng, Huang, & Yang, 2015).

From the literature (The Economist, 2017), the authors identified the HTC Vive System (Figure 1 [Appendix]) and the Oculus Rift System (Figure 2) as best-in-class systems of virtual reality, and they identified 3D Organon VR Anatomy (Figure 3), Ocean Rift (Figure 4) and Star Chart (Figure 5) as the best-in-class apps tools of virtual reality for students with Autism Spectrum Disorders, for this study. The apps tools were further identified from the subjects learned by the students

from their special education teachers. The students with Autism Spectrum Disorders were interested in the tools as they were mostly "natives" of gamer technology tools – virtual reality tools.

The evaluation of the virtual reality technology tools was formed by factors from previous studies at the Seidenberg School (Lawler, & McKenna, 2018). The comfortability factors, of *ease of use* in interactively interfacing with the tools, *flexibility of use* in navigating functionality options in virtual reality, *information perceptibility* in perspicacity of the presentations of the subjects in the virtual reality world, *intuitiveness* in processing sequences of the tools in virtual reality and *limited requirements* in progressing without fatigue in the restrictions of the hardware physical technology, were also formed from principles of universal design (The Center for Universal Design, 2003). These factors were formed moreover from previous interactions in the gamer technology known to students with Autism Spectrum Disorders (Cheng & Ye, 2010).

FOCUS OF PAPER

The focus of this preliminary research is to evaluate the feasibility of the functionality of virtual reality applications (apps) systems for the non-profit organization. This research is foundational for a larger study of virtual reality for students with Autism Spectrum Disorders (ASD) and with other developmental and intellectual disorders (IDD). Even though the literature of the scholarly sources is frequently indicating the potential of these systems, more research on the technology, and on those with disorders, is needed for proper study (Boser, Goodwin, & Wayland, 2014). In fact, virtual reality systems in learning organizations are in the infancy of the technology (Kessler, 2017). Thus, the preliminary findings of this study may be important for special education non-profit organizations and teachers evaluating the instructional relevance of virtual reality technology.

METHODOLOGY OF PAPER

The authors evaluated the comfortability functionality of the 3D Organon Anatomy, Ocean Rift and Star Chart applications (apps) on the HTC Vive System and the Oculus Rift System. The functionality of the apps was evaluated from the aforementioned factors of *ease of use*, *flexibility of use*, *information perceptibility*, *intuitiveness* and *limited physical requirements*, relative to the apps on the systems of virtual reality. The apps on the systems were evaluated by the second and third authors of this research, who are undergraduate students in the Seidenberg School of Computer Science and Information Systems of Pace University.

Each of the 3 apps on each of the 2 systems was navigated by n=13 higher-functioning (i.e. less impaired) high school students with Autism Spectrum Disorders (ASD) of the middle school of the non-profit organization. Each of the high school students at mid-spectrum was navigating each of the apps on each of the headset systems (i.e. 13x3x2) in individualized sessions estimated at 25-45 minutes for each of the apps on each of the systems in an elapsed 6 days of sessions in spring

2018. The n=2 undergraduate students were observing the n=13 high school students as they were navigating the apps on the systems.

(Each of the apps on each of the systems was navigated separately by a control group of n=16 Seidenberg School undergraduate students without disorders in individualized sessions in spring 2018.)

The evaluation of the functionality of the apps on the systems was interpreted by the observing undergraduate students with the high school students and with the observing non-profit organizational staff, with a Likert-like instrument of survey. The evaluations with the factors of functionality were fulfilled on a perception scaling of (5) very high to (1) very low in comfortability satisfaction and were inserted in EXCEL for further interpretation by the undergraduate students; and the findings were examined for final interpretation by the first author of this research, who is the professor on the project in the Seidenberg School. The findings were confidential as to the identity of the individual high school students.

The methods of this research were similar to the methodologies of other prior studies in the Seidenberg School of technologies for those with developmental and intellectual disorders (Lawler, & McKenna, 2018). Most of the population samples of scholarly studies on those with disorders and virtual reality are small (Mitchell, Parsons, & Leonard, 2007), as in this study. Nevertheless, this research is a preliminary stage, as to the comfortability of the functionality of virtual reality for a favorable foundation for a secondary stage, as to the instructional interventions of virtual reality systems for learning outcomes measurable of learning skills and of skills of sociality, which will be researched with relevant special education teachers in a subsequent study.

The findings of the undergraduate students are in the next section of this study.

FINDINGS FOM PRELIMINARY STUDY

The descriptive findings of the preliminary study are consistently highlighting favorability in the perceptions of the n=13 high school students of the HTC Vive System (means = 3.58 / 5.00) and the Oculus Rift System (4.10). The perceptions of the students with Autism Spectrum Disorders (ASD) as to the functionality of the applications (apps) of 3D Organon Anatomy (3.46) and Star Chart (3.70) on the HTC Vive System and 3D Organon Anatomy (3.70), Ocean Rift (4.33) and Star Chart (4.30) on the Oculus Rift System are favorable reviews. The favorability of the students for the virtual reality systems is formed from their comfortability of the apps in encouraging exploration on the systems.

The factor findings are essentially highlighting the favorability of the students with cognitive disabilities for the functionality of the virtual reality systems, as detailed below:

Table 1: 3D Organon Anatomy App on HTC Vive and Oculus Rift Systems

Factors of Functionality	HTC Vive System	Oculus Rift System
	Means	
	3.46	3.70
Ease of Use	2.50	3.75
Flexibility of Use	4.00	3.75
Information Perceptibility	3.67	3.63
Intuitiveness	4.33	3.63
Limited Physical Requirements	3.67	3.75

Legend: (5) – Very High in Comfortability of Functionality Satisfaction to (1) Very Low in Functionality Satisfaction with the Apps Tools

Table 2: Ocean Rift App on Oculus Rift System

Factors of Functionality	HTC Vive System	Oculus Rift System
	Means	
	N/A	**4.33**
Ease of Use	N/A	4.50
Flexibility of Use	N/A	4.38
Information Perceptibility	N/A	4.25
Intuitiveness	N/A	4.38
Limited Physical Requirements	N/A	4.13

Note: HTC Vive System - Ocean Rift was not played due to elapsed playing of the other apps on the systems, as the high school students were enthusiastically focused for extended periods on the other apps on the systems, a finding frequently indicated in the literature (Escobedo, Tentori, Quintana, Favela, & Garcia-Rosas, 2014).

Table 3: Star Chart App on HRC Vive and Oculus Rift Systems

Factors of Functionality	HTC Vive System	Oculus Rift System
	Means	
	3.70	**4.30**
Ease of Use	3.50	4.63
Flexibility of Use	3.75	4.38
Information Perceptibility	3.50	4.13

Intuitiveness	2.75	4.38
Limited Physical Requirements	4.75	4.00

These findings of favorability for the virtual reality systems are indicating the feasibility potential for this technology for those with cognitive disorders.

This favorability of the functionality of the apps on the systems is helped by generic but inherent principles of universal design (The Center for Universal Design, 2003), on both of the systems and by the interests of the students.

3D Organon Anatomy design is *clear*, *easy to concentrate* and *easy to explore, consistently easy to use*, and evident in *flexibility of use*, in manipulating into its anatomical structures, with *immediate information perceptibility* of its text. Organon is evident in its *intuitiveness* in moving in sequences of steps in the tool. Though cumbersome in design and in different gadgets, as indicated in the literature (Metz, 2018), the hardware headsets of both systems are *not intrusive* for the limitations of movements within their physical requirements.

Ocean Rift is also *compelling in content*, *easy to use*, evident in *flexibility of use*, evident in *intuitiveness to learn,* and evident in *intuitiveness to navigate* into its Safari scenarios of the seas. It navigation of options of stories on the Oculus Rift System, engaged and enjoyed by the high school students with Autism Spectrum Disorders, is an improvement in *information interest perceptibility* to Organon, motivating the students to learn more about the seas, a motivation indicated in the literature (Mineo, Ziegler, Gill, & Salkin, 2009). The hardware of the headsets is *less inhibiting in intrusiveness* than Organon.

The Planetarium of Star Chart is *easy to concentrate* and *easy to explore*, essentially *easy to use*, its simulations of the solar system, and evident in its *flexiblity of use* and *intuitiveness in its functionality* in personalizing its journeys into the system. *Information perceptibility* perspicacity is helped by a SkyView stimulus, and the physical technology is *not indicative of intrusiveness or limitations* in transitioning through Star Chart.

Both the HTV Vive System and the Oculus Rift System are generally homogeneous in immersive presentations of the simulations on their systems, though not heterogeneous to the skills or non-skills of the students.

Except for the fitting of the headsets of the HTC Vive System and the Oculus Rift System, none of the n=13 students with cognitive disorders were instructed by the n=2 Seidenberg School undergraduate students on the operations of the 3D Organon Anatomy, Ocean Rift and Stat Chart apps tools.

Finally, the findings from the study are highlighting favorability in the perceptions of the n=16 control group of undergraduate students without disorders in the Seidenberg School, of the HTC Vive System (3.59 / 5.00) – 3D Organon Anatomy (3.40) and Star Chart (3.78) and the Oculus Rift System (4.35) – 3D Organon Anatomy (4.40), Ocean Rift (4.43) and Star Chart (4.23), encouragingly in ranges similar to the favorability of the systems by the students with disorders.

Overall, the findings of the preliminary study are highlighting the feasibility of a foundation for a fruitful learning program with the virtual reality technology if integrated with instructional design principles and with learning outcomes of problem-solving skills (Jacobson, 2018) measurable for the students with cognitive disorders.

IMPLICATIONS FOR PRACTICE

"By the 2030s virtual reality will be … realistic … and we will spend most of our time in virtual environments." – Ray Kurzweil in (Bank of America Merrill Lynch, 2016, p.16)

The findings of the preliminary paper are an indication that applications (apps) of virtual reality can be beneficial in comfortability for high school students with Autism Spectrum Disabilities (ASD). The functionality found in this study of these systems is improved by inherent principles of universal design (The Center for Universal Design, 2003). The integration of the principles, and of the technologies (Bolte, Golan, Goodwin, & Zwaigenbaum, 2010), increased the interest of the high school students in learning the subjects on the tools. Not clear is the educational effectiveness of the virtual reality tools in increasing the learning skills if not the skills of sociality of the students. The findings of this study are a foundation however for the potential of virtual reality as a learning program for high school students with cognitive disabilities.

The findings of the study are an additional indication that, in a further initiative, apps of the virtual reality may be helpful in instructional interventions for the high school students. Instructional interventions with learning outcomes measurable of the performance of learning skills and of living skills of sociality are compelling ingredients to the potential of virtual reality systems for the high school students with Autism Spectrum Disorders. The integration of an individualized education program (IEP) with outcomes for the students from the apps tools is critical for the progress of these students. The impairments of the special education students in navigating the tools of virtual reality if relevant are also critical to know in a population of those with developmental and intellectual disorders. The findings of the study are an indication of the possibility not the reality of virtual reality for special education of the students.

The initiative of non-profit organizations in investigating the educational efficacy of the technology is crucial in the potential of virtual reality. The integration of this technology in a learning program for students with cognitive disorders is the responsibility of special education teachers, not of the apps technologists. Though reliable research in virtual reality for students with disorders at mid-spectrum is limited in the literature of scholarly sources (Stoyanov, Hides, Kavanagh, Zelenko, Tjondronegoro, & Mani, 2015), the responsibility of special education teachers is crucial in the integration of measurable relevant systems of the technology. Teachers might research rubrics for relevant tools of virtual reality for those with disorders (Papadakis, Kalogiannakis, & Zaranis, 2017). Inevitably the initiative of special education teachers in investigating virtual reality is reliant on a learning program for themselves.

Inasmuch as the findings of the paper are implying an indication of the responsibility of the special education teachers, the teachers might be involved more in pedagogical preparation of virtual

reality. As professionals they are inherently sensitive to systems for students with disorders, though they might not be inherently sensitive to the technology. Therefore, they might be collaboratively involved in learning more of the relevant technologies of virtual reality through pilot programs with technologists of virtual reality, such as through the Immersive Education Initiative (http://immersiveeducation.org [Figure 6 of Appendix]). They might be learning more through project sponsorships of non-technologists (Hanc, 2018) and technologists (Heasley, 2018). The findings are an indication that initiative in maximizing the potential of virtual reality systems for students with Autism Spectrum Disorders is the role of the special education teachers.

Lastly, maximizing the potential of virtual reality is now a project of technologists. Literature of the practitioner sources is forecasting the frequency of new simplified smart systems – glasses instead of headsets - of virtual reality, as a technology trend in 2018 – 2022 (Panetta, 2017). The proliferation of such systems might be a further incentive for general and special education teachers to be learning more of this technology (Maples-Keller, Bunnell, Kim, & Rothbaum, 2016). Students with disorders might be more motivated to be navigating these systems. The forecasts for this technology are important into justifying a subsequent study of virtual reality for those with cognitive disorders.

LIMITATIONS OF PAPER AND OPPORTUNITIES IN RESEARCH

The findings are from a preliminary stage focusing on the comfortability feasibility of the technology, as a step to the feasibility of interventions with learning outcomes of virtual reality. The findings from this stage are from a necessarily small population of students with cognitive disabilities, apart from other mental or physical disorders, mild or severe; and the findings are from a small population of non-collaborative tools for non-multiple users. They are not generalizable, as they are of one organization partnered with one university. Nevertheless, the paper is a foundation for further learning outcome possibilities for skills teaching with virtual reality. These possibilities will be reviewed with the rubrics of the special education teachers in a subsequent study.

CONCLUSION OF PAPER

This paper contributes findings as to the comfortability feasibility of systems of virtual reality for high school students with Autism Spectrum Disabilities (ASD). The descriptive findings from this preliminary study highlight favorable perceptions of the HTC Vive System and the Oculus Rift System for the students with cognitive disabilities. The factor findings on the 3D Organon Anatomy, Ocean Rift and Stat Chart applications (apps) on the systems highlight learning outcome possibilities with the tools. These findings highlight the feasibility of a foundation for fruitful measurable outcomes of programs for the high school students at mid-spectrum. Moreover, the findings are highlighting the interest of the high school students to be on the systems of virtual reality. To distinguish from the frequent hyperbolic positivity of technologists, the paper is highlighting initiatives that special education teachers might be joining to be learning more of the

potential of virtual reality. Importantly, the paper is indicating the responsibility of special education teachers in investigating this technology. Though the paper is on a small population of students with Autism Spectrum Disorders, the findings may be helpful for general and special education teachers involved with such students. The technology is highly promising for a frequently neglected population of students with cognitive disorders. Overall, the preliminary results of this research-in-progress study is positioning the reality of virtual reality for students with cognitive disorders for a subsequent study.

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APPENDIX

Figure 1: HTC Vive System of Virtual Reality

Figure 2: Oculus Rift System of Virtual Reality

Figure 3: 3D Organon VR Anatomy App - Virtual Reality System Tool

Figure 4: Ocean Rift App – Virtual Reality System Tool

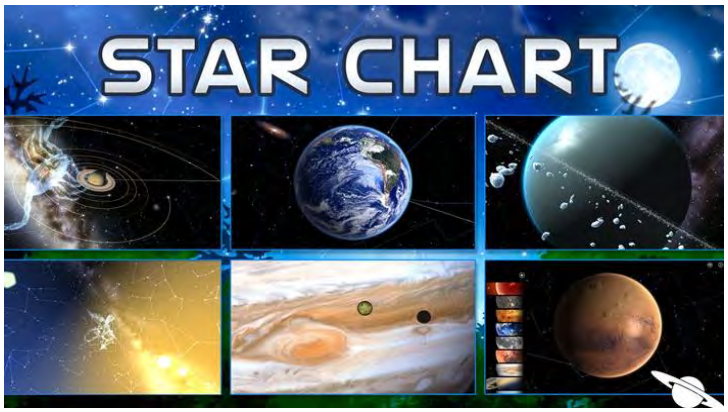

Figure 5: Star Chart App – Virtual Reality System Tool

Figure 6: Immersive Education Initiative for Special Education Teachers

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Financial Literacy Initiative at a Liberal Arts College: What student's want *(& need)*!

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ABSTRACT

The college years are an important time in the life of young adults as they are faced for the first time with important personal financial decisions. Since they have reached the legal age to enter into binding contracts, these decisions have potential long-term negative consequences. Students are graduating with large amounts of debt and starting out in their careers with very limited spending which impacts their ability to obtain car or home loans [4]. Education institutions play an important role in developing financially literate citizens. This paper discusses the need and interest in a financial literacy program at a small liberal arts college in Virginia.

INTRODUCTION

The college years are an important time in the life of young adults as they gain increased independence and responsibility. In addition, to managing their schedules, student are often faced for the first time with important personal financial decisions. For example many students encounter real-world debt related issues, such as credit cards or students loan. Since they have reached the legal age to enter into these binding contracts, these financial decisions can have potential long-term negative consequences such as damage to their credit history. According to Friedman [5] in a recent Forbes article, student loan debt is estimated at $1.52 trillion which is a $29 billion dollar increase just in the last quarter. The average debt for students graduating in 2016 was $37,172, with student loan debt accounting for the second largest source of consumer debt only behind mortgages. The current average default/delinquency rate is 10.9% which is over $60 billion. Students graduating with these large amounts of debt and starting out in their careers are very limited in their spending and their ability to obtain car or home loans which fuels the economy [4]. According to Ergun [2], "governments and some organizations have realized that financially knowledgeable citizens are essential for a nation's well-being". Therefore few argue about the importance of financially literate citizens with educational institutions having an important role to play. The purpose of this paper was to evaluate the need and interest in a financial literacy program at a small liberal arts college in Virginia. In the next section, a brief review of the literature will focus on the timing of education delivery, various educational models and the topics of interest reported by students.

LITERATURE REVIEW

Research [16] supports the idea that financial literacy programs should not just focus on students nearing graduation, but start right from the beginning of a student's college career to potentially prevent future problems. The top reason students drop out of college is due to financial issues and the need to work [16]. According to a recent survey, Money Matters on Campus [12], many students starting college are already exhibiting risky behavior with almost 30% of all students entering college having a credit card and most having more than one. The concerning issue is that around 25% of these students already have an outstanding balance greater than $1,000 and 5% with a balance greater than $5,000. These early warning signs of financially risky behavior at the start of the college experience increases the stress to successfully complete a degree. According to Nguyen [15], "nearly 30% of college students who took out loans dropped out of school according to a report by Education Sector and these dropouts are four times more likely to default on their loans than students who graduate".

Unfortunately students are coming to college unprepared to make the important financial decisions they will encounter. This may not come as a surprise to some as only 17 states require a high school course in personal finance [17]. As noted in a 2009 research study by the National ndowment for Financial Education, over 60% of college students surveyed indicated that they had never taken a personal finance course while in high school, underscoring the need for more financial education while in college.

Research has documented [3] [10] five specific approaches to financial education: 1) interactive online programs, 2) classroom-based programs, 3) game-based education, 4) event-based programs, and 5) individual counseling. Interactive online programs are popular at larger institutions since they are cost efficient and allow students to learn at their own pace on their own

schedule. The main downside is the lack of human interaction, which can be offset by incorporating multimedia videos to increase student engagement [4]. Another option is classroom-based programs, such as, semester length courses or guest lectures in certain classes. Again this approach is relatively low cost since large numbers of students can be reached at one time; however the ability to tailor the education and counseling to individuals within the class is somewhat limited. Also the use of financial games, which can include simulations, contests, board games, card games, or electronic games, increases the "fun factor" which can create a collaborative learning environment. Special events are the fourth method often used to help programs gain visibility on campus, create buy-in and deliver program content. The final approach is individual counseling, which can be provided by professional staff members or student peers in various formats, such as face-to-face, over the phone or web-based [7]. The counseling services provided can range of services from providing assistance when dealing with financial problems to more preventive assistance, such as, goal setting, establishing a budget which can include managing cash and credit.

According to research by the Coalition of Higher Education Assistance Organizations (COHEAO) there is no perfect operational model for a campus financial literacy program which are managed by a wide variety of campus departments most often within academic affairs or student affairs [7]. However several studies [8] [6] have found that students are most interested in the online delivery method, followed by workshops and then counseling centers. Goetz et al. [6] suggests that based on the strong interest in various educational formats, higher educational institutions should consider a multipronged approach with research indicating that the methods are complementary in nature.

Many studies have found that college students are interested in financial education [8] [9] [12] which is encouraging. A study by U.S. Bank [1] of 1,628 undergraduate college and high school students ages 18-30 was conducted online followed by 21 more detailed interviews with individual students. According to this research students reported interest in the following topics: saving money (51%); investing money (43%); understanding credit (40%); and debt and money management (28%). So the literature supports starting early in the educational career of a college student by offering a multi-pronged approach to instruction. Next the survey administered at the focus institution for this paper is discussed.

SURVEY RESULTS

Students on one campus of a small liberal arts college in southwestern Virginia were surveyed to better understand their level of financial literacy, interest in a program and topics most important to them. A capstone course in the intellectual inquiry curriculum (INQ) was selected as the population to complete the survey. The INQ program consists of seven classes, which are required as part of the general education curriculum. The Contemporary Issues capstone class varies dramatically by topic, however still encompasses the importance of empowerment for individuals to solve problems with complexity, diversity, intellect, and creativity. This class was chosen to complete the survey because it is a capstone requirement in the general education sequence that encompasses all majors and minors, and is typically taken by upper level students. In addition, since most of these students were nearing the end of their college careers we felt they

would have a better perspective on the types of financial issues and decisions faced by college students. The survey questions can be found in Appendix 1.

There were 376 students enrolled in this course during the 2017-2018 academic year. The survey was completed by 198 students in total of which 182 students (92%) were seniors and the remaining 8% were juniors. Students were asked about their perceived level of financial intellect, as well as, a few detailed questions to test just that. When asked about their current financial situation, 34% of students stated they were just barely keeping up while 66% claimed to be financially stable. When students graded themselves on managing their money, the result was very honest but also alarming. Over half the students graded themselves with a D in managing money while less than 5% of students graded themselves A or B.

Students were asked to rate their interest in learning about financial literacy on a 0 to 5 scale, with 5 indicating high interest. The mean score was 3.97. More importantly, we asked the students how important it was to them that Roanoke College offer opportunities to learn about personal finances, which resulted in a mean of 4.39 out of 5. In addition students selected topics they were interested in learning more about with managing money being the topic choice, followed by investing and budgeting. The responses on each of the 11 financial topics can be found in Appendix 2.

Not only do students in liberal arts education have a desire to learn more about financial literacy, they also have a *need* for it. We asked students what they thought the average interest paid on savings account in the United States is currently, and 70% of students answered incorrectly. Students were also asked about the frequency they engaged in seven different financial behaviors with responses supporting the need for education. For example only 32% of students admitting they keep track of their expenses on a regular basis.

The message is clear, liberal arts students have the interest, need, and desire to learn more about financial literacy. So what is the most effective way to teach about financial literacy in such a diverse group of students with various interests and abilities? From the students perspective, 64% suggested classroom instructions, 50% liked the idea of one-on-one support, 34% suggested computer based instruction or online videos, 38% suggested workshops, and 26% wanted a webpage. The student's two least favorable methods of teaching financial literacy were email blasts and newsletters.

Overall, the students need for a classroom environment or one on one support, with the additional online resources seems to be the most popular idea of how the students would like to learn. These findings seem to be in line with other research [8], [9], [6], [13] of strong interest by students in learning more about financial topics as well as support for a multi-faceted approach to education. Putting all of these resources together can ensure that many students would have an avenue to learn about important financial literacy topics that are necessary post-graduation. Since a large majority of students in liberal arts colleges are not business or finance oriented majors, they lack this type of education unless they take the liberty to learn about it on their own. Many students lack the resources and find themselves at a loss of where to start educating themselves on these topics, and this is where we can help!

NEXT STEPS

Fortunately, colleges and universities are becoming more aware of their unique opportunity to help prepare students to achieve a better financial future. As a result financial literacy initiatives are becoming more common as institutions strive to increase student retention and graduation rates and address rising student loan default rates. In addition by offering financial education programs colleges and universities are doing their part in contributing to the community and overall economy by preparing more informed citizens.

Next steps related to this project is to evaluate how to implement a program on the campus surveyed. A first step is to explore external vendors that provide the curriculum and often the instructors or training for the instructors and compare this to the option of developing a program in-house from scratch. The evaluation will include obtaining a list of services, cost of the services, and reviews of schools using the service of external vendors. After review and evaluation, this information will be shared with relevant areas on campus including Academic Affairs, Business Affairs and Financial Aid for input and feedback.

APPENDIX 1

Financial Literacy at Roanoke College

Survey Questions:

1) What is your academic status?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior

2) Please rate your interest in increasing your financial knowledge
    a. 1-5 Star rating

3) What topics would you be most interested in learning about? (Select all that apply)
    a. Employment
    b. Banking
    c. Budgeting
    d. Investing
    e. Interest Rates
    f. Student Loans
    g. Personal Spending
    h. Paying for College
    i. Getting out of/Avoiding Debt
    j. Saving
    k. Managing money

4) How would you like personal financial learning opportunities delivered to you? (Select all that apply).
    a. Classroom instruction
    b. Newsletters
    c. Computer-based instruction
    d. Online Web Page
    e. Workshops
    f. One-on-one support
    g. E-mail blasts
    h. Online Videos

5) Rate your financial behaviors based on the following statements. (Never/Rarely/Sometimes/Always)
    a. I put aside money for savings, future purchases, or emergencies
    b. I pay my credit card bills on time each month
    c. I prepare a monthly budget
    d. I comparison-shop or buy things on sale
    e. I keep track of my expenses on a regular basis
    f. I know how much my student loans will add up to by my graduation date
    g. I feel secure in my current financial situation.

6) How important is it that Roanoke College offer opportunities to learn about personal finances?
    a. 1-5 Star rating

7) Select your highest monthly expense form the 5 categories below.
    a. Food
    b. Rent
    c. Clothes
    d. Alcohol and/or drugs
    e. Other

8) What do you think the average interest paid on a savings account in the United States is?
    a. 0-1%
    b. 1-3%
    c. 3-5%
    d. 5-7%
    e. +7%

9) How would you grade yourself on managing your money?
    a. A/B/C/D/F

10) What sounds most like your current financial situation?
    a. I'm barely keeping up
    b. I'm doing just fine

APPENDIX 2

What Topics would you be most interested in learning about? (Select all that apply)

#	Answer	Response	%
1	Employment	102	51.52%
2	Investing	120	60.61%
3	Personal Spending	95	47.98%
4	Saving	116	58.59%
5	Banking	65	32.83%
6	Interest Rates	67	33.84%
7	Paying for College	75	37.88%
8	Managing Money	127	64.14%
9	Budgeting	119	60.10%
10	Student Loans	114	57.58%
11	Getting out of/Avoiding Debt	112	56.57%

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INTERACTIVITY AND STUDENT LEARNING EXPERIENCE IN ONLINE LEARNING

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ABSTRACT

According to WCET Distance Education Enrollment Report 2016, the number of students who enrolled in at least one online course increased from 1.6 to 5.8 million between 2002 and 2014. Despite the growth and benefits of online learning, there have been questions about the effectiveness of online learning. According to a report on online education, with current design, online courses are difficult, especially for the students who are least prepared. The report found that such students' learning performance is worse (e.g., higher dropout rates and lower grades) when they take online courses than it would have been if these same students had taken in-person courses. It also argues that the major difference between online and in-person courses is student-faculty interaction. Thus, student learning experience in online learning is quite different from that in the face-to-face learning, especially for student-instructor interactions and engagement.

While prior research has identified student-instructor interactions and engagement as critical factors on student learning experience and performance in online learning, there has been little discussion on how to promote such interactions and engagement in the online learning context. This study attempts to address how we can make online learning more effective by promoting the interactions between students and instructors, and ultimately improve student engagement and satisfaction in online learning. Thus, we pose the following research questions.

> Can an interactive communication tool facilitate students' online learning by promoting their perceptions on instructor presence and engagement?

In answering the questions, we draw on theories of constructivism, social presence, and engagement, and propose and empirically test a research model including four constructors of interactivity, instructor presence, student engagement, and student satisfaction in online learning. We believe that the findings in this paper would help us better understand the student learning experience mechanism in online learning where the use of interactive tool for communication contributes to students' perception on instructor presence, promotes student engagement, and eventually leads to student satisfaction.

To test the research model, we collected data from a sophomore level business statistics course, using Microsoft Teams, as the medium of the classroom communication, which was designed for workplace communication and collaboration by combining chat, meetings, notes, and attachments. Survey method has been used to collect data and test the hypotheses in this study. Preliminary data analysis with PLS shows that all hypotheses are supported, except for the hypothesized path between interactivity and student engagement.

MESSAGING APPS AND THE DARK SIDE OF COURSE SOCIAL CLIMATE: ARE ONLINE COMMUNICATION TOOLS HELPING OR HURTING STUDENT LEARNING AND ETHICAL BEHAVIOR?

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ABSTRACT

There has been a growing interest in the value of course climate considerations in the learning environment. Course climate addresses matters such as: social interaction and the use of online, social and interactive tools and methods for learning, collaboration and communication with instructors and students. Previous research supports the importance of social interaction for cognitive development in the course environment (Price, 2011; Brown, Collins, & Duguid, 1989). Social interaction/Social climate has also been associated with: lower dropout rates, higher levels of student involvement and lower levels of risky behaviors (Ambrose, 2010).

Ambrose et al, 2010 defines course climate as "the intellectual, social, emotional, and physical environments in which our students learn. The social climate includes a combination of factors that interact together which includes: online communication and presentation tools, student-student interaction, faculty-student interaction and the presentation of course materials and content.

However, in recent years, there is increasing attention on a darker side of social interaction and online communication tools that are used for academic courses. There have been increasing reports of academic dishonesty associated with mass cheating among student members who are using group messaging applications (apps) such as GroupMe. The messaging apps allow students to communicate through group chats instead of texting or emailing.

Cheating is becoming more common in the classroom. Wilson (2008) suggests that students are cheating more because of pressure from parents who are more focused on obtaining the degree within a certain time frame and not as much on the learning. Mcabe & Butterfield, 2012) state that academic dishonesty is widespread throughout college campuses because everyone thinks its ok because "everyone does it" and because there are no consequences.

Messaging applications for academic purposes create opportunities that can be beneficial but also detrimental. For example, messaging applications can be very useful when used for legitimate purposes such as forming a study group or communicating with project members or sharing upcoming due dates for assignments. However, if they are being used to share answers to a test or to copy and turn in duplicate work this is harmful to the students receiving it as well as to those giving the work.

This research seeks to understand the following: what factors contribute to mass cheating through messaging applications; if mass cheating is more prevalent in online versus traditional classrooms and what steps can be taken to decrease academic cheating. This research will examine students' perceptions of online messaging applications and the ethical implications associated with being a member of a messaging application.

Initial research will focus on interviews which will be used to develop a questionnaire. The questionnaire will be distributed to students who have taken both online and traditional courses.

STUDENT ASSESSMENT IN A CAPSTONE COMPUTING COURSE

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ABSTRACT

The capstone computing course at our university provides students with experience working on real-world computing and information systems projects. Students have the opportunity to develop both the hard and soft skills that are sought after by industry. The structure of the course has evolved from a traditional face-to-face format to a web-assisted format with only three face-to-face class meetings. With the current essentially online nature of the course, student assessment has required development of improved assessment tools. Both the project work team-level assessment and the peer evaluation individual-level assessment methods have been extensively revised, while maintaining student satisfaction and quality of project deliverables at a high level.

Keywords: Capstone computing courses, student assessment, project-oriented courses, distance education, collaborative skills.

1. INTRODUCTION

A capstone masters-level course is required in most master's programs to bring together major aspects of the academic disciplines related to the major [4] [7]. The aim of our capstone course in computing is to familiarize students with how their trade is plied in organizations, so that the program of study delivers "the practice" part of the promised "theory and practice." The projects are real-world because they entail the development of an application desired by a real-world customer. As in industry, applications are developed by a small, collaborative team which needs to communicate with the customer, coordinate its activity, attend to internal decision-making, and, as observed by Denning and Dunham [6], be sensitive to delivering value. The applications usually require familiarity with current technology. Students learn about real-world technology through their own group's experiences as well as through the reports from other groups. Important soft skills, emphasized by activities throughout the capstone experience, are the ability to communicate on technical concepts and issues orally, in written reports, and via Web media; to both peers and non-technical people. The soft skills acquired through a capstone course are one of the greatest rewards of the capstone experience. These include problem solving, communication, and teamwork skills which are essential for work in industry [8].

A 15- year review [12] of our capstone course in computing (2001-2015) described changes over the years, the most significant one from a two-semester, face-to-face format to a one-semester, web-enhanced course where dispersed students collaborate remotely except for three face-to-face classroom meetings. This paper focuses on student assessment in the course.

The remaining sections of the paper cover the following material: section 2 presents the course management activities, section 3 describes how students are assessed; and section 4 provides conclusions.

2. COURSE MANAGEMENT

Most projects are generated by real-world customers and approved by the instructors, often after discussions and modifications to make the project appropriate for the course. Project sources include faculty research, doctoral student research, internal university needs (databases with web interfaces, IRB system, etc.), and external community systems (computing systems for local hospitals, collaborative research with other universities, etc.), local hospitals or university departments needing various types of computing infrastructure. Project descriptions are posted on the course website and the students complete a survey where they list their project preferences, technical skills, and geographic location. The instructors assign students to teams and projects based on the student survey input. This selection process achieves diversity of academic performance, location, gender, and nationality which helps students develop important social and teamwork skills necessary to develop the project systems [10]. Many of the teams are geographically dispersed [14] which prepares the students for the growing business demand [9].

Our university has campuses in New York City and Westchester, NY. Currently about two-thirds of the students live or work in the greater New York City area. The remaining third are mostly from other regions of the East Coast with some from as far away as California and foreign countries. The distributed team issue is handled by a number of mechanisms and guidelines. For example, to facilitate communication among the project stakeholders, we insist that, except for extenuating circumstances, communication between a team and instructor, and between a team and a customer, be through the team leader, with all team members copied on communication email and given summaries of face-to-face meetings. This reduces communication to the instructor from individual students and keeps all stakeholders updated on project activities. The instructor also creates and uses email distribution lists for the whole class, for each project team including the customer, and for the customers. Project team leaders must be local, either living or working in the greater New York City area, to permit occasional face-to-face meetings with the project customers and instructor. Another challenge is the ability to build trust among team members. The term “jelled team” has been used to describe a strongly knit team that relies on trust. The probability of project success for “jelled teams” increases significantly when compared to other teams [11].

An extensive course website maintained by the instructor efficiently presents all the course information for convenient centralized access as follows:

- Homepage – instructor information, textbooks, course description and goals, course requirements, and grading system.
- Syllabus – weekly readings and assignments.
- Projects – a table of the semester’s projects provides for each project the customer's name and contact information, the project description, and the names of the students on the project.
- Students – contains student photos so students know their classmates and the instructor can recall a student, possibly years later, to provide letters of recommendation.
- Project Deliverables – lists and describes project deliverables.

- Grades – contains table of graded events and the current student grades indexed by the last 4 digits of their university ID number.
- Link to the Blackboard educational software system [1] used for quizzes, discussions, and collecting digital assignments.

Three 3-hour classroom meetings are important to bring the local students together (students outside the greater New York City are not required to attend) so they can meet some of their teammates and form face-to-face bonding. The first meeting occurs after the first week of the semester. By this time:

- the students have introduced themselves online through a Blackboard forum, reviewed the course website, and submitted project preference information to the instructor
- the instructor has received the students' project preferences and associated information, formed the student project teams, assigned teams to projects, chosen project team leaders, and posted the information on the project's page of the course website

At this meeting the instructor and students introduce themselves face-to-face (half hour), the instructor gives a lecture on the nature and value of conducting real-world projects in a capstone course (one hour), the instructor reviews the specifics of the course material and describes each of the projects (one hour), and the students group themselves into their project teams and begin planning project activities (half hour). At the second mid-semester meeting the students make PowerPoint slide presentations of their project prototypes. Material covered in these presentations includes, as appropriate and as time permits, a subset of the following items: brief description of project, summary of project specifications, frequency of meetings with customer/stakeholders and usual method of communication, plans to address changes in customer requirements, summary of user stories collected (if any), analyses accomplished (object-oriented might include defined classes and operations), design decisions and the trade-offs encountered, work breakdown structures, PERT chart, and/or Gantt chart, components built/planned, testing strategy, what was accomplished to complete the prototype, what will be added in the remainder of the semester, what has been easy/difficult during this half of the semester, and a prototype demonstration. Many customers attend the second meeting. At the third (semester-end) meeting the students present their final project system. This meeting is similar to the second meeting, and most of the customers attend the final presentations.

The project teams hold weekly meetings (often using such applications as Skype, GoToMeeting, Google Hangouts, etc.) and submit weekly progress reports. The graduate assistant monitors the reports and occasionally drops in for a short time on team meetings. Each team submits a technical paper draft each quarter. The first quarter (Q1) draft must be in the proper paper format, include an appropriate title, abstract, introduction, literature review citing appropriate references, and an approach or methodology. The second quarter (Q2) draft must include a list of key terms, essentially finalized literature review, a methodology, and preliminary findings/results; if a system is being developed, the system should be essentially complete (80-20 rule); and if experiments are being performed, preliminary results should be presented and discussed. The third quarter (Q3) draft must contain all sections and be essentially complete except for final updates; if a system is being developed, the system should be essentially complete except for final updates; and if experiments are being performed, essentially completed results should be presented and discussed. The fourth quarter (Q4) final paper must be in final form for the conference proceedings.

3. STUDENT ASSESSMENT

3.1 Overall Student Grade Determination

In this projects course, 80% of the student's grade is based on the project work and the remaining 20% on the individual work of taking quizzes based on the reading material (Table 1). Grades on the project work are assigned on a quarterly basis with increasing points as the semester progresses. The maximum number of points that can be earned during the semester is 1000 (100%). Current grades are posted on the course website at each quarter (Q1, Q2, Q3, Q4), indexed by the last four digits of the student's university ID for anonymity.

Table 1. Course grades.

	Grades A=93, A-=90, B+=87, B=83, B-=80, C+=77, C=73, C-=70							
	Project Work				Individual Work			
Student	Q1 - 10%	Q2 - 20%	Q3 - 20%	Q4 - 30%	Quizzes - 20%	Total	Total	Letter
ID	100 pts	200 points	200 points	300 points	200 points	1000	%	Grade
U1234	84	180						
...	...	...						
...	...	...						
U9003	80	170						

As described in the next two sections, the number of project-work points assigned to a student at a quarterly checkpoint is determined by computing a team assessment relative to the other teams and an individual team member assessment within the team.

3.2 Team Project Work Assessment

The team assessment is computed from instructor and graduate assistant (GA) input, together with the format correctness and Turnitin scores of the technical papers (Table 2).

Table 2. Team assessment: 8 teams, two instructors, one graduate assistant.

Team	Instr 1	Instr 2	GA	Format	TurnItIn	Average
1						
2						
3						
4						
5						
6						
7						
8						

The instructor assessment comes primarily from the content quality of the team technical papers. The graduate assistant's input comes primarily from the quality of the weekly project team status reports and occasional spot checking of the quality of the team meetings. The format input comes from the graduate assistant's checking of the correctness of the IEEE format of the technical papers

(length and quality of the abstract, correct citing of references, completeness of references, etc.). The Turnitin input comes from the score of the Turnitin software that measures the degree of potential plagiarism [13]. A Turnitin software score under 20 indicates low potential plagiarism and the score increases as more plagiarism is suspected. Therefore, to obtain a reasonable value in the range 0-100 the Turnitin score is subtracted from 100. After the first two quarterly checkpoints, the Format and Turnitin scores are dropped in order to focus more on the content and quality of the project work and because the teams have usually by this time correctly formatted the paper and properly cited the earlier work.

3.3 Individual Team Member Assessment of Contribution to the Team Effort

Peer evaluations are used to assess the project contributions of each team member. Obtaining individual student grades on teamwork has been reported in the literature. Clark, Davies, & Skeers [5] created an elaborate web-based system to record and track self and peer evaluations, Brown [3] has a system similar to ours but which uses more granular numerical input, and Wilkins & Lawhead [15] use survey instruments. This course employs the numeric peer evaluation scheme reported by Brooks [2], with extensions to include input from the instructors, the graduate assistant, and the project customers.

The students are required to provide peer evaluations four times during the semester, one at each of the quarterly checkpoints. For these peer evaluations each student distributes 10 points among the other members of the team based on the student's estimate of the team effort contribution of the other team members. The students are told that the main criterion for allocating points is the value of a student's contribution to the project work, with secondary consideration given to a student's attendance at weekly meetings and the student's work ethic and attitude.

A sample peer evaluation summary chart with associated grades is shown in Table 3 for a four-member team. Each of the four team member evaluation columns shows the evaluation of a team member evaluating the other team members, each team member allocating a total of ten points among the other team members as suggested by Brooks [2]. This study extends the evaluations to the customer, the instructors, and the graduate assistant. Therefore, the table includes additional columns, shown in yellow, for evaluations from the customer, the instructors, and the graduate assistant. The summary column shows the adjusted sum of each row of evaluations after subtracting the expected average (the total of the sum column must add to zero), and the grade column shows the individual team member grades. In this example, a team grade of 85% is first determined and then individual grades are adjusted relative to the team grade, and the formulas in the spreadsheet cells perform the calculations automatically.

Table 3. Team summary chart with peer evaluations and extensions.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Eval Cust	Eval Inst1	Eval Inst2	Eval GA	Sum	Grade
1		4	2	7	5	5	4	5	12	97
2	5		4	1	1	1	2	1	-5	80
3	0	3		2	1	1	2	2	-9	76
4	5	3	4		3	3	2	2	2	87
Total	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**0**	**85**

3.4 Summary of Student Assessment on Project Work

The sequence of grade computations at each quarter is as follows:

1 Obtain team grades by completing the team project grade sheet (Table 2).
2 Complete the peer evaluation summary chart and enter the team grade from Table 2 into the lower right-hand corner to finalize the individual grades (Table 3). This adjusts individual team member grades relative to the team grade.
3 Enter the individual grades into the course grade sheet (Table 1) and post it on the course website.

At each quarterly checkpoint, each students is also asked a number of general questions – the number of hours per week spent on project work, their specific contributions, their strengths and how these were used, their areas needing improvement, and what has enhanced and/or challenged their team's performance – and the responses might influence an instructor or graduate assistant evaluation of a student's contribution to the team effort. For additional input the instructors can discuss team member contributions with the team leader.

Since this is a project-oriented course with no midterm or final exams, student grades depend mostly on their contribution to the project work. The usual expected time commitment per student for a 3-credit course is three hours per week in class and twice that outside of class, for a total of nine hours per week. However, because this is essentially an online course where students save commuting time, the expected time commitment is about ten hours per week, and this additional time commitment is one of the advantages of a distance-learning course.

4. CONCLUSIONS

Capstone courses are important to computing and information systems education. Students develop hard and soft skills, are exposed to a wide range of topics, and foster interdisciplinary collaboration. The project deliverables also provide valuable systems for the customers and support student and faculty research. This enhances relationships between the university and local technology companies, and affords students the opportunity to acquire internal and external publications. Our yearly internal conference is complete with a review process and proceedings, and we have found that working to produce publications is a strong motivating factor for the students. Current students report high satisfaction with the course and graduates working in industry report the value of having had the experience of working on real-world projects.

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DECISION SCIENCES INSTITUTE

Student Learning in Quantitative Courses and its Impact on Critical Thinking Skills

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ABSTRACT

In this study, authors focus on the relationship between student learning experience in quantitative business courses (specifically business statistics and operations management), and critical thinking skills. Critical thinking skill is quantified by three variables: scientific/quantitative reasoning; critical reading and evaluation; and critiquing an argument. By using multiple regression models, comparative analysis is performed between key factors such as the amount spent online, communication with students and instructor, the pagers and participation, time spent in tutorial sessions, etc. Authors also assess student learning outcomes in an online vs. traditional statistics course taught in different institutions.

KEYWORDS: Critical Thinking, Business statistics, Operations management, Online teaching, Traditional teaching, Regression

2018 Spring CLA SCORES Summary

	Sci/Quan Reasoning			Critical Reading and Evaluation			Critique an Argument			Total			Total time spent		
Department	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min
MMEN	693	491	256	686	472	273	740	519	377	1257	982	804	84	49	7
AFHI	658	468	261	742	479	315	740	511	377	1216	1007	806	80	55	29

	Sci/Quan Reasoning			Critical Reading and Evaluation			Critique an argument			Total			Total time spent		
Major	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min
MGMT	645	501	256	643	481	315	740	549	395	1239	1014	825	82	53	19
MKTG	507	438	391	627	540	449	667	531	378	1170	996	896	77	47	24
ENTR	693	484	356	640	456	319	660	550	449	1201	967	821	54	41	36
GENL	658	498	391	686	459	273	618	498	377	1257	969	804	84	49	7
HCM	658	483	356	742	508	365	693	511	395	1216	996	806	67	51	37
ACCT	645	481	306	627	487	343	740	554	448	1172	1079	917	80	65	40
BF	557	455	391	538	420	315	589	472	377	1137	1000	907	68	59	40
MIS	551	402	261	600	422	319	544	485	378	1108	937	823	70	50	29

	Sci/Quan Reasoning			Critical Reading and Evaluation			Critique an argument			Total			Total time spent		
Transfer	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min
no	693	482	256	742	500	319	740	520	377	1257	1000	810	84	49	7
yes	658	476	306	686	448	273	660	509	377	1239	988	804	82	55	21

	Mastery level						
Major	accomplished	proficient	basic	below basic	well below	NA	All
MGMT	2	0	4	5	0	0	11
MKTG	0	1	3	1	0	0	5
ENTR	0	1	1	4	0	0	6
GENL	1	2	10	13	0	1	27
ACCT	0	5	4	1	1	0	11
BF	0	1	4	2	0	0	7
HCM	0	4	12	7	0	0	23
MIS	0	1	1	4	0	1	7
All	3	15	39	37	1	2	97

THE RULES OF STUDENT ENGAGEMENT: A TEST OF INSTRUCTOR INPUTS AND STUDENT LEARNING OUTCOMES IN ACTIVE VS. PASSIVE LEARNING ENVIRONMENTS

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ABSTRACT

As a guide or moderator in the classroom, professors more actively engage students in the learning process and capture their interest. Students' performance expectations of themselves are also impacted based on the learning environment created by instructors and the classification of the student. Instructors will learn the best way to complement the learning experiences of traditional vs. non-traditional students and graduate vs. undergraduate students. The importance of the study centers on how the current tech-savvy student learns best and what teaching methods instructors should consider in order to be optimally effective.

INTRODUCTION

Among the plethora of challenges facing higher education, student engagement and performance remain a primary concern. Whether based on problematic retention and graduation rates or for the quality of their educational brand, colleges and universities continually seek to enhance their pedagogical content and impact. By incorporating more effective strategies and methods, educational institutions better prepare today's technologically advanced students with marketable, employable skills while engaging in efforts to improve their retention and graduation rates.

In support of the same, this study details the classroom engagement and performance of 139 undergraduate and graduate students from two universities, namely Florida A&M University (FAMU) and University of Houston Downtown (UHD). The participating 72 male and 67 female students were completing coursework in the business schools within these respective universities. The goal of the study was to analyze student performance and engagement, specifically the total, physical, and emotional engagement, in three main categories: 1. active versus passive learning environments; 2. traditional versus non-traditional students; and 3. undergraduate versus graduate students based on a 34-question, Likert scale survey instrument.
A total of twelve hypotheses were set forth in the three categories. The results of the study demonstrated that eleven of the twelve hypotheses were supported, signifying higher engagement and performance explicitly in both physical and emotional measures, in active rather than passive class environments, by non-traditional, undergraduate students. The importance of this study centers on providing professors with additional studies that will encourage innovative, pedagogical techniques to promote greater engagement and performance in academia and beyond. This poses great significance to educational stakeholders like colleges and universities, professors, and students as well as employers and new graduates.

ACTIVE VERSUS PASSIVE CLASSROOM LEARNING ENVIRONMENTS

With tech-savvy, Generation-NeXt students, professors must consider when an active versus passive learning environment is demonstrated best in the classroom. The active learning environment incorporates activities that place the student into more responsive roles requiring critical thinking and problem solving, thus complementing student learning experiences through increased content knowledge and understanding [16] [2] [11] [15, pp.1-13]. Interactive small group exercises, applying business theories in case study analyses, field experiences, student-led course discussions in addition to Socratic questioning methods and devising content scenarios with accompanying answers all demonstrate effective examples of active learning approaches [22] [27, pp. 116-126]. Incorporating more engaged, experiential learning practices reinforces the pedagogical concept that students better recall information through active rather than passive learning methods [11] [25, pp.244-258]. As a by-product of classroom engagement activities, a disengaged student may transform into a highly engrossed participant by shifting the focus from the professor as a lecturer to the professor.

As a guide or moderator, professors more actively engage students in the learning process and capture their interest in support of long-term content knowledge, recall, and application [23] [26, pp.97-112]. These methods may yield numerous benefits to students and higher education institutions. Students who are actively engaged in classrooms have heightened course experiences, higher grades and class averages, and "psychological energy" to involve themselves in university-related collaborations like professional student organizations and thus relationship development [2]. Furthermore, colleges and universities may have increased retention and graduation rates, which could result in better recruitment efforts for future students.

In contrast, passive learning may render less desirable results for both students and their institutions. Passive learning promotes the professor as the focal point, lecturer, or wielder of knowledge [14] [26, pp. 97-112]. Herein, in traditional classroom settings, the professor actively imparts knowledge to students who may passively listen, take notes, and seldomly pose questions. Traditional lecture-style class structures may allow large classes to profit from a more convenient, direct content distribution method [14]. Nevertheless, overuse of this teaching style can severely minimize student engagement and lead to unwanted consequences **(See H1).**

Lack of student engagement may negatively impact regular class attendance, resulting in students missing valuable course content. When students are present, it may impede concentration, which reduces learning outcomes and could possibly lead to failure of courses. As passive learners, they fail to utilize the multiple levels of cognitive thinking, critical analysis, and ingenuity that are sought after by employers [19] [14, pp. 227-235]. Unlike students in active learning environments, passive learners also find it more difficult to connect socially on college campuses [7] [2, pp. 569-590]. Therefore, passive learning may also lead to the lack of development in the skills needed to understand concepts, to successfully pass courses, to socially engage or network, and to obtain certain preferred soft skills, possibly affecting college retention, graduation, and post-college employment rates. Consequently, the classroom performance expectations of active learners are likely better than with passive learners **(See H2).**

Regarding active versus passive classroom learning environments, it is hypothesized that:

H1: Students in active learning classroom environments will have higher levels of (a) total, (b) physical, and (c) emotional engagement than students in passive classroom learning environments.
H2: Students in active learning classroom environments will have higher performance expectations than students in passive classroom learning environments.

TRADITIONAL VERSUS NON-TRADITIONAL STUDENTS

In 2015, 40.5% of the millions of undergraduate students attending college were categorized as traditional students [18]. Traditional students consist of those who attend college within one year or less of high school graduation, fall in the age range of 17 to 24, and are mainly from middle or upper class families [9] [6, pp. 27-50] [12]. According to studies conducted by Fritschner [8], the age of a student provides a relatively strong indicator as it relates to class participation; in fact, the studies demonstrated that traditional students were about twice as likely to not engage in class participation as non-traditional students were [12] **(See H3)**. Various factors may explain the differences in student engagement among traditional students. Essentially, studies revealed that the total number of students in a course, whether the course is lower or upper level, and pedagogical methods implemented may all play a role in engaging students [12]. Furthermore, traditional students have additional interests, such as social integration, that may compete with the time and attention that is given to class preparation, especially since some are removed from the primary familial environments to which they are more accustomed.

Social integration centers on the level of belongingness that a student feels based on structured and unstructured connections to peers outside of the classroom; students integrate by joining campus organizations and participating in school-sponsored events as well as formulating study groups and gathering for leisurely activities [9] [2, pp. 569-590]. Academic integration maintains a profound significance as well. The level of academic integration may impede the ability of traditional students to actively engage in class settings. “Academic integration typically has been operationally defined and measured as a student’s estimation of their academic and intellectual development, grade point average and student’s perception of faculty concern for teaching and student development” [2]. As a result, the lower the social and academic integration, then the more likely that a traditional student is not actively engaged in a course and therefore may not be retained by the college or university [2] [7, pp. 63-74].

Conversely, non-traditional students often have different academic and personal responsibilities that impact their college experience. Non-traditional students may be categorized by three primary criteria: 1. age; 2. socio-economic status; and 3. retention risk factors [9] First, they are described as older students or adult learners who did not enroll and attend college within three to four months of high school graduation; thus, these students may be 23 years or older at the time of enrollment and attendance [9] [12] [8, pp. 342-362]. Second, the backgrounds of non-traditional students widely vary. They may be employed or unemployed, seek full-time or part-time course enrollment, be single with children but are largely married with children, be financially stable or seeking a degree to obtain more financial stability, and represent diverse racial and ethnic groups [9] [8, pp. 342-362].

Unlike traditional students who are usually entering college and creating various social networks

therein, non-traditional students are more likely to have sustainable non-academic social networks that may provide support for them. Therefore, they are presented with the unique task of assessing how to properly manage the competing academic interests with existing personal and professional responsibilities [9] [8, pp. 342-362]. **(See H4)**. An international study involving 228 non-traditional students, of which roughly 68.2% were 23 years or older, demonstrated that their academic engagement centered on investing time in attending class, nurturing relationships with professors outside of the classroom, and networking, thereby validating the premise that relationship cultivation is the primary factor in significantly increasing the performance and retention of non-traditional students [9]. Another study revealed that non-traditional students are twice as likely to engage in active discussion in lectures than traditional students while also being almost thrice as likely to take more ownership and responsibility for navigating and responding to questions posed by the professor; all in all, approximately 45% of non-traditional students versus 17% of traditional ones engaged in active discussions [12]. As a result, performance expectations for non-traditional students are likely to be higher than for traditional students.

Regarding traditional versus non-traditional students, the following is hypothesized:

> H3: Non-traditional students will have higher levels of (a) total, (b) physical, and (c) emotional engagement than traditional students.
> H4: Non-traditional students will have higher performance expectations than traditional students.

UNDERGRADUATE VERSUS GRADUATE STUDENT

Undergraduate students encompass a combination of traditional and non-traditional students. Depending on their level of preparation and experiences in academic matriculation through high school, undergraduate students have varying performance expectations for themselves. Previous studies have shown that approximately 33% of undergraduate students had insufficient educational foundations in preparation for college coursework [1]. Accordingly, one conclusion has been that academic preparedness is a primary and significant factor in academic success but does not account for all situations [1] [24, pp. 1-17]. Other factors like socio-economic status and work-academic balance play critical roles in student performance and thus expectations.
Challenges with securing funding to pay for college educations plague low-income students while their wealthier counterparts may have more time to focus on academic and social integration rather than balancing class responsibilities and work [1] [13, pp. 265-286]. Although not absolute, higher integration levels may mean better grades and advanced levels of performance expectations from the percentage of undergraduate students in certain socio-economic backgrounds **(See H5)**. Nonetheless, motivation levels, regardless of socio-economic status, may be a critical factor that accounts for excellent student performance. For instance, a 2009 analysis showed that undergraduate freshmen who were taught to psychologically connect or associate their current academics to their future graduation and career goals were represented as being more academically motivated with higher performance expectations [4].

In addition, those undergraduate students who performed well academically in high school may have higher performance expectations in college **(See H6)**. This premise is supported by a study of Wisconsin high school students who were taught to link their secondary academics to college

entrance and academic expectations; it revealed the positive correlation between student perceptions of the relevance of academics to their future goals and success levels [5]. Therefore, regardless of background, undergraduate students may have high performance expectations when academic pursuits are aligned with the relevance of future professional goals; their undergraduate performance may also be a strong indicator of who attends graduate school [17] [5, pp. 93-112].

Interestingly, the performance expectations of graduate students may differ from those in undergraduate studies **(See H6)**. This may be, in part, due to the multiple factors affecting the vigorous expectations of graduate school. One factor deals with adjusting the social identity of the graduate student to one who is "a scholar or knowledge producer", which tremendously contrasts with the role of undergraduate students [21] [3, pp. 108-137]. This factor makes the social and academic integration of the graduate students even more imperative for their academic success. Similar to non-traditional students who may have existing social networks outside of academia, graduate students are challenged to foster social inclusion in college, thus creating competing circumstances with work, family, and course responsibilities. Such competition may be a chief concern for international graduate students who are in foreign countries for educational purposes, thus supporting a study setting forth that they held various academic interaction as supremely important and for that reason had higher rates of integration [3] [21, pp. 748-774]. However, graduate students also may have added stressors that negatively impact their mental health due to the different social identity factors necessary in graduate school **(See H5)**.

Despite having higher class engagement in comparison to undergraduate students, graduate status often brings an increase in personal academic accountability, more coursework, balancing time with school, work, and family schedules, paying for school, and professional behavior expectations that may cause stressors that impair mental and emotional health; this was reflected as challenging for both single and married graduate students [10] [20, pp. 451-456]. For example, an assessment of stressors in graduate school reported the following statements from graduate students regarding their academic performance expectations:

- "[T]he best paper is a done paper.";
- "It doesn't have to be good, it just has to be finished.";
- "Putting things in perspective … having reasonable standards for yourself"; and
- "Well this is really hard, like I can't be a good mother and be like the great graduate student."

  [10].

As a result of these competing factors, it is hypothesized (in relation to undergraduate versus graduate students) that:

> H5: Graduate students will have higher levels of (a) total, (b) physical, (c) emotional, engagement than undergraduate students.
> H6: Undergraduate students will have higher performance expectations than graduate students.

METHODOLOGY

Sample and Data Collection

For this study, one hundred and thirty-nine (139) data points were collected to analyze the responses of learners in an active learning environment versus a passive learning environment. The data collected included 40 graduate and 99 undergraduate students. The three different types of learning environments included were face-to-face (F2F) delivery, online delivery, and hybrid delivery, which was a combination of face-to-face and online. The respondents were also classified into traditional and non-traditional students. Surveys were administered during class and were collected over a two-week period. Data was collected by faculty members who taught the course and students received extra credit for their course work for completing the survey. This was a convenience sample of university students.

A passive classroom learning environment was examined in online and face-to-face classes that met twice per week for seventy-five minutes. An active classroom learning environment was examined in a hybrid course where students met once a week with the professor in class and then course work was completed outside of the classroom for the second period. Assignments were submitted before the beginning of class, thereby requiring students to study and learn the course material individually or in small groups. Students subsequently met with the professor to review and complete more interactive assignments.

For the purposes of this study, non-traditional students were those of an average age of 30 and who returned to college after graduating high school and starting respective careers while traditional students were between 17-22 years old due to entering college within the same calendar year of graduating from high school. Graduate students were pursuing a Master of Business Administration (MBA) whereas undergraduate students were pursuing a Bachelor of Science as a general business degree. All students were enrolled in the business schools at FAMU and UHD.

Instrument

The survey instrument, presented in Appendix 1, included thirty-four questions. They were comprised of the following areas: a. student background (six items), b. student learning outcomes (four items), and c. academic motivation scale (twenty-four items). In each question, the respondent was provided a seven-point Likert scale to use in their responses. The Likert scales range of responses were: 1 (Strongly Disagree) to 7 (Strongly Agree), 1 (Worse) to 7 (Better), 1 (Does Not Correspond At All) to 7 (Corresponds Exactly), 1 (Nothing to Do With Me) to 7 (Totally Due to Me), and 1 (Never Present) to 7 (Always Present).

RESULTS

SPSS and Microsoft Excel (Excel) were both used to conduct the statistical analysis. Excel helped to create contingency tables and to isolate certain subgroups of data with select characteristics. Once each subgroup within the study was isolated, the means and standard deviations were calculated for the participants' responses. In some instances, multiple item responses were combined for these calculations. Subsequently, F-tests, t-tests, and ANOVAs were used to analyze the collected data. Of the 139 completed surveys, 51.8 percent of the respondents were male and 48.2 percent were female. Approximately, 20.9 percent were single and 79.1 percent were married. Concerning ethnicity, 51.8 percent of the respondents were Caucasian, 5.8 percent were Hispanic, 7.9 percent were African American, 25.2 percent were Asian, and 9.3 percent were Middle Eastern. The average age of the respondents was 25.76 years old.

With regards to collegiate education completed, 1.4 percent had completed one year, 38.2 percent had completed two years, 28.8 percent had completed three years, 22.3 percent had completed four years, 6.5 percent had completed five years, 1.4 percent had completed six years, and 1.4 percent had completed seven years. Furthermore, 71.2% were undergraduate students while 28.8% were graduate students. 31.7 percent of respondents were in an active classroom setting whereas 68.3 percent of respondents were in a passive classroom setting. 7.9 percent reported they had only completed high school, 57.5 percent had completed some college, 31.7 percent were college graduates, and 2.9 percent possessed a graduate degree, such as MBA, Juris Doctorate (JD), or Doctor of Philosophy (Ph.D.).

Table 1 shows the overall averages and standard deviations for the selected questions on the student learning outcome of Performance Expectation. In reference to the Performance Expectation questions, the average responses dropped to Slightly Disagree to Disagree range. For the category Self-Reported Performance, the response averages came back up to the Slightly Agree to Agree range.

TABLE 1: Averages and Standard Deviations of Student Learning Outcome (Performance Expectation)

Question	Average	Standard Deviation
Performance Expectation		
I often feel like I may not be able to meet my instructors' expectations.	3.22	1.86
I am often anxious that I won't be able to perform as well as others.	3.69	1.98

I often feel like the student requirements of my class and school are beyond my capability.	2.60	1.79
I often feel like I may not be able to keep my performance up with others in my class and school.	2.78	1.82

Table 2 shows the overall averages and standard deviations for the selected questions on Academic Motivation. These questions are further divided into four different categories: a. Emotional Engagement, b. Physical Engagement, c. Cognitive Engagement: In Class, and d. Cognitive Engagement: Out of Class. All of these questions used the seven-point Likert scale (1 - Strongly Disagree to 7 - Strongly Agree). These Emotional Engagement questions address the emotional state of the student, such as excited, enthusiastic, and/or energetic toward the class. The Physical Engagement statement determines the effort contributed during class. Cognitive Engagement: In Class addresses whether the student is focused and paying attention while in class. Whereas, the Cognitive Engagement: Out of Class addresses the student's focus and attention level on class material when not in the classroom setting.

The average response rate for all of the engagement satisfaction categories is above 5.0, which is in the Slightly Agree to Agree range. The only exception is in response to the statement: "When I am reading or studying material related to this class/course, I am absorbed by class discussion and activities." The average response rate is a 4.95, which is Neutral to Slightly Agree.

TABLE 2: Averages and Standard Deviations of Academic Motivation (Engagement)

Question	Average	Variance
Emotional Engagement		
I am enthusiastic about this class/course.	5.40	1.46
I feel energetic when I am in this class/course.	5.16	1.57
I am interested in material I learn in this class/course.	5.76	1.34
I am proud of assignments I complete in this class/course.	5.60	1.37
I feel positive about the assignments I complete in this class/course.	5.79	1.23
I am excited about coming to this class/course.	5.35	1.56
Physical Engagement		
I work with intensity on assignments for this class/course.	5.43	1.36
I exert my full efforts toward this class/course.	5.45	1.45
I devote a lot of energy toward this class/course.	5.17	1.61
I try my hardest to perform well for this class/course.	5.73	1.35
I strive as hard as I can to complete assignments for this class/course.	5.88	1.30
I exert a lot of energy for this class/course.	5.16	1.60

Cognitive Engagement: In Class		
When I am in the classroom for this class/course, my mind is focused on class discussion and activities.	5.55	1.36
When I am in the classroom for this class/course, I pay a lot of attention to class discussion and activities.	5.60	1.36
When I am in the classroom for this class/course, I focus a great deal of attention on class discussion and activities.	5.59	1.37
When I am in the classroom for this class/course, I am absorbed by class discussion and activities.	5.32	1.31
When I am in the classroom for this class/course, I concentrate on class discussion and activities.	5.55	1.22
When I am in the classroom for this class/course, I devote a lot of attention to class discussion and activities.	5.55	1.25
Cognitive Engagement: Out of Class		
When I am reading or studying material related to this class/course, my mind is focused on class discussion and activities.	5.25	1.38
When I am reading or studying material related to this class/course, I pay a lot of attention to class discussion and activities.	5.27	1.40
When I am reading or studying material related to this class/course, I focus a great deal of attention on class discussion and activities.	5.21	1.43
When I am reading or studying material related to this class/course, I am absorbed by class discussion and activities.	4.95	1.53
When I am reading or studying material related to this class/course, I concentrate on class discussion and activities.	5.12	1.51
When I am reading or studying material related to this class/course, I devote a lot of attention to class discussion and activities.	5.14	1.50

The researchers tested to see if there were any differences in responses between active learners in hybrid classes and passive learners in face-to-face and online courses with regards to performance and engagement. The engagement category was separated into emotional and physical areas.

A statistical difference existed in all four of the active versus passive learning environment hypotheses tested. With regard to Engagement, the active learners had a higher score than the passive learners (p-value = .00). Also, breaking the engagement category into emotional and physical, there was a significant difference in physical engagement (p-value = .00) and emotional engagement (p-value =.09). The results of the study revealed that the performance expectations were greater from respondents in an active learning classroom (p=.06). Table 3 presents the tested hypotheses and their corresponding p-values.

Table 4 depicts the next set of hypotheses that researchers further tested compared to traditional student responses and non-traditional student responses to the same hypotheses. Similar to the

last set of hypotheses in Table 3, all four hypotheses rejected at a p-value less than five percent. Non-traditional student responses were higher for overall Engagement, Physical Engagement, Emotional Engagement, and Performance (p-value = .00, .00, .00, and .01, respectively). There was one hypothesis that was borderline for p-value. Table 4 presents the tested hypotheses and their corresponding p-values.

TABLE 3: Active Classroom versus Passive Hypotheses Results (Included undergraduate and graduate students in both groups)

	Active Learning means are reported below the Passive Learning means.	**Mean (Variance)**	**t**	**P**
H1A	In an active classroom learning environment, **Engagement** is greater than in a passive classroom learning environment. (This is with all Engagement questions combined.)	5.37 (2.03) 5.49 (2.01)	-5.15	*.00
H1B	In an active classroom learning environment, **Physical Engagement** is greater than in a passive classroom learning environment.	5.27 (2.11) 5.91 (1.99)	-5.94	*.00
H1C	In an active classroom learning environment, **Emotional Engagement** is greater than in a passive classroom learning environment.	5.46 (1.94) 5.61 (2.38)	-1.32	*.09
H2	In an active classroom learning environment, **Performance Expectation** is greater than in a passive classroom learning environment.	2.98 (3.34) 3.27 (4.24)	-1.57	*.06

TABLE 4: Traditional versus Non-Traditional Hypotheses Results (Traditional students met face-to-face. Non-traditional students met online and in hybrid formats.)

	Non-Traditional means are reported below the traditional means.	**Mean (Variance)**	**t**	**P**
H3A	**Engagement** is greater in non-traditional students than in traditional students**.** (This is with all Engagement questions combined.)	5.18 (2.22) 5.74 (1.90)	-7.84	*.00
H3B	**Physical Engagement** is greater in non-traditional students than in traditional students**.**	5.05 (2.36) 5.81 (1.75)	-7.52	*.00
H3C	**Emotional Engagement** is greater in non-traditional students than in traditional students**.**	5.31 (2.06) 5.67 (2.04)	-3.58	*.00
H4	**Performance Expectation** is greater in non-traditional students than in traditional students**.**	2.87 (3.18) 3.23 (3.95)	-2.26	*.01

The researcher further tested undergraduate student responses versus graduate student responses. Per Table 5, this group had four hypotheses rejected at a p-value less than five percent. It was determined that the graduate student Emotional Engagement and Physical Engagement averages were greater than undergraduate student's averages (p-value .01, and .02, respectively). In contrast, undergraduate Student Performance averages were greater than the graduate student averages (p-value .00). With p-values of ten percent reported, graduate student Emotional

Engagement was greater than undergraduate student averages (p-value .10). The tested hypotheses and their corresponding p-values are presented below.

An ad-hoc test was conducted using ANOVAs to determine whether there were true differences between the student groups divided by instructional methods: face-to-face versus online versus hybrid instructional methods. The researchers tested to see if those three groups responded differently to the topics of Performance, Overall Engagement, Emotional Engagement, and Physical Engagement. With regards to this, three of the four hypotheses were rejected at a p-value having a significance level equal to .00. The results suggest that there was a difference in the three groups when testing for overall engagement, emotional engagement, and physical engagement. It is interesting to note that the face-to-face method had the lowest response rate for the three groups when dealing with overall engagement, emotional engagement, and physical engagement. Table 6 presents their corresponding p-values.

TABLE 5: Undergraduate versus Graduate Hypotheses Results (Graduate students met face-to-face. Undergraduate students met online, face-to-face, and in hybrid formats.)

	Graduate means are reported below the undergraduate means.	**Mean (Variance)**	**t**	**P**
H5A	**Engagement** is greater in graduate students than in undergraduate students**.** (This is with all Engagement questions combined.)	5.43 (2.14) 5.63 (2.05)	-2.42	*.01
H5B	**Physical Engagement** is greater in graduate students than in undergraduate students**.**	5.40 (2.13) 5.64 (2.21)	-2.15	*.02
H5C	**Emotional Engagement** is greater in graduate students than in undergraduate students**.**	5.46 (2.15) 5.61 (1.90)	-1.26	*.10
H6	**Performance Expectation** is greater in undergraduate students than in graduate students**.**	3.21 (3.77) 2.72 (3.13)	2.79	*.00

TABLE 6: Face-to-Face versus Online versus Hybrid Student Group Hypotheses Results

	Mean (Variance)	**F**	**P**
Engagement responses are different in Face-to-Face versus Online versus Hybrid Instructional Methods. (This is with all Engagement questions combined.)	5.18 (2.22) 5.71 (1.49) 5.74 (2.05)	31.55	*.00
Physical Engagement responses are different in Face-to-Face versus Online versus Hybrid Instructional Methods.	5.05 (2.36) 5.68 (1.40) 5.94 (1.89)	37.71	*.00
Emotional Engagement responses are different in Face-to-Face versus Online versus Hybrid Instructional Methods.	5.31 (2.06) 5.74 (1.60) 5.64 (2.29)	7.64	*.00
Performance responses are different in Face-to-Face versus Online versus Hybrid Instructional Methods.	2.87 (3.18) 3.18 (3.59) 3.15 (4.09)	1.81	.16

HYPOTHESES SUPPORTED AND HYPOTHESES NOT SUPPORTED

Hypotheses Supported

All 12 hypotheses were supported: H1A, H1B, H1C, H2, H3A, H3B, H3C, H4 and H5A, H5B, H5C, and H6. When testing active learning environments versus passive learning environments (H1A, H1B, H1C, and H2), the hypotheses concerning Overall, Physical, and Emotional Engagement were rejected (p-value = .10).

When testing traditional students versus non-traditional students, again all four of the hypotheses proved to be significant (H3A, H3B, H3C, and H4). Non-traditional student responses were higher than traditional student responses when concerned with Performance, Overall Engagement, Physical Engagement, and Emotional Engagement (p-value = .01, p-value = .00, .00, and .00, respectively).

When testing undergraduate responses versus graduate responses, all hypotheses that were rejected at (p-value = .05) (H5A, H5B, H5C, and H6). The graduate responses were higher than undergraduate responses concerning overall Engagement, Physical Engagement, and Emotional Engagement (p-value = .01, 02, and .10 respectively). In contrast, per H6, the undergraduate responses were higher than graduate responses concerning Performance (p-value = .00). As such, all four hypotheses were supported.

Last, when conducting the ad-hoc ANOVA tests comparing the three subgroups (Face-to-Face, Online, and Hybrid): three hypotheses were rejected. These hypotheses involved Overall Engagement, Physical Engagement, and Emotional Engagement (p-value = .00, .00, and .00, respectively). One hypotheses concerning Performance was not rejected (p-value = .16). It was previously noted that the lowest scoring of the three groups was the face-to-face group.

CONCLUSION

As a guide or moderator in the classroom, professors more actively engage students in the learning process and capture their interest. Students' performance expectations of themselves are also impacted by the learning environment created by instructors and based on the classification of the student. This study suggests that instructors develop methods and best practices to complement the learning experiences of traditional versus non-traditional students and graduate versus undergraduate students.

Managerial and Research Implications

Educators are challenged with the need to balance engaging Generation NeXt learners in the classroom while meeting assessment requirements of accrediting organizations (i.e., student performance). This challenge may be addressed when educators create opportunities for Generation NeXters to learn in a new and remixed way. There is some research on active learning and student learning gains in the math and science disciplines. However, there is a lack of empirical evidence in the business education disciplines. The results of this study suggest that

an instructors' active learning teaching style positively improves the classroom environment to increase student engagement as well as student learning in the business education arena. Further, it is reported that graduate and non-traditional learners are more engaged than undergraduate and traditional learners.

The interesting finding rests in the examination of the performance expectations of these groups. The findings suggest that while traditional learners have higher performance expectations than non-traditional learners, undergraduate students report having higher performance expectations that graduate learners. On this outcome, undergraduate students demonstrate giving greater attention to their performance when compared to graduate students.

Limitations and Future Areas of Research

In the future, it is recommended that data be collected using a 5-point Likert scale. Given the current survey format, respondents displayed a tendency to stay in the neutral zone when responding. This pattern of response behavior is likely due to the fact that there were too many answer options provided in a 7-point Likert scale.

In addition, predictor questions (yes/ no) should be included in order to expand the statistical analysis. The current survey is limited to Likert scale responses which does not allow for binary prediction using regression models.

APPENDIX: Survey Instrument

The survey was comprised of the following areas: a. student background (six items), b. student learning outcomes (four items), and c. academic motivation scale (twenty-four items).

STUDENT BACKGROUND

1. How old are you?
2. What is your gender (Check one)
    a. Male/ Female
3. What is the highest level of education you have completed (Check one)
    a. High School/ Some College/ College Graduate/ Graduate Degree
4. How many collegiate years have you completed? For example, if you are a junior then you have completed 2 years.
5. What is your marital status? (Check one)
    a. Single/ Married
6. What is your ethnic background? (Check One)
    a. Caucasian/ Hispanic/ African-American/ Asian/ Middle Eastern/ Other

STUDENT LEARNING OUTCOME

Performance Expectation

1. I often feel like I may not be able to meet my instructors' expectations.
2. I am often anxious that I won't be able to perform as well as others.
3. I often feel like the student requirements of my class and school are beyond my capability.
4. I often feel like I may not be able to keep my performance up with others in my class and school

ACADEMIC MOTIVATION SCALE

Physical Engagement

1. I work with intensity on assignments for this class/ course.
2. I exert my full efforts toward this class/ course.
3. I devote a lot of energy toward this class/ course.
4. I try my hardest to perform well for this class/ course.
5. I strive as hard as I can to complete assignments for this class/ course.
6. I exert a lot of energy for this class/ course.

Emotional Engagement

1. I am enthusiastic about this class/ course.
2. I feel energetic when I am in this class/ course.
3. I am interested in material I learn in this class/ course.
4. I am proud of assignments I complete in this class/ course.
5. I feel positive about the assignment I complete in this class/ course.
6. I am excited about coming to this class/ course.

Total Engagement (Physical and Emotional and Cognitive Engagement Measures)

Cognitive Engagement: In Class

1. When I am in the classroom for this class/ course, my mind is focused on class discussion and activities.
2. When I am in the classroom for this class/ course, I pay a lot of attention to class discussion and activities.
3. When I am in the classroom for this class/course, I focus a great deal of attention on class discussion and activities.
4. When I am in the classroom for this class/course, I am absorbed by class discussion and activities.
5. When I am I the classroom for this class/ course, I concentrate on class discussion and activities.
6. When I am in the classroom for this class/ course, I devote a lot of attention to class discussion and activities.

Cognitive Engagement: Out of Class

1. When I am reading or studying material related to this class/ course, my mind is focused on class discussion and activities.
2. When I am reading or studying material related to this class/ course, I pay a lot of attention to class discussion and activities.
3. When I am reading or studying material related to this class/ course, I focus a great deal of attention on class discussion and activities.
4. When I am reading or studying materials related to this class/course, I am absorbed by class discussion and activities.
5. When I am reading or studying material related to this class/ course, I concentrate on class discussion and activities.
6. When I am reading or studying material related to this class/ course, I devote a lot of attention to class discussion and activities.

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TINELOK BUSINESS CASE

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ABSTRACT

The TineLok Case deals with a one product company that has a “cutting edge” product with seemly unlimited target markets, not just in the United States, but also throughout the world. Yet, what appears to be a simple enough product and company has evolved into a never ending change of corporate structures and ownerships. A brief history of the development of the product and then a longer history of the company’s formation, development, changes, and current situation are provided. There are strategic management, target markets issues, corporate structure changes and potential growth that forms the basics of the major issue, “where do we go from here?”

While the case can be used for a Principles of Marketing course, its issues of corporate structure and the variety of target markets make its use in a Strategic Marketing course - depending on the scope of the particular course. The case can show the interaction of the marketing mix (4p’s) through the development of a Competitive Advantage. Using the formula Competitive Advantage = low cost + differentiation + scope to address cost behavior, special needs and integration. address the company’s functional managers need to decide a future direction The sources of the competitive advantage are based on the various patents developed for the unique and patented vibration-proof, self-locking fastener system. Decisions now need to be made concerning the functional areas of the company, specifically in the domain of marketing. Other strategic decisions, concerning the future of the firm, also need to be considered.

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Workshop on Academic Dishonesty in Higher Education, Best Practices adopted by Major Universities Regarding Prevention and Dealing with Violations.

By

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Cheating is omnipresent in higher education in the United States. A recent article in the Atlantic pointed out that in 2015, Dartmouth College suspended 64 students suspected of cheating in—irony of ironies—an ethics class in the fall term. The previous school year, University of Georgia administrators reported investigating 603 possible cheating incidents; nearly 70 percent of the cases concluded with a student confession. In 2012, Harvard had its turn, investigating 125 students accused of improper collaboration on a final exam in a government class. Stanford University, New York State's Upstate Medical University, Duke University, Indiana University, the University of Central Florida and even the famously honor code-bound University of Virginia have all faced cheating scandals in recent memory.

With the advent of the online education and related technologies, students have discovered many more ways to cheat than were available to previous generations. Many students across the country have several options when choosing course schedules; the options of online, hybrid or face to face courses are currently available in most colleges and universities. Colleges and

Universities are quite concerned that cheating will increase as student are learning and being assessed away from the eyes of their instructors. The research on academic dishonesty in general is quite extensive, with more recent focus on student cheating in online courses. This workshop materials have been developed from an extensive literature review that provided numerous strategies and suggestions to help faculty deter academic dishonesty, manage the process of dealing with a violation, and create an atmosphere of academic integrity.

The development of this workshop stemmed from research on the cheating behaviors of two groups of colleges of business students at universities in the south eastern United States. The authors have recently completed the study and the next step for the authors includes looking at the issue from the perspective of the academics and investigating the best practices for dealing with the issue. Some of the suggestions and strategies that have are presented in this workshop are touted by the academic institutions that have published them as best practices for dealing with Academic Dishonesty. Research on cheating has shown that many of these practices, such as addressing academic dishonesty in your course syllabi and having an in-class discussion, will deter many students from cheating.

Perhaps the most critical actions a teacher can take to prevent academic dishonesty is to model ethical behavior. The attitudes concerning cheating at an academic institution can be crucial too. When the college or university can establish a strong sense of community with an emphasis on integrity, research indicates it will be that much harder for academic dishonesty to exist. Ignoring the problem, inconsistent policies and lack of uniformity in dealing with the issue seems to create an environment in which academic dishonestly can flourish.

At Lander and Savannah State Universities, we completed our AD research recently which indicates that the ubiquitous problem persists. In our examination of the issue, we gathered information pertaining to the prevention of academic dishonesty and have compiled a list of best practices we wish to share in a workshop for SEDSI in 2019. The workshop will include statistics from literature reviews on the current status of the problem along with information regarding best practices for prevention of cheating, as well as, how to handle violations and a section on online teaching as regarding academic dishonesty. Handouts will be provided, and an Anonymous Faculty Survey of personal experiences concerning this issue, we will end with a question and answer period. Additionally, examples of best practice materials can be found below.

Contents of the Workshop:

Icebreaker

Defining the Problem

- Scope of the Problem
- Best Practices for dealing with Academic Dishonesty
- Plagiarism
- Tips Regarding the Syllabus
- Tips Regarding Assignments and Testing
- Tips Regarding Violation Management
- Tips for Preventing Online Cheating

- Discussion and Questions
- Survey of Participants

This workshop will provide important strategies and suggestions for dealing with the persistent problem of academic dishonesty that seems to plague all institutions to one degree or another. This exercise will provide teaching faculty with evidence-based best practices by which they may deter the problem and improve their teaching in both traditional and online courses.

IS, IT, Information Privacy and Security, and Social Media

3D Printing and Public Policy

Oral

Dr. Donna Schaeffer [1], ***Dr. Patrick Olson*** [2]

1. *Marymount University,* ***2.*** *National University*

3D Printing is a physical process that prints an object from a three-dimensional digital model, typically by laying down many thin layers of a material, usually plastic, in succession. In the 1980s, firms in France and the United States filed patents for the technique, which was then called Additive Manufacturing. Since then, it has been commercialized in manufacturing, especially for rapid prototyping. There are applications in food, particularly chocolate and candy, as well as in fashion design for shoes and clothing. The medical field uses 3D Printing for implants and prosthetics. As technology advanced and costs dropped, 3D Printing has entered the hobbyist and consumer markets.
The current relevant public policy regarding 3D Printing comprises three areas: intellectual property, product liability and data protection. 3D Printing also brings about health and safety concerns.

In this paper, we examine the relevant United States legislation that covers 3D Printing, raise questions on issues where policy lags, and discuss global concerns.

Bitcoin: What it is and How it works

Poster

Dr. Harry Katzan [1]

1. *Webster University*

Numerous innovations have altered the fabric of society. Electricity, the telephone, the automobile, the airplane, and the concept of the corporation come readily to mind. For persons engaged in technology, the personal computer, the Internet, social media, and mobile devices have done more than alter society, they have radically changed society and opened up new horizons for everyday life. Basic to all of this, however, is the medium of exchange that permits society to function as a well-oiled system. Normally, that form of exchange is thought of as money in its various forms. The barter system came first, and then as civilization matured, it became objects of exchange, such as cows, grain, and finally metallic elements such as gold. For convenience, metal was replaced by paper that eventually led to the expeditious printing of money to solve financial problems. The government in conjunction with banks controlled the flow of money. Many people, at various times, have felt that a per-to-per exchange of money would be less problematical. The rest is history. A networked form of monetary exchange, known as **bitcoin**was invented. The subject of bitcoin is introduced in this paper, which serves as an introduction to its form of storage and interchange known as **blockchain**. It is covered in an accompanying paper.

Blockchain: What it is and What it can be

Oral

Dr. Harry Katzan [1]

1. *Webster University*

Innovation and leadership in the areas of computer and information systems have traditionally been associated with the business world in general and to the major corporations in particular. That conjecture has definitely been the case with blockchain technology that has heretofore been the province of cryptocurrency applications, such as the well-known Bitcoin networks. Bitcoin technology has been available since 2009, and it has attracted considerable attention, even though it is considered by some to be obfuscatory and hubristic. Actually, nothing can be farther than the truth, since Bitcoin is not blockchain even though it does in fact use blockchain architecture. This paper gives an introduction to blockchain data management and identifies some blockchain design concepts. The notion of basing computer applications on blockchains may, in fact, alter the direction of certain aspects of computer technology.

Have Academics Answered the Call for New Methods of Quantifying Information Security Risk?

Oral

Dr. Elizabeth Rasnick [1]

1. *Georgia Southern University*

In 2004, Cashell et al. identified a theme in the information security literature as “a drive to develop new methodologies that allow for quantification of risk.” This research examines the information security literature since 2004 to identify what methodologies have been applied to information security research.

The information security literature has been searched to identity articles with the terms “information security” and “risk management.” As this research is looking for research methods used after Cashell et al.’s 2004 article, the years included in the search were limited to 2005 and later. There was no restriction on which journals were considered. The primary reason for this is with the relative newness of information security there are many outlets publishing articles on it in various disciplines.

The methods for quantifying information risk identified in the study literature are compared to those previously identified. Which methods are most common and trends in the methods being used are also examined. By focusing on the methods for quantifying information risk assessment, a standard method of assessment could be established. This would allow for a common measurement of the cost of cyberattacks. Having a common measurement will make assessing the true cost of information security violations a less erratic process across firms and organizations.

Information security has become a component of almost every aspect of life. Health records, entertainment, education, and commerce are all highly data driven. That data is managed and stored online. Because of this, it is paramount that there are well-developed and standard methods of assessing the risk of loss.

Innovation Community Learning Instrument Development: A Pilot Study of the AWS Community on YouTube

Oral

Dr. Zhengzhong Shi [1]

1. *University of Massachusetts at Dartmouth*

This paper is a pilot study to develop the innovation community learning instrument. The resource-based view is applied as the theoretical lens for this effort. The cloud computing technology is chosen as the focal innovation around which community learning data are collected to develop the instrument. Two dimensions of the innovation community learning construct are proposed, including the community resources (including volume and quality) and the community participation (including volume and quality). In the pilot study, four sample re:invent AWS presentations related to DynamoDB (posted on YouTube) are used to demonstrate the calculation of the proposed community learning measures. In future large-scale studies, Google APIs should be used to collect the large amount community learning data from the AWS YouTube channel. With the instrument developed in this paper, future studies could investigate the impact of community learning on community growth and financial performances of community sponsors.

Must Blockchain Technology Have a Role in A Company's Information Infrastructure?

Oral

Dr. Cynthia Knott [1]

1. *Marymount University*

Must blockchain technology have role in a company's information infrastructure? Spoiler Alert: My answer is No! But as with all new Hot Technologies, a company's IT folks must be prepared to defend any decision they make. I identify three Hot Technologies now: blockchain, the cloud and encryption. (Note if you thought I should have used "block chain" rather than "blockchain" this is an important paper for you to read.)

A blockchain is a set of data with all transactions to that data. It is frequently referred to as a distributed ledger. Companies now have centralized ledgers or databases. The question is, "Does decentralizing a company's operational data make any sense?

While not a requirement for being a blockchain generally all data is encrypted. Data encryption and decryption comes with a computer processing cost. The often-cited benefit of blockchain technology is its ability to detect and refuse hacker data from being processed into a dataset. However, this is not the same as refusing wrong data from valid employees.

This paper will discuss the pros and cons of blockchain technology in a high-volume processing environment of today's corporations.

ON THE IMPACT OF INFORMATION TECHNOLOGY ON MICROENTERPRISES

Oral

Dr. Mysore Ramaswamy [1]

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Emerging information technologies provide ready to use, end-to-end solutions and allow microenterprises to focus on their core business. Recent innovations in information technology have positively impacted businesses. With the emergence of web services, the convergence of telecom and computing is finally reaching maturity in a unified platform for doing business in the 21st century. Business enterprises have invested heavily in information technology and the benefits have been well documented. However there is still a dearth in the current literature that analyzes how this digital technology can help microenterprises in such areas as business process reengineering and data analytics. This paper seeks to fill this gap and proposes a framework that helps in choosing the appropriate technology. It is essential that business processes are identified based on their cost, complexity, and criticality and then reengineered and automated based on analyzing the domain specific data.

The Efficacy of Consumer Feedback on Ecommerce Sites

Oral

Dr. Amita Goyal Chin [1], ***Dr. Elena Olson*** [1], ***Dr. A. James Wynne*** [1]

1. *Virginia Commonwealth University*

It has become commonplace for Ecommerce sites to include feedback from customers that have engaged in transactions on the site. This feedback often includes both quantitative and qualitative aspects. Feedback may include rating items or a service in multiple categories in addition to leaving a freeform qualitative assessment, or the feedback may simply provide an overall quantitative rating in addition to the qualitative verbiage. Vendors routinely provide aggregate numbers on their sites, for example, the average number of stars a product or service has received, with the hopes of soliciting future customers.

The purpose of this study is to assess the impact of such feedback on new purchases. For example, do consumers place a heavy emphasis on this feedback when choosing to engage in an online transaction? Are consumers likely to steer away from products that have an average or negative feedback, or no feedback at all?

We plan to design a survey instrument to gauge the attitude of potential purchasers with regards to the feedback of previous customers. Our study will focus on undergraduate students in information systems at a regional southeastern university, as this generation represents ready adopters of social media and the ecommerce platform. We will validate our survey instrument using a pilot study before proceeding to general data collection.

TOWARDS UNDERSTANDING THE EFFECTS OF WEB 2.0 FOR KNOWLEDGE MANAGEMENT ON ORGANIZATIONS' PERFORMANCE

Oral

Dr. Anupam Nath [1]

1. *Georgia Gwinnett College*

Knowledge management (KM) is the process through which organizations generate value from their intellectual and knowledge-based assets.

A relatively newer generation of Internet-based collaborative tools, commonly known as Web 2.0, has increased in popularity, availability, and power in the last few years in organizations. In our research, We study the relationship between the use of Web 2.0 in Knowledge Management (KM) and its effect on the Organizations' performance. We also examine the role of organizational level KM context variables on this relationship. We adopt a qualitative positivist case study based research approach to confirm the relationships between the use of Web 2.0 technology and KM, and its effectiveness. We studied three organizations. Findings show that the uses might not have a decisive positively effect. However, the effect of context variables is evident.

BITCOIN
WHAT IT IS AND HOW IT WORKS

Harry Katzan, Jr., Webster University, USA

ABSTRACT

Numerous innovations have altered the fabric of society. Electricity, the telephone, the automobile, the airplane, and the concept of the corporation come readily to mind. For persons engaged in technology, the personal computer, the Internet, social media, and mobile devices have done more than alter society, they have radically changed society and opened up new horizons for everyday life. Basic to all of this, however, is the medium of exchange that permits society to function as a well-oiled system. Normally, that form of exchange is thought of as money in its various forms. The barter system came first, and then as civilization matured, it became objects of exchange, such as cows, grain, and finally metallic elements such as gold. For convenience, metal was replaced by paper that eventually led to the expeditious printing of money to solve financial problems. The government in conjunction with banks controlled the flow of money. Many people, at various times, have felt that a per-to-per exchange of money would be less problematical. The rest is history. A networked form of monetary exchange, known as **bitcoin** was invented. The subject of bitcoin is introduced in this paper, which serves as an introduction to its form of storage and interchange known as **blockchain**. It is covered in an accompanying paper.

Keywords: Bitcoin, blockchain, cryptocurrency

INTRODUCTION

What is Bitcoin? It is a form of electronic cash, usually referred to as cryptocurrency. It is different from the usual everyday currency, because there is no central bank with which to contend. The cryptocurrency can be exchanged from user-to-user on a peer-to-peer bitcoin network. There is a saying that a technological luxury once experienced becomes a necessity, and that has certainly been the case with personal computers, the Internet, and smart phones. Bitcoin has had a much slower rate of adoption, but it's future looks very bright, and its use is dependent on just those technological advances.

The term *bitcoin* refers to two components: the bitcoin token and the Bitcoin protocol. The *bitcoin token* is a snippet of code that represents the ownership of an asset. The *Bitcoin protocol* is a distributed network which is used to maintain a ledger of bitcoin balances. Payments are held, sent, and received electronically by computers, electronic pads, and smart phones. Conceptually, bitcoins can be used to pay for things, provided that both parties are in the system. Bitcoin transactions are secure, verifiable, and immutable and

the operations are based on cryptography. The idea of a bitcoin was first proposed by a pseudonymous person known as Satoshi Nakamoto in 2008, and the name bitcoin was determined at that time.

Characteristically, the bitcoin infrastructure is decentralized and is not controlled by a central organization. The Bitcoin system runs on an open network of dedicated computers throughout the world. A Bitcoin user is identified by the address of its bitcoin wallet that provides a method of verifying users and insuring valid transactions. To satisfy legal requirements, the Bitcoin network is totally transparent. The smallest unit of bitcoin is known as a *satoshi* that exists as one hundred millionth of a bitcoin (0.00000001). The acronym for bitcoin is BTC; the system is denoted by Bitcoin; and the currency is referenced as bitcoin, the latter with a lower-case letter b. The Bitcoin data is stored in a data structure originally named "block chain," and subsequently changed to simply *blockchain*. Operational details are stored in a collection of ledgers stored as the blocks in the blockchain.

The blocks in the Bitcoin blockchain cannot be modified once written, and the participant in a Bitcoin transaction is identified by a string of digits that is unique to one bitcoin exchange. Because of its inherent transparency, duplicity and fraud are avoided because the user community can view each and every operation. Anonymity is preserved because no identifying information is present on the blocks of the Bitcoin blockchain.

BITCOIN BLOCKCHAIN

A *blockchain* is a stack of blocks, each containing a maximum of 1000 bytes, and numbered in sequence starting with the numeral 0 that is dated 3 January 2009. Each block in a chain is linked to the previous block and the collection is termed the *shared public ledger* of the entire Bitcoin system. The Bitcoin ledger is totally transparent so that the complete history of all transactions in the Bitcoin is readily available to all users of the system. A user's privacy is assured because each transaction is identified with only a coded string of characters. The Bitcoin blockchain permits bitcoin value to be transferred between Bitcoin wallets, and a *private key* is used to assure that a transaction is valid. On 24 August 2017, there were 481,824 blocks on the Bitcoin blockchain. [Wiki, Bitcoin, 2018]

MINING

Mining is a distributed system of software participants that compete to add bitcoin transactions to the Bitcoin blockchain. Transactions of the form "payer X sends Y bitcoins to payee Z" are broadcast to the network to be picked up by software components called *miners* that pack the current set of transactions into a pending block that is broadcast to the network to achieve independent verification of the transaction. Each software participant has its own copy of the ledger. Each miner applies a mathematical algorithm to

a hash function of the block contents and a small value called a *nonce.* The first miner that completes the puzzle gets its block added to the Bitcoin blockchain and also receives a reward, usually taken to be a small portion of a bitcoin. The reward is a transaction fee that is charged to the sender. The mining process is exceedingly sophisticated and requires a large amount of computing power.

THE BITCOIN WALLET

A *bitcoin wallet* is a software component for storing bitcoins. It is useful to regard a bitcoin wallet as a place to store the credentials for your bitcoin holdings. [Wikipedia, *Bitcoins*, 2018] When filling your wallet, the software performs a foreign exchange function and assigns a sequence number that is encrypted using public key cryptography. It is prudent to store bitcoin sequence numbers offline for security purposes.

HOW BITCOIN WORKS AND WHAT IT IS USED FOR

At the generic level, Bitcoin is the transfer of monetary value between two parties that may be individuals or organizations. The objective of the transfer is most probably to purchase something, to execute a personal exchange of funds, or to perform an investment transaction by buying and selling a unit of bitcoins. There may be other reasons for getting involved with Bitcoin activity, but those reasons are left for an advanced presentation. The storage systems associated with Bitcoin operations are also sometimes an item of concern and of which knowledge is needed for other applications.

CONCERNS WITH BITCOIN

Throughout the short life of Bitcoin technology, there have been serious concerns as well as an enormous amount of optimism. There is nothing legally wrong with Bitcoin, but it is important to consider the other side of the bitcoin. First and foremost, profits are taxable and the technology cannot be used for money laundering and illegal drug activities. The US Drug Enforcement Administration, the US Department of Justice, the Federal Bureau of Investigation, and several foreign governments have taken some interest in it.

The price of a bitcoin is extremely volatile, ranging from $998 to $19,666 in 2017, and closing at $6,469 on 1 July 2018. Thefts of cryptocurrency and governmental intervention have affected the price. It is difficult to know how many individuals are involved with digital currency, since any single individual could have many wallets. The University of Cambridge estimates in 2017 that there were 2.9 to 5.8 million unique users. [Wikipedia, *Bitcoin*, 2018]

Some researchers have called Bitcoin a Ponzi scheme while others regard it as anti-establishment, anti-system, and anti-state. Others probably won't like anything.

SUMMARY

Whether the Bitcoin concept has been successful or not probably depends on whom you ask. If you ask a person interested in computer/Internet technology, the answer would most certainly be that it is the most forward-looking form of financial interchange to date that takes advantage of the latest technology. That person would necessarily add that it takes good advantage of distributed computing, hashing, cryptography, and freedom from governmental control and nothing could possibly be better than that. A person that is not particularly interested in computers and the Internet, except of course smart telephony, would probably reply that they never heard of it, or if they did, then it really is too complicated for words. The negative person would add that the current system, based on established bank processes, works just fine and we don't need anything new. Then again, there is the idea that because you can do something does not necessarily imply that you should do it. Perhaps, Bitcoin is just one small step on the road to something really significant. Already, the blockchain aspect of Bitcoin operations has awakened an interest in that useful form of technology.

It's straightforward to use Bitcoin; in fact, there is a website that gives free bitcoins to try out the system. [Sterry, 2112] There is no need to create an account, and the Bitcoin software can guide a user through the process. All a user has to realize is that bitcoins belong to addresses; bitcoins move from one address to another; and a user can have many addresses. [Sterry, op cit., page 16] Here are some web sites for help:

https://www.coindl.com/youcan	Allows you to purchase something
https://freebitcoins.appspot.com	Get free bitcoins

The address of the free bitcoins is sent to the purchase app and you are on your way to using the Bitcoin system. It takes some patience, but the software will take care of the operational details. Most users will build a wallet to hold bitcoins and perform operations at:

https://blockchain.info/wallet/new	Builds a wallet
https://blockchain.info	Perform most operations

From here on, the operational details are handled by the Bitcoin system and the Bitcoin blockchain is updated to hold whatever tasks ensue.

There is an extremely large collection of written literature on Bitcoin, and many electronic books are free downloads.

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BLOCKCHAIN
WHAT IT IS AND WHAT IT CAN BE

Harry Katzan, Jr., Webster University, USA

ABSTRACT

Innovation and leadership in the areas of computer and information systems have traditionally been associated with the business world in general and to the major corporations in particular. That conjecture has definitely been the case with blockchain technology that has heretofore been the province of cryptocurrency applications, such as the well-known Bitcoin networks. Bitcoin technology has been available since 2009, and it has attracted considerable attention, even though it is considered by some to be obfuscatory and hubristic. Actually, nothing can be farther than the truth, since Bitcoin is not blockchain even though it does in fact use blockchain architecture. This paper gives an introduction to blockchain data management and identifies some blockchain design concepts. The notion of basing computer applications on blockchains may, in fact, alter the direction of certain aspects of computer technology.

Keywords: Blockchain, Bitcoin

INTRODUCTION

What is Blockchain? It is a collection of data blocks that are connected to form a chain. The attributes that characterize a blockchain include, but are not limited to, the following items: size of the blocks, how the blocks are connected, where the blocks are stored, whether the contents of the blocks can be modified, the structure of the chain of blocks, who can access the blockchain, the contents of the data block in the blockchain, and so forth. So far in the history of time, blockchains have been used for security, privacy, and trust. In the future – perhaps the near future – blockchains will be used to store and access data on almost all platforms and for almost all applications.

The most widely known application of blockchain technology involves the cryptocurrency known as Bitcoin in which security, privacy, and trust are of prime importance. Bitcoin is not a blockchain, per se. Bitcoin uses a blockchain, and that blockchain is not representative of all blockchains.

In general, there are three types of blockchains: public blockchain, permissioned blockchain, and private blockchain. Public blockchains are typically large distributed networks that are open to all users at all levels. With public blockchains, the data is immutable and multiple copies of the blockchain exist at various locations. Usually the blocks in a blockchain are local, but the general definition permits the blocks in a single

blockchain to be distributed. In a permissioned blockchain, users have roles and those roles may address functions that can be performed locally or in a distributed fashion. In a private blockchain, the blocks tend to be local and permissions are granted on a confidential basis.

A block chain is composed of three parts: the block, the chain, and the network.

BLOCKS

During the course of everyday affairs, participants exchange information, and, in most cases, that information must be stored for future reference. The medium for information of this type is a ledger placed in a book or digital record in a computer database. Typically, agreed upon items are recorded for security, privacy, and integrity. With blockchains, information of this type must be immutable and transparent. The objective is to place the agreed upon information in a block that is connected to other blocks in a particular domain, similar in fact to the pages in a ledger book. In order to achieve immutability, transparency, and privacy, the blocks and the chain must be constructed in such a fashion that users can observe the information without being able to alter the blocks and the chain while at the same time preserving the identities of the persons involved. The means that the blocks are chained together is such a fashion that they are prevented from being altered, deleted, or having a block inserted between two existing blocks.

The blockchain concept is not a single idea, but an architectural design principle that can be modified to satisfy the needs of a specific problem domain. Because it seems as though Bitcoin is the only example known to many people, some of the information necessarily relates to that application.

Here is the information that should be available in a block:

- Block ID
- Block size
- Hash of the previous block in sequence
- Number of transactions in the block
- The actual transactions contained in the block
- Reference data contained in the block, such as date, time, encryption information, owner information, etc.

The *block ID* is a sequence number of the form 0, 1, 2, … . The block numbered 0 is the beginning, often referred to as the genesis block. In general, any method can be used for blockchain. The *block size* is limited to 1000 characters in Bitcoin, but theoretically, it can be fixed or variable, based on the data architecture. A block sequencing mechanism is needed and one method that has been used is to compute the *hash* of all of the characters in

the preceding block. The method known as SHA-256, a secure hash algorithm developed by the National Security Agency that maps any sequence of characters into a random 256 bits or 32 characters, has characteristically been used in blockchain applications. The number of transactions in a block is typically variable, even though some systems have limited the length in bytes of a transaction to 40 characters.

THE BLOCKCHAIN

The transparency of a blockchain network is achieved through decentralization and multiplicity in order to provide functionality and verifiability. What this implies is that a blockchain contains all of the transactions in a given domain, such as the ordering, shipping, and payment for goods in a business-to-business (B2B) network or, perhaps, the transfer of land ownership documents in a government office. What this means, however, is that the blocks are not decentralized, but the whole network of blocks is distributed, such that each user computer system contains a complete copy of the chain of blocks. This is the design philosophy of Bitcoin. It does not preclude, however, that a system could have a centralized blockchain with distributed access. Thus, a blockchain could be centralized, decentralized, or distributed. The blockchain concept permits the elimination of intermediaries.

SHARED LEDGER

Many organizations share documents through an intermediate facility such as a database system. A typical scenario is that two users can access the same document, but one of them is locked out while the other is performing an update operation. This is a common operation in data processing. So, what's the problem? The problem is that once the document is changed, it's changed for both parties unless some special operation is performed – like saving an extra copy beforehand. With a ledger system, each operation to the transaction is a separate page to the ledger document, whether it is a book or its database equivalent. This is the precise visualization of a shared leger facility available with blockchain. As an example, consider a collection of legal documents in which each version involves passing copies between participants.

POINT OF FAILURE

In a data repository, organized as a blockchain, identical blocks of data are stored across a network so there is not single point of failure, as well as no point of control. Because of the nature of distribution, privacy is assured through crypto-technology. Data and transactions are transparent because of the design specifications of blockchain. Khan had the following to say on the subject of blockchain: "Blockchain truly is a mechanism to bring everyone to the highest degree of accountability. No more missed transactions, human or machine errors, or even an exchange that was not done with the consent of the parties involved.

Above anything else, the most critical area where Blockchain helps is to guarantee the validity of a transaction by recording it not only on a main register but on a connected distributed system of registers, all of which are connected through a secure validation mechanism. [Ian Khan, TEDx Speaker (http//www.iankhan.com/)]

SUMMARY

The use of Blockchain technology reduces the complexity of ordinary transactions in a business environment. Transactions are recorded as versions of documents, orders, payments, deposits, and almost any interaction normally experienced in everyday activity. In blockchain, transactions are stored in blocks and connected in a chain representing a particular application. Transactions are transparent, immutable, private, and secure.

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INNOVATION COMMUNITY LEARNING INSTRUMENT DEVELOPMENT: A PILOT STUDY OF THE AWS COMMUNITY ON YOUTUBE

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ABSTRACT

This paper is a pilot study to develop the innovation community learning instrument. The resource-based view is applied as the theoretical lens for this effort. The cloud computing technology is chosen as the focal innovation around which community learning data are collected to develop the instrument. Two dimensions of the innovation community learning construct are proposed, including the community resources (including volume and quality) and the community participation (including volume and quality). In the pilot study, four sample re:invent AWS presentations related to DynamoDB (posted on YouTube) are used to demonstrate the calculation of the proposed community learning measures. In future large-scale studies, Google APIs should be used to collect the large amount community learning data from the AWS YouTube channel. With the instrument developed in this paper, future studies could investigate the impact of community learning on community growth and financial performances of community sponsors.

INTRODUCTION

IT innovation community evolves over time by learning both in the collective and by the collective [4]. On the one hand, learning in the collective refers to the learning by community members (as individual professionals interested in the focal IT innovation and/or employees from organizations at various stages in the innovation's diffusion process). These members may effectively learn different aspects of the focal IT innovation through participating in community discourses by learning-by-doing and/or learning-about [4]. On the other hand, learning by the collective refers to the contribution of knowledge by members to the community through publishing various artifacts (such as supporting documents, organizing visions, software codes, bug fixes, etc.) surrounding their painstakingly learned experiences with the focal IT innovation. A variety types of knowledge (including such as know-what, know-why, and know-how) may be contributed by different types of community members (such as technology vendors, adopters, research analysts, journalists, and consultants as identified in [4]).

While Wang and Ramiller's paper [4] develops a conceptual model (in Figure 1) on the community learning and partially verifies the model with their archival data focusing on the ERP innovation, they specifically recommend further empirical research in 1) verifying their model with different IT innovation communities and 2) exploring the process and implications of such IT innovation communities. To echo their call, we believe that it is imperative to develop the community learning instrument and advance this stream of study through empirical research. This current paper is intended to be a pilot study with focus on the

instrument development task using data generated by the Amazon Web Services community on the its YouTube channel.

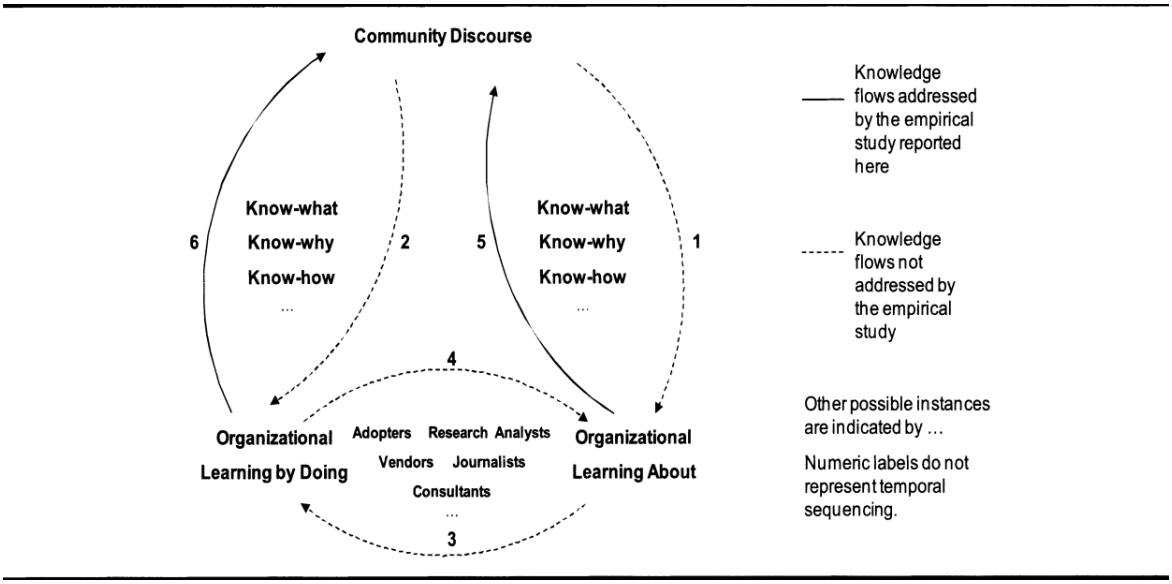

Figure 1: A conceptual Model of community and organizational learning (Adopted from [4]))

CONSTRUCT DIMENSIONALITY OF COMMUNITY LEARNING

For the construct of the innovation community learning, we propose two dimensions. The first dimension is related to relevant educational resources because one of the fundamental reasons why community members are attracted to a community and then further actively participate in the community learning activities is that they can benefit from the educational resources available in the community. Teece, Pisano, and Shuen [1] asserted that competitive advantage for firms "lies 'upstream' of product markets and rests on the firm's idiosyncratic and difficult-to imitate resources". While there are significant differences between firms and communities in terms of governance and compensation mechanisms, resources, as the fundamental elements in any entities, are critical for their long term survival and prosperous.

Based on the resource based-view of the firm [2][3], all the resources can be differentiated based on the degree to which they can be imitated and their level of idiosyncratic characteristic. For example, resources in the AWS YouTube community are mostly video presentations about know-what, know-how, and know-why related to various AWS services and links to other valuable resources. These resources may very well differentiate the AWS community from other cloud computing technology communities. Two measures are proposed for this dimension, namely, resource volume and quality. A significant amount of quality educational resources in the AWS Youtube community is likely to help with establish a powerful community.

We propose that the second dimension for the construct of community learning is related to the sustained community participation, which is supported by situated learning [5]. Resources

are contributed by various types of community members (including community product developers, users, partners, sponsors, and interested professionals). For example, in the AWS YouTube community, different players may post various types of video contents and make comments about both the content in those videos and other members' comments. Topics in these videos could be introduction to AWS service features and capabilities (i.e., know-what), design principles and best practices (i.e., know-how), and costs, benefits and risks (i.e., know-why). Community members participate in community learning through presenting their knowledge and experiences and discussing others' presentations. Two measures are proposed for this dimension, namely, participation volume and participation quality. A significant amount of quality participating activities is likely to sustain an attractive and meaningful innovation community.

METHOD

AWS Community on YouTube

As the cloud computing services are becoming the fundamental platform for many firms to reengineer their business processes, products, and services, an investigation of the cloud computing technology community is surely helpful. Based on the annual report [6] from RightScale about the top cloud platform providers in 2017, "Amazon Web Services showed strong fourth quarter growth and an annual run rate of $20.4 billion. It's worth noting that AWS accounted for all of Amazon's 2017 operating income." We thus decide to choose the AWS community as the source of data for this pilot study.

AWS sponsors annual re: invent conferences to launch new product and services and present case studies, best practices, and deep-dive talks about its various services and technologies (including such as virtual computing EC2, virtual private cloud (VPC), simple storage services (S3), non-SQL DynamoDB, data warehouse Redshift, and machine learning services including SageMaker, comprehend, and transcribe and many others). The (more-or-less codified) knowledge produced by these conferences through presentations, discussions, workshops are valuable educational resources facilitating the development of the AWS community and enabling the community learning. AWS video-tape all the presentations and post the videos on its YouTube channel, likely leading to an active learning community benefiting all community members.

Community Learning Data from the AWS YouTube Channel

In this pilot study, the community on the AWS YouTube channel around the non-SQL DynamoDB service is chosen as the source of data. DynamoDB was initially offered in January 2012 [7]. While the traditional relational database focuses on minimizing the disk storage through normalizing data structure with limited vertical scalability for ad-hoc query views, the recently developed and more and more widely-used non-SQL database system focuses on optimizing CPU capabilities by de-normalizing data structure with powerful horizontal scalability for instantiated query views. In the annual AWS re:invent conferences, there are presentations about this non-SQL technology. Community learning data from these presentations from 2014, 2015, 2016, and 2017 are sampled. In the following two Tables,

the statistics of four selected sample presentations about DynamoDB from year 2014, 2015, 2016, and 2017 are presented.

Table 1: Video Basic Information
(focusing on the community for the AWS DynamoDB service)

Video No.	Year	URL Video ID on YouTube	Presentation Title	Published Date
1	2017	v=jzeKPKpucS0	AWS re:Invent 2017: [REPEAT] Advanced Design Patterns for Amazon DynamoDB (DAT403-R)	2-Dec-17
2	2016	v=bCW3lhsJKfw	AWS re:Invent 2016: Deep Dive on Amazon DynamoDB (DAT304)	3-Dec-16
3	2015	v=ggDIat_FZtA	AWS re:Invent 2015 | (DAT401) Amazon DynamoDB Deep Dive	12-Oct-15
4	2014	v=tDqLwzQEOmM	AWS re:Invent 2014: From Zero to NoSQL Hero - Amazon DynamoDB Tutorial (BDT203)	17-Nov-14

Note: The full video web address should have https://www.youtube.com/watch prepended before the video ID.

Table 2: Measures for the Community Learning

	Content Length	Content Quality		Participation Volume			Participation Quality	
Video No.	Video Length (in minutes)	Video Likes	Video Dislikes	Number of Views	Number of Threads	Number of Comments	Comments Likes	Comments Dislikes
1	49	269	2	15,917	11	19	37	0
2	56	531	12	46,920	19	28	13	0
3	56	115	1	19,873	1	1	4	0
4	45	204	13	40,457	7	18	5	0

Demonstration of Innovation Community Learning Instrument Measures

In the following, with data presented in Table2, we demonstrate the calculation of proposed community resource and participation measures.

1) Measures for resource volume:

- The average number of minutes per video = 206 minutes/4=51.5 minutes/video
- The total number of videos related to the DynamoDB services (not included in this pilot study)

2) Measure for the resource quality:

(The total number of video likes – the total number of video dislikes)/(Total number of videos) = 1091/4=272.75 per video

3) Measure of Participation Volume

This is measured as the average participation volume for each video. Three factors are considered, including the number of views, the number of comment threads, and the number of comments.

Step 1: To calculate the participation volume for each video:

(1/3*(log (number of views))+1/3*(number of threads)+1/3*(number of comments))
Note: In the above formula, 1/3 is the weight given to each raw measure. Other weights may be tried for the large-scale empirical research in future studies.

Step 2: To calculate the average participation volume for all sampled videos

SUM($Participation\ from\ Each\ video$)/(The total number of videos) = 10.15

4) Measure of the Community Participation Quality

This is measured as the average number of likes (after excluding dislikes) per video.

(The total number of comment likes – the total number of comment dislikes)/(the Total number of videos) = 14.75

FUTURE RESEARCH PLAN

In this pilot study, we develop the community learning instrument and demonstrate how to calculate the measures in the instrument with the sample data collected from the AWS YouTube channel surrounding the non-SQL DynamoDB service. It is our hope that this pilot study lays the ground for future large-scale empirical studies leading to a better understanding of IT innovation communities in terms of their growth and impacts on both community members and community sponsors.

With a large amount of community learning data to be collected from the AWS YouTube channel, it is imperative to develop computer programs to collect and transform these data. Programming APIs supported by Google should be used to develop these programs. It is our plan to apply the node.js running environment with the JavaScript language to accomplish this data collection task.

The community learning measures developed in this paper could be used to assess the effectiveness of community management and more importantly, they can be applied to predict the level of community success in terms of its impact on future community growth, community product/service market share and sales, and other financial performance

measures for the community sponsor. Consequently, findings in future studies along this stream of research should be valuable for community sponsors.

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Must Blockchain Technology Have Role In A Company's Information Infrastructure?

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Keywords: Blockchain, Crypto currencies, Bitcoin, Security, Privacy, Information Infrastructure

Abstract

Must blockchain technology have role in a company's information infrastructure? Spoiler Alert: My answer is No! But as with all new Hot Technologies a company's IT folks must be prepared to defend any decision they make. I identify three Hot Technologies now: blockchain, the cloud and encryption. (Note if you thought I should have used "block chain" rather than "blockchain" this is an important paper for you to read.)

A blockchain is a set of data with all transactions to that data. It is frequently referred to as a distributed ledger. Companies now have centralized ledgers or databases. The question is, "Does decentralizing a company's operational data make any sense?

While not a requirement for being a blockchain generally all data is encrypted. Data encryption and decryption comes with a computer processing cost. The often-cited benefit of blockchain technology is its ability to detect and refuse hacker data from being processed into a dataset. However, this is not the same as refusing wrong data from valid employees.

This paper will discuss the pros and cons of blockchain technology in a high-volume processing environment of today's corporations.

Introduction

To be clear, my point is not that blockchain technology will be used in the corporate environment, but that it will not replace a company's main operational databases maintained on a major database, such as Oracle or SAP. It is clear that for some corporate applications, the ability of a blockchain to secure the data set, could have significant advantages.

Blockchain technology was "invented" as part of the development of cryptocurrencies, particularly "Bitcoins." It is beyond this paper to discuss this beginning, but the point is that blockchain technology in an independent technology that is separate and distinct from cryptocurrencies.

Perhaps because of the development as part of untraditional cryptocurrency, blockchain technology was perceived as a way to overcome problems in the traditional banking system. Or as others have noted, to escape the controls inherent in using the traditional banking system. Banks are almost always serving in this intermediary or middleman role. Blockchain users want the ability to process payments without a need to use a middleman, who keeps track of all transactions, charges a fee to make these transactions, and has a government reporting responsibility.

One important aspect of blockchain technology is it allows a developer to customize it. A blockchain can be open to the public, or it can be private, allowing only authorized users access to the data. Bitcoin blockchains are a public blockchain, that allows anyone to join. Corporate users will generally require private blockchains.

Business Blockchain vs. Database Technology

Blockchain technology can be used by businesses for different forms of record-keeping and datasets.

Usual business databases have a central computer, or server, providing access to individual users. Consequently, there is a single centralized database which is protected from intrusion by unauthorized users. Typically, there are copies of the database made on a regular schedule and each transaction to the database is recorded in a transaction data set. The idea being that if there is a problem in the database, a backup version can be brought online, and brought to a current state by applying the string of transactions.

Blockchain is a distributed database and there is no centralized server. New data are added to anyone of the shared electronic ledgers by authorized members. As with the data, it can include such things as the record of an event, a document, a transaction, the automation of previously manual business processes that span many participants, asset transfers, etc.

Blockchain security uses public-private key cryptography. A *public key* is an "address on the blockchain". Transations find a home by using this address. The *private key* can be thought of as a password that gives the owner rights to their digital assets or the means to otherwise interact with the various capabilities that blockchains support.

Every node in a decentralized system has a copy of the blockchain. Data quality is maintained by database duplication. There is no centralized or "official" copy and users are equal. Transactions are communicated to the network using software. Each node has a complete database. Some nodes are mining nodes, mining nodes that validate transactions, add them to basically each mining node adds a new transaction to the block they are building. As a block is completed, it is sent to all nodes. Several mining nodes may create a finished block before any other node. Blockchains use time-stamping schemes, such as proof-of-work, to sequence changes. Alternative consensus methods include proof-of-stake. In a corporate database application, there will be no competition among mining nodes to "win." It is unclear how this will be handled within a corporate IT environment.

This is a "peer-to-peer" network. A change to any one of the "ledgers" will be soon reflected in all of the "ledgers." Consequently, a blockchain database cannot

be destroyed or corrupted by acquiring entry into one or even a few of the decentralized “ledgers.”

Blockchain data is not under the control of a single party. Financial records, evidence, contracts, and anything else, where an accurate historical of a data set is important.

However, blockchain technology does have its own risks. For example, in the bitcoin application the ownership was completely determined by who had the proper key to the bitcoin record. If an owner loses custody of his private key, the underlying asset could be transferred, and the owner would have no recourse.

Privacy is an issue. Private blockchain technology will resolve this issue to some extent. However, if data is protected by public and private key technology as well as strong encryption technology the underlying data is unavailable to anyone without access to the keys. This would include legal actions where courts have ordered that the underlying data be produced and turned over to authorities. Clearly there may be consequences for refusing to produce subpoenaed data, but legal authorities will not be able to get around any refusal by having a third party acquire and decode the data.

Another concern is simply that blockchain technology is new and not well understood by many people. In particular, corporate IT professionals have little or no experience with block chain technology. So adopting a blockchains solution to a particular problem may meet with resistance. Currently blockchain technology, as a solution to a data processing problem, is not one of the tools in most IT departments.

However, there are now major players entering the market to provide IT services, which include blockchain applications. The largest of these is Amazon, which has Amazon Web Services or AWS.

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ON THE IMPACT OF INFORMATION TECHNOLOGY ON MICROENTERPRISES

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ABSTRACT

Emerging information technologies provide ready to use, end-to-end solutions and allow microenterprises to focus on their core business. Recent innovations in information technology have positively impacted businesses. With the emergence of web services, the convergence of telecom and computing is finally reaching maturity in a unified platform for doing business in the 21st century. Business enterprises have invested heavily in information technology and the benefits have been well documented. However there is still a dearth in the current literature that analyzes how this digital technology can help microenterprises in such areas as business process reengineering and data analytics. This paper seeks to fill this gap and proposes a framework that helps in choosing the appropriate technology. It is essential that business processes are identified based on their cost, complexity, and criticality and then reengineered and automated based on analyzing the domain specific data.

Keywords: Information Technology, Business Data Analytics, Business Process Reengineering, Microenterprises

INTRODUCTION

Emerging information technologies provide ready to use, end-to-end solutions and allow microenterprises to focus on their core business. Recent innovations in digital technology can play a significant role in spurring the growth of small businesses. Microenterprises account for more than 88 percent enterprises in the United States [10]. Significant research shows that these businesses contribute to economic growth in multiple ways. Their presence in an economy leads to more competitive large enterprises that can outsource some of their activities to smaller firms. Compared to their relatively small sizes, they create more jobs than large firms [16]. Smaller size is an advantage, particularly in terms of the ability to anticipate and respond to changes and achieve a deeper and closer interaction with the customers.

Information is an important asset that gives small businesses a competitive advantage in the new economy. Information access plays a critical role in the informed decision making process, making it easy for these businesses to make good competitive decisions [15]. The ability of small businesses to survive in an increasingly competitive global environment is largely predicated upon their capacity to leverage information as a resource. In today's fierce competitive environment, small businesses need to be highly responsive and adaptive to demands of customers, actions of competitors, and changes in economic conditions [20]. Data analytics can be as useful to small businesses by identifying those business processes that are capable of exploiting the new innovations in that area.

This paper is organized as follows. First we briefly describe the current scenario pertaining to microenterprises. Business process reengineering as applied to small businesses is discussed next. This is followed by a discussion of how business data analytics can be used to help microenterprises. The next section proposes a framework that will help adopt the appropriate technology for microenterprises. Concluding remarks form the last section.

MICROENTERPRISES

Even though the economic importance of microenterprises has been known, they were considered comparatively unimportant during the great Internet boom during the 1990s and early 2000s [16]. Use of broadband information technology required extensive investment in technological assets and a long term access to capital. Such capital requirements were not available to small businesses. Today small businesses can compete and excel due to continual improvements in Internet technology as well as breakthroughs in cloud computing and mobile connectivity.

Access to capital and an established brand name are the main advantages of large organizations. One of the greatest advantages small businesses have is flexibility. Many microenterprises have a single owner who is free to change policies, and technologies [23]. For example, the owner of a small grocery store can decide to use broadband to create an automatic reorder system with suppliers. microenterprises can offer new services and change internal processes without having to clear a multitude of committees that would exist in a large organization. Cloud computing, and open source software have brought down the investment requirements and costs. This has resulted in the availability of broadband technologies to small businesses to streamline business processes, grow the customer base, and enlarge existing offerings.

There is a lack of knowledge about the potential benefits of information technology and strategies to support microenterprises in achieving their business objectives. Small businesses face the challenge that generally they are owner managed and the owner makes all or most of the decisions about the business [7] [27]. Unfortunately, owner-manager's limitations become limitations of the business. Information technology needs to be considered a key player for the small business in reaching its goals. As information technology is perceived to be expensive by small businesses, they often do not budget for it. The other problem with regard to the cost of IT is that small businesses may invest in unnecessarily big solutions due to sales pitches, hype of specific products or market patterns without considering their real need [8]. Technology is constantly evolving which raises two issues. On the one hand the small businesses need to monitor the kind of technologies that their clients are using and try to make sure that they are ready to serve them. On the other hand, the small businesses s do not need to change every time there is a change in technology as this depends upon the focus area of the small businesses. The competitiveness of a small business depends on the way in which IT is used to support business processes.

EMERGING INFORMATION TECHNOLOGIES

Emerging information technologies provide ready to use, end-to-end solutions and allow small businesses to focus on their core business. Some of these emerging information technologies are:

- Software-as-a-Service (SaaS),
- Infrastructure-as-a-Service (IaaS),
- Platform-as-a-Service (PaaS),
- Everything-Else-as-a-Service.

Software as a service (SaaS) provides a service that is directly consumable by the end user. SaaS is a model in which the customer licenses applications and provides them to users on demand. The services run on the provider's infrastructure and are accessed through a public network connection. Applications may be made available through the Internet as browser applications, or may be downloaded and synchronized with user devices. SaaS services are centrally managed and updated [22]. The most common pricing model is based on the number of users, but there may be additional fees based on bandwidth, storage, and usage. There are many similarities between SaaS and the services offered a few years ago by application service providers (ASPs). However, there are also some important differences in the approaches to multi-tenancy, the pay-as-you-go model and the ability to provision on demand. SaaS offers several compelling benefits. It simplifies licensing. In fact, the customer doesn't need to acquire (or directly pay for) a software license at all. This is a task of the provider. There is also no need to calculate maximum capacity. It outsources the tedious task of application maintenance and upgrades and ties customer costs to usage, which lowers fixed costs and capital investment.

Infrastructure-as-a-Service (IaaS) provides flexibility for small businesses to install their own applications in a shared environment quickly and easily. The technology that makes IaaS offerings possible is virtualization. Virtualization is the ability to create a virtual representation of an otherwise physical hardware platform. In an IaaS model, virtualization apples to servers, the computing hardware. IaaS gives small businesses the ability to have their business applications hosted on a centralized platform with a utilitarian billing model and virtually unlimited capacity. This will be very valuable for start-up companies.

Platform-as-a-Service (PaaS) is targeted towards small businesses that create their own applications. PaaS provides a middle ground between SaaS and IaaS. PaaS provides application service enterprises a central platform to host their applications. PaaS provider manages all backend components of the infrastructure for application hosting such as load balancing, hardware, operating systems, scaling, and infrastructure monitoring. PaaS is better than traditional web platforms in terms of geographically distributed collaboration, reduced cost of infrastructure through the pay-as-you-go model and cost reduction through higher level programming abstractions. PaaS is simpler to manage than IaaS and represents a smaller platform to distribute and can leverage more functionality and services from the provider.

SaaS and IaaS have paved the way for a multitude of other services that can be grouped as "Everything-Else-as-a-Service". Database-as-a-Service provides database instances through the Internet for customers. Amazon's Relational Database Service (RDS) provides various MySQL and Oracle database instances for use. Another example of this is Xeround. Security-as-a-Service leverages on the SaaS model. Security companies provide a SaaS offering which meets various security needs of businesses. Small businesses can obtain significant security advantages by acquiring email security services, Web protection services, vulnerability assessments, and certification services all using an as-a-service model. As storage costs are lowering and

broadband speeds are increasing, Storage-as-a-Service offerings are available. As a result of fast data transfer speeds, users can choose cloud-based storage services. Some Storage-as-a-Service offerings provide desktop integrations for automatic synchronization of files [16].

Monitoring-as-a-Service offerings provide small businesses managed and hosted monitoring capabilities. Through an external monitoring service, service enterprises can ensure round-the-clock managed monitoring across various locations. Some monitoring services perform profiling of an enterprise's applications. Profiling is the ability to perform deeper diagnostics of an application. For small businesses, this means that they can quickly identify bottlenecks, inefficiencies, or other exceptions in their applications. Analytics-as-a-Service is very useful for Web-based enterprises. Small businesses using e-commerce channels can understand their customers better by identifying traffic patterns which can lead to other metrics such as shopping patterns and frequently viewed products. Analytics can also track user activity and how users were referred to the site.

Automation-as-a-Service provides automation services such as event driven execution of tasks. Some automation services are provided through deployment of agents in the customer environment. The agents regularly check for changes in schedule from a centralized server managed by the service provider. Tokenization-as-a-Service is used for data security. Tokenization is the process of abstracting sensitive data into a series of tokens. This amounts to virtual replacement of sensitive data with a unique identifier that cannot be mathematically reversed. By offloading the receipt and storage of sensitive information such as credit card information, small businesses can be relieved of the burden of maintaining security and compliance. Logging-as-a-Service reduces the burden of analyzing log files by providing consolidation and analysis services.

BUSINESS PROCESS REENGINEERING

Business process reengineering (BPR) began as a private sector technique to help organizations to fundamentally rethink how they do their work in order to dramatically improve customer service, cut operational costs, and become more competitive [1][5]. A key stimulus for reengineering has been the continuing development and deployment of sophisticated information systems and networks. BPR involves changes in structures and in processes within the business environment.

Redesign, retooling, and re-orchestrating form the key components of BPR that are essential for an organization to focus on the outcome that it needs to achieve. The entire technological, human, and organizational dimensions may be changed in BPR. Information technology plays a major role in business process reengineering as it provides office automation, it allows the business to be conducted in different locations, provides flexibility in manufacturing, permits quicker delivery to customers and supports rapid and paperless transactions [1] [28].

The BPR technique implements organizational change based on rapid change, employee empowerment, and training and support by information technology. In order to implement BPR to an enterprise, the following key actions need to take place:

- Selection of the strategic processes for redesign,

- Simplify new processes – minimize steps – optimize efficiency – modeling,
- Organize a team of employees for each process,
- Organize the workflow – document transfer and control,
- Assign responsibilities and roles for each process,
- Automate processes using information technology,
- Train the process team to efficiently operate the new process,
- Introduce the redesigned process into the new organizational structure.

Applying BPR techniques to small businesses differ substantially from the way large enterprises deal with this issue. BPR concept requires an organization to have a strategy and then set business objective to achieve that strategy. In order to achieve the objective effectively, organization can apply BPR concepts to put the right processes in place [20] [29]. However, in the case of many small businesses, this classical approach may not be workable. Most of the successful people in small businesses are hands on persons and most likely they do not even bother about the word 'strategy', especially in the business environment of developing countries. It is more effective to try out hands on approach to make changes quickly. They are only looking for short term objectives.

Here are some guidelines that are especially relevant to small businesses [13]:
- Read the market for your business clearly by SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis,
- Develop a strategy that optimizes cost, quality, time, and flexibility,
- Execute the developed strategy by strengthening the processes identified for reengineering and without interfering unnecessarily.

Small businesses can leverage techniques and tools that have become increasingly available as open source software such as 'Alfresco' software for content management (Passerini, 2012). Along with the traditional knowledge management processes that include acquisition/creation, storage and retrieval, dissemination and application, SMEs benefit from various size based advantages. For example, in the area of knowledge storage and retrieval, the proximity of project teams to the company owner enables quicker and more frequent transactions compared to large organizations.

BUSINESS DATA ANALYTICS

Small businesses are often intimidated by the cost and complexity of handling large amounts of digital information. In the past, companies seeking to tap into big data needed to purchase expensive hardware and software, hire consultants and invest huge amounts of time in analytics. But trends such as cloud computing, open source software, and software as a service have changed all that [25]. Data analytical strategies can help small businesses, whose marketing budgets are limited; employ better web design and marketing concepts. Today, web designers and marketers have access to a wealth of information which makes for useful intelligence with proper application. It is important to focus on critical data required for the analytics process. In the first stage, data is filtered to keep only what is relevant for the business 33] [4]. Next, the particular metrics which will draw out people from the general pool who are likely to become customers is identified. In the third stage, web and data analytical tools are used to track Internet

marketing campaigns and measure results. Lastly, the available data is analyzed to derive meaningful interpretations and structures that can inform both online marketing campaigns and design strategies to result in better customer management.

Data intelligence can be applied to strengthen search engine optimization (SEO) strategies and to raise customer engagement with the business, which is also important for effective web design [26]. It gives small business more cost efficient and effective tools and information to track online marketing achievements and give more consumer targeted strategies. The online environment gives small businesses boundless room for expansion for their reach and visibility. Big data can be used to draw out customer intelligence for more optimal design and marketing strategies [5] [9]. Some of the ways through which small businesses can concentrate on strategies which will enable them to reach a bigger audience without sacrificing the quality of engagement are listed below:

- Building a website to leverage the Internet's ability to broadcast your business to a geographically limitless audience,
- Leverage the knowledge and skills of web design/development experts to ensure your business website is able to offer the best user experience including better online viewing and navigation for site visitors,
- Apply data analytics to take stock of different mobile devices used by your potential audiences and ensure that your website design effectively renders on all these devices. It should fit their viewing behavior and be optimized for as many mobile platforms as possible,
- Use social media data and search engine optimization (SEO) metrics to grow your social media assets which will increase your business exposure in organic search and social media networks [3] [29].

Customer preferences are constantly changing, and data analytics provides a reliable tool to collect and process this information on consumer behavior and buying habits. Big data gives small businesses measurable metrics and intelligence which can improve the relevance of your site and content to your target audience. This is done through the use of predictive models like audience segmentation which can monitor your customers' buying habits to separate old customers from new, repeat customers from single-purchase ones, among others. Listed below ae some of the techniques that can be adopted:

- Customers are grouped as per their buying behavior and preferences, and the new segments are used to create more targeted messages
- Social data intelligence can be used to understand how and how much consumers are engaging with the business/brand on social platforms
- Intelligent algorithms and tools are applied to big data to give better customer insights and deliver targeted ads to every consumer

Customer data intelligence empowers small business owners by giving them more meaningful data to analyze customer behavior and business performance. Objective and valuable data thus collected from internal and external resources can then help drive business growth, and help small businesses direct their limited marketing resources towards strategies that will result in the highest conversions, engagement and sales. Passerini [16] in her case study of "Transport Designs" analyzes how a firm that used computers only for payroll and scheduling done on

subjective guesswork evolved into a company that uses wireless Ethernet to transfer draft drawings from the design office's computer to the factory floor's computer.

FRAMEWORK FOR ADOPTION OF APPROPRIATE TECHNOLOGY

Although technology can create new or modified business practices at a rapid rate, successful adoption of new best practices must stand up to market forces. Technology and the marketplace are continually reshaping business activities and as a consequence, business strategies. An organization must continually work towards an alignment that fits into the organization's business strategy and IT strategy. This alignment should improve the likelihood that new initiatives are explicitly linked to areas that are critical to successful business performance, provide a source of competitive advantage. The role of IT should be that of a strategic enabler for competitive success, rather than just an operational supporter.

In the first stage, existing business processes are examined. The number of processes is indeed very large as these pertain to upstream and downstream of the supply chain as well as operations related to the specific business. The gamut of these processes/interactions is also very diverse. The analysis is conducted along the three dimensions of complexity, criticality and cost. Socio-technical factors are considered in the second stage. Not only will this help towards transparency, but it will also make acceptance by constituents easier, Socio-technical factors pertain to exacerbated accountability dysfunctions that can occur as a consequence of automation. According to Bovens [2], manual procedures are automated, it has to be ensured that there are no problems due to such dysfunctions.

Rule-obsession or Output-obsession refers to the focus on outcomes over process. 'Proceduralism' refers to increased emphasis on procedures to avoid responsibility and accountability. Strict adherence to procedures cam render the bureaucracy to lose the ability to balance procedures with corporate values. Relying heavily on encoded computer procedures can undermine the effectiveness of organizations.

Processes are restructured in the third stage. Automating legacy procedures that afforded plenty of opportunities for inefficiency will not yield results. At this stage, the results of data analytics are used to modify processes [14] [16]. The main objective of restructuring various processes before transforming them into digital interactions is to improve the effectiveness as a system. When automated processes result in disintermediation, it is necessary that the relevant entities are on board with new procedures. After completion of the restructuring stage, we are ready for implementing in the fourth and final stage.

The degree of automation can vary across a wide range. Smith [26] states a scale of nine degrees of automation starting from the first level where the computer offers no assistance to the ninth level where the computer decides everything. In between these extremes, there are several levels where a varying degree human-computer interaction occurs. The appropriate level of IT intervention depends on the particular interaction that has to be automated.

This framework also provides a means of evaluating extensive (if not comprehensive) series of business process transactions. Depending upon the value of the parameters of the given

transaction, we are able to make inferences on the potential of that transaction for potential of IT intervention. This naturally opens up a wide arena of analysis, particularly for others who wish to specialize and focus specifically on the dynamics and characteristics of specific interactions where IT intervention is useful. This approach is effective since it focuses on specific critical processes of small businesses and renders overall improvement.

RESEARCH FINDINGS

In this section, we summarize the results of two business surveys conducted by the U.S. Chamber of Commerce in January 2018. The first survey consisted of a national poll of 1,000 small businesses and 50 state-level polls of 100 microbusinesses. The second survey was a national consumer poll of more than 5,000 adults on the perceived benefits of digital platforms. Examining the use of digital platforms as a whole in the United States, the national survey finds that the use of digital platforms by small enterprises is ubiquitous:

- 84% of small enterprises are using at least one major digital platform to provide information to customers;
- 80% are using at least one major platform to show products and services, as well as to advertise;
- 79% are using digital tools to communicate with customers and suppliers, and
- 75% are using tech platforms for sales.

The national survey also revealed the importance of digital skills to managers in small businesses when hiring:

- 62% of small businesses surveyed stated that digital and social media skills are an important factor when hiring; a higher proportion reported this as a more important consideration than where a candidate attended school.

Even in a country with nearly universal Internet access, American businesses still view the cost of Internet services as a constraint to building an online presence: 55% reported that the cost of Internet and connectivity is a challenge. On the skills side, 57% of small businesses surveyed said that lack of familiarity with the digital tools available is a challenge. This finding suggests that even if a business obtains Internet access, it can be hard to know which tools to use. Recruiting skilled employees is a challenge for 61% of small businesses surveyed by the U.S. Chamber of Commerce in January 2018. Even when owners are able to successfully launch their businesses, they still have difficulty finding employees to expand operations.

One advantage to digitization is the ability to buy and sell across borders at a low cost. Of the small businesses surveyed, 27% reported selling goods or services to another country, a substantially higher proportion than the national proportion of U.S. firms that export. Yet, many small businesses are reluctant to trade internationally. When asked whether they think export activity is an important business activity, less than half of respondents stated that they believe that it is important to sell to other countries. Looking only at businesses that do not report exports, 43% said that they do not think there is demand for their goods and services in other countries, and 40% said that international exporting is too expensive. It should be noted that minor interventions such as using new tools to develop and improve websites, using electronic databases instead of paper files have positive impact.

CONCLUSION

Microenterprises can benefit from using techniques made available by emerging information technologies. New technologies are paving the way for new market creation. As a direct result of this, we have seen new small businesses emerging to cater niche markets as an alternative to impersonal commercial companies. Business process engineering and business data analytics have been used successfully in the corporate world. However, using these techniques for small businesses poses some problems. The basic building blocks of IT implementation consist of digitized versions of interactions among various business processes. In this paper, we have presented a framework that can identify and categorize the different types of business processes/transactions. Restructuring these processes and then automating them in a systematic way as suggested in this paper affords a practical approach to leverage information technology. Monitoring the critical success factors will help in evaluating the success of these measures. Future work in this area focuses on developing a comprehensive framework that will enable entrepreneurs and researchers to point out the potential priority areas that need to be automated first and also yield a realistic estimate of resources needed to achieve such transformation. In addition, such an approach will also help in giving a better insight into process restructuring.

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THE EFFICACY OF CONSUMER FEEDBACK ON ECOMMERCE SITES

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ABSTRACT

It has become commonplace for Ecommerce sites to include feedback from customers that have engaged in transactions on the site. This feedback often includes both quantitative and qualitative aspects. Feedback may include rating items or a service in multiple categories in addition to leaving a freeform qualitative assessment, or the feedback may simply provide an overall quantitative rating in addition to the qualitative verbiage. Vendors routinely provide aggregate numbers on their sites, for example, the average number of stars a product or service has received, with the hopes of soliciting future customers.

The purpose of this study is to assess the impact of such feedback on new purchases. For example, do consumers place a heavy emphasis on this feedback when choosing to engage in an online transaction? Are consumers likely to steer away from products that have an average or negative feedback, or no feedback at all?

We plan to design a survey instrument to gauge the attitude of potential purchasers with regards to the feedback of previous customers. Our study will focus on undergraduate students in information systems at a regional southeastern university, as this generation represents ready adopters of social media and the ecommerce platform. We will validate our survey instrument using a pilot study before proceeding to general data collection.

Users' Perceived Security and Privacy in IoT Environment: A Trust based Perspective

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Abstract

Knowledge management (KM) is the process through which organizations generate value from their intellectual and knowledge-based assets. A relatively newer generation of Internet-based collaborative tools, commonly known as Web 2.0, has increased in popularity, availability, and power in the last few years in organizations. In our research, we study the relationship between the use of Web 2.0 in Knowledge Management (KM) and its effect on the Organizations' performance. We also examine the role of organizational level KM context variables on this relationship. We adopt a qualitative positivist case study-based research approach to confirm the relationships between the use of Web 2.0 technology and KM, and its effectiveness. We studied three organizations. Findings show that the uses might not have a decisive positively effect. However, the effect of context variables is evident.

Management, Organizational Behavior, Organizational Theory, and Human Resource Management

Challenges of the changing workforce landscape across generations: retaining millennials

Oral

Dr. Inessa Korovyakovskaya [1]

1. *Savannah State University*

The Millennial generation is poised to comprise the majority of the workforce share in the United States and around the world in the near future. Millennials are already projected to make up about 75% of the total global workforce by 2025. These employees view job loyalty and career paths quite differently than Baby Boomers.Overall, Millennials are more diverse than preceding generations, with 44.2 percent being part of a minority race or ethnic group(U.S. Census Bureau, 2015).Trends reveal that Millennials pursue personal and professional development over job satisfaction which urges managers and academicians to revamp motivational theories with a focus on changed needs of the Millennial generation. This study presents a new research model of job engagement as an integral and critical factor in the Millennial employee's job satisfaction that leads to the employee's retention. We argue that job satisfaction mediates the relationship between job engagement and results in higher job and organizational performance. While the employee's job satisfaction and job engagement are both critical to maintaining a happy and productive workforce, achieving only job satisfaction without job engagement will have significantly lower impact on job and organizational performance. The study findings reveal significant transformation in Millennials' preferred work styles, meaning of work, communication channels, and workplace requirements. Compared to previous generations, Millennials are more focused on a faster career development and a greater career mobility. Today, Millennials expect organizations to provide them with relevant training opportunities and structured career development paths. Further, Millennials value diversity management that is focused on employees' differences and inclusion through a creation of emotionally and psychologically safe work settings. It is recommended that managers start building challenging and collaborative workplace environments to retain talented and creative millennials.

Determinants of Executive Career Success in Strategic Leadership

Oral

Dr. J. Lee Brown [1], ***Dr. Burcu Adivar*** [1], ***Ms. Sogand Tayebinaz*** [1]

1. *Fayetteville State University*

Career success in general has been typically measured by objective and visible metrics such as salary and number of promotions. Recent studies consider various variables to predict objective career success. Some of these variables can be categorized as demographic, human capital, motivational, organizational, industry and location/region. In this study, authors focus on the characterization of human capital variables that include quantity and level of education, type of education, tenure/experience, board of director position in addition to compensation, industry, region and demographics. Since serving in other firms'board of directors is an important attribute of an objective career success, we select top level managers who are serving as a board of director in multinational firms. Based on data on the demographic, education, experience and careers of 359 executives, we analyze the relationship between different education backgrounds and success factors for top corporate management. Analysis of results reveal that both bachelor's degree and master's degree in business administration are significant success factors. In addition, international experience and gender make a difference in climbing the ranks of top management.

KEYWORDS: Executive career success, corporate management, strategic leadership, board of directors, education

IMPROVING THE PERSONNEL SELECTION PROCESS BY USING A MULTIPLE CRITERIA DECISION MAKING APPROACH

Oral

Dr. Helen Moshkovich [1], ***Dr. Alexander Mechitov*** [1]

1. *University of Montevallo*

Personnel selection is one of the critical tasks of Human Resource Management. Selecting the right candidates for the advertised positions ensures stability of the system and successful performance. At the same time hiring the wrong person may result in dissatisfaction and the necessity to repeat the hiring process.

Many personnel decisions are made through a committee structure. It is especially true when a faculty member in higher education is being hired. Objective and thorough analysis of applicants is the major goal of the committee activities. An often problem though in the personnel selection by a committee is that biases of the members have a tendency to overate one attribute while neglect others. Highly "likable" applicants may outweigh applicants with better needed qualifications.

We propose to use a special multi criteria approach based on Verbal Decision Analysis paradigm to improve the process. Our approach allows: 1) thoroughly and systematically evaluate applicants in a consistent manner; 2) separate evaluation of applicants against the criteria by the committee members from the policy of how to integrate evaluations; 3) use verbal criteria scales and preferences in an ordinal form to easily provide estimates and explain them to others; 4) re-adjust criteria and scales at different steps of the selection process.

Contrary to some other attempts of applying multi criteria decision making to personnel selection, our approach does not average individual values and weights of the committee members but provide a process which concentrates on forming mutually agreed evaluations for each of applicants. Our approach also provides the necessary separation of duties between those who evaluate and those who make decisions based on the evaluations.

Investigating the Role of Interpersonal and Organizational Trust in Motivation: A Literature Review

Oral

Dr. Ed Showalter [1]

1. *Randolph-Macon Col.*

This paper will update an older review of the literature exploring Trust, defined as a willingness to put oneself at risk due to a positive expectation, as it plays a role in motivation as described by the Expectancy Theory of Motivation (Vroom, 1962.) An individual's motivation determines the direction, intensity, and persistence of the individual's behavior. The elements in Expectancy Theory are 1) a quantitative belief (probability) that a certain Effort level will lead to a specific Performance level, 2) the quantitative belief (probability) that a specific Performance level will lead to a specific Outcome, and 3) the value (Valence) placed on that Outcome. Motivational force is determined as the product of the three elements.

The two theses to be explored in this review are: 1) the role of Generalized Organizational Trust (trust of systems and people) as it relates to Performance to Outcome expectancy, and 2) the role of Self-Efficacy (trust in self) at it relates to Effort to Performance expectancy.

CHALLENGES OF THE CHANGING WORKFORCE LANDSCAPE ACROSS GENERATIONS: RETAINING MILLENNIALS

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The Millennial generation is poised to comprise the majority of the workforce share in the United States and around the world in the near future. Millennials are already projected to make up about 75% of the total global workforce by 2025. These employees view job loyalty and career paths quite differently than Baby Boomers. Overall, Millennials are more diverse than preceding generations, with 44.2 percent being part of a minority race or ethnic group (U.S. Census Bureau, 2015). Trends reveal that Millennials pursue personal and professional development over job satisfaction which urges managers and academicians to revamp motivational theories with a focus on changed needs of the Millennial generation. This study presents a new research model of job engagement as an integral and critical factor in the Millennial employee's job satisfaction that leads to the employee's retention. We argue that job satisfaction mediates the relationship between job engagement and results in higher job and organizational performance. While the employee's job satisfaction and job engagement are both critical to maintaining a happy and productive workforce, achieving only job satisfaction without job engagement will have significantly lower impact on job and organizational performance. The study findings reveal significant transformation in Millennials' preferred work styles, meaning of work, communication channels, and workplace requirements. Compared to previous generations, Millennials are more focused on a faster career development and a greater career mobility. Today, Millennials expect organizations to provide them with relevant training opportunities and structured career development paths. Further, Millennials value diversity management that is focused on employees' differences and inclusion through a creation of emotionally and psychologically safe work settings. It is recommended that managers start building challenging and collaborative workplace environments to retain talented and creative millennials.

Determinants of Executive Career Success in Strategic Leadership

DECISION SCIENCES INSTITUTE

Determinants of Executive Career Success in Strategic Leadership

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ABSTRACT

Career success in general has been typically measured by objective and visible metrics such as salary and number of promotions. Recent studies consider various variables to predict objective career success. Some of these variables can be categorized as demographic, human capital, motivational, organizational, industry and location/region. In this study, authors focus on stratification/characterization of human capital variables that include quantity and level of education, type of education, tenure/experience, board of director position in addition to compensation, industry, region and demographics. Since serving in other firms' board of directors is an important attribute of an objective career success, we select top level managers who are serving as a board of director in multinational firms. Based on data on the demographic, education, experience and careers of 359 executives, we analyze the relationship between different education backgrounds and success factors for top corporate management. Analysis of results reveal that both bachelor's degree and master's degree in business administration are significant success factors. In addition, international experience and gender make a difference in climbing the ranks of top management.

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IMPROVING THE PERSONNEL SELECTION PROCESS BY USING A MULTIPLE CRITERIA DECISION MAKING APPROACH

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ABSTRACT

Personnel selection is one of the critical tasks of Human Resource Management. Selecting the right candidates for the advertised positions ensures stability of the system and successful performance. At the same time hiring the wrong person may result in dissatisfaction and the necessity to repeat the hiring process.

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We propose to use a special multi criteria approach based on Verbal Decision Analysis paradigm to improve the process. Our approach allows: 1) thoroughly and systematically evaluate applicants in a consistent manner; 2) separate evaluation of applicants against the criteria by the committee members from the policy of how to integrate evaluations; 3) use verbal criteria scales and preferences in an ordinal form to easily provide estimates and explain them to others; 4) re-adjust criteria and scales at different steps of the selection process.

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Marketing, International Business, Hospitality, Recreation and Sports

ATTITUDES TOWARD WOMEN AS MANAGERS IN CHINA: AN EXAMINATION OF GENDER, AGE, AND WORK STATUS DIFFERENCES

Regular Session

Prof. Adeyemi-Bello, Tope [1], ***Prof. Cody Chullen*** [1], ***Mr. Xiao-yu Xi*** [2]

1. *East Carolina University,* ***2.*** *China Pharmaceutical University*

A number of studies around the world have examined the attitudes toward women as managers. These studies have focused on developed as well as developing economies. The general consensus is that negative attitudes persist across various cultures. While the focus of most of these studies have been on gender differences, in this study, we also examined the impact of age and work status as differentiators of the attitudes toward women as managers. Our results indicate that consistent with previous studies, men have more negative attitudes toward women as managers in China. We also found that life stage affects Chinese attitude toward women as managers.

Strategic Capabilities, Market and Nonmarket Strategies, and Financial and Non-Financial Performance in Ghana

Oral

Prof. John Parnell [1], ***Prof. Edwin Mensah*** [1], ***Mr. Derek Oppng*** [2]

1. *University of North Carolina at Pembroke,* ***2.*** *Central University/Data Link Institute*

This paper investigates factors associated with strategic capabilities, market and nonmarket strategies (NMS), and firm performance in Ghana. Different capability-strategy "paths" to financial and non-financial performance were identified. Technology capabilities, cost leadership, and political NMS were linked to financial performance, whereas management capabilities, differentiation, and social NMS were linked to non-financial performance. Marketing capabilities contributed to both financial and non-financial performance. Directions for future research are presented.

Technology Readiness and Adoption at Kenosha Harbor Market

Regular Session

Dr. Thomas Groleau [1], ***Mr. Theodore Ruffalo*** [1], ***Ms. Maria Salerno*** [1]

1. *Carthage College*

Technology is an increasingly important force in the world today, pervading everyday life in a myriad of ways. This is no less true in the field of retail than elsewhere. However, farmers' markets—the prevalence of which has grown considerably from 1,755 markets in 1994 to 8,669 in 2016 (USDA, 2016)—may represent an unusual case because of its cultural associations. Moreover, the nature of technology adoption in general often follows patterns similar to those of the fashion industry, whereby a new concept has an initial surge in popularity only to be abandoned with similar relative speed (Sun, 2013). This process may be driven by opinion leaders or especially prominent and influential "anchor vendors" who occupy a special position in the establishment of shared market spaces (Gatzlaff, Sirmans, & Diskin, 1994). In order to understand the role of technology in the context of the modern farmer's market and what drives this role, this study seeks to quantitatively analyze a broad cross-section of farmers' market vendors to not only determine their technology usage, but also to understand the drivers of this technology usage. Taking a cross-sectional approach, the study categorizes farmers' market by vendor types and seeks to understand both the characteristics of technology use and the sources of influence of this usage within individual vendor types. The results have implications for the theoretical understanding of the farmers' market context and how it compares with other retail contexts, and also for technology companies seeking to expand their services to include the vendors of these increasingly prominent markets.

The Myth of Big-Data: Misinterpretation of Consumer Insights without the Human Element

Regular Session

Dr. Cherie Rains [1]

1. *Lander University*

The value of emotional intelligence has long been documented in research on consumer behavior. In today's Digital Age, many researchers are relying on Big Data in order to predict how their consumer's will behave in the marketplace. Big Data allows insights into almost every level of the consumer journey and then uses complicated algorithms to predict what behavior the consumer is most likely to engage in. Amazon is the leading company who has built an industry on using Big Data to identify what their consumers would also be interested in or likely to purchase. Although many companies try to emulate their success, they are doing so in a vacuum. Amazon sells everything from A to Z, so we buy everything from A to Z. That allows their algorithms to provide more accurate insights. Most companies, though, only sell a consumer a product/service for a specified function (clothes, personal products, food, etc.), so they have a very limited snapshot of their consumer's behavior. This research will look at the need for using both quantitative and qualitative data to ensure that consumer insights are captured and interpreted in a holistic manner.

Measurement scales of customer satisfaction (ACSI, CSAT, NPS, etc.) are well established in the marketing literature and will be utilized in this study. While this is useful information for marketers and brands, it only reflects a quantitative score and does not tell the full story. In measuring satisfaction, we often assume the attributes companies deem as important are truly what is important to the customer, which is often not the case. In order to assure reliability of these attributes, we must first ask the customer what *they* deem as important so that the data can be used as an effective measurement. This research will examine the relationship of attributes as a measurement of customer satisfaction using both traditional and holistic scales that are derived directly from qualitative insights. In order to examine a consumer's intention to purchase, the Theory of Reasoned Action will be utilized and compared across attribute scales to determine which is the most reliable predictor of future behavior. Both managerial and theoretical implications will be discussed and future research identified.

THE SCRUM MANAGEMENT: EXAMPLES FROM MICROSOFT GLOBAL AND MICROSOFT TURKEY

Oral

Prof. Tuğba Karabulut [1]

1. *Istanbul Commerce University*

A scrum management is a new team oriented management in software development sector. The purpose of this paper is to explain a scrum management and present examples related to a scrum management in Microsoft Global and Microsoft Turkey to attract attentions of management scholars to this new team oriented management approach. Microsoft has engaged its development journey to reduce release cycles down to respond the changing business demands. Learning its experiences can make contributions to software development sector to expand and enhance applications of a scrum. It is also expected that management scholars can figure out adaptations of a scrum in different sectors as well.

Tine-Lok

Regular Session

Dr. mario zaino [1]***, Dr. Sara Kiser*** [1]

1. *Alabama State university*

The TineLok Case deals with a one product company that has a "cutting edge" product with seemly unlimited target markets, not just in the United States, but also throughout the world. Yet, what appears to be a simple enough product and

company has evolved into a never ending change of corporate structures and ownerships. A brief history of the development of the product and then a longer history of the company's formation, development, changes, and current situation are provided. There are strategic management, target markets issues, corporate structure changes and potential growth that forms the basics of the major issue, "where do we go from here?"

While the case can be used for a Principles of Marketing course, its issues of corporate structure and the variety of target markets make its use in the Marketing Management or Strategic Marketing courses a possibility - depending on the scope of the particular course. The case can show the interaction of the marketing mix (4p's) through the development of a Competitive Advantage. Using the formula Competitive Advantage = low cost + differentiation + scope to address cost behavior, special needs and integration. The sources of the competitive advantage are based on the various patents developed for the unique and patented vibration-proof, self-locking fastener system. Decisions now need to be made concerning the functional areas of the company, specifically in the domain of marketing. Other strategic decisions, concerning the future of the firm, also need to be considered.

ATTITUDES TOWARD WOMEN AS MANAGERS IN CHINA: AN EXAMINATION OF GENDER, AGE, AND WORK STATUS DIFFERENCES

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ABSTRACT

A number of studies around the world have examined the attitudes toward women as managers. These studies have focused on developed as well as developing economies. The general consensus is that negative attitudes persist across various cultures. While the focus of most of these studies have been on gender differences, in this study, we also examined the impact of age and work status as differentiators of the attitudes toward women as managers. Our results indicate that consistent with previous studies, men have more negative attitudes toward women as managers in China. We also found that life stage affects Chinese attitude toward women as managers.

INTRODUCTION

Historically, the differences between men and women have been used as excuses to exclude females from certain jobs. Occupational segregation is the term that has been used to describe the heavy concentrations of men and women into different job categories. For example, occupational segregation supposedly explains why men dominate top-level managerial positions while women are often consigned to other occupations with lower pay, status, and responsibility. The low number of women in top managerial positions is supported by considerable research of the negative stereotypes held about them. Schein [21, 22] reported that both male and female middle managers perceived that successful managers in general possessed characteristics ascribed more to men than to women. These characteristics include among others aggression, dominance [4], and achievement orientation [1]. In fact, the characteristics (e.g., co-operative and communicative) that have often been ascribed to women are considered 'unmanagerial' [e.g., 19]. Schein [23] concluded that such stereotyping tends to reduce the opportunities for females to advance within business organizations even though the perceived sex differences do not actually exist. The negative stereotyping also explain in part why women represent a very low percentage of top executive positions and are often not considered for expatriate assignments [1].

Significant changes have taken place in China over the past two decades. More women are receiving college education and participating in the labor force. Nevertheless, there are few women in leadership roles [30]. In 2016 for example, of all the legislators, senior officials, and managers in China, only about 17 percent were women even though they account for almost 49 percent of the population. In the business sector, less than 20 percent of Chinese firms have women as top-level managers [26]. Specifically, less than four percent of Chinese companies have women as their Chief Executive Officer [6]. The representation of women on corporate boards or serving in the Chief Financial Officer was 9.2 percent and 22 percent, respectively in 2015 [5, 7]. Currently the nine-member Politburo Standing Committee of the Communist Party, the country's highest decision making body, are all men.

The ascribed positive attitudes toward a particular group is typically promoted by members of the group. In essence, individuals tend to maintain and promote attitudes which reflect an advancement in status, position, or power of the group to which they belong [9, 14, 15, 28, 29]. In particular, the research done to date indicate that women tend to embrace more favorable attitudes toward women managers than their male counterparts [10]. Therefore, we propose that:

H1: Chinese women will have more favorable attitudes toward women as managers than their male counterparts

Over the years, various factors have been hypothesized as indicators and/or moderators of the attitudes toward women. These include prevailing attitudes in a particular nation and the historic and traditional roles within a culture. Age cohorts have also been found to influence attitudes toward women's roles in society. Dambrot, Papp, and Whitmore [8], for example, found that older men and women are more conservative in their attitudes toward women's role in society than their younger counterparts as confirmed by Sorce, Perotti, and Widrick [24] that age affects online purchasing behavior. Conversely, Ng and Feldman [17] found among others that gender, organizational tenure, education level, moderates the relationship between age and job attitudes related to work tasks, colleagues, and supervisors. Also, Bentein et al [2] found that job attitudes are likely to change over time. Specifically, Ng and Feldman [16], found that older workers are more likely to exhibit greater organizational citizenship behaviors and less likely to engage in counterproductive ones. We therefore make the proposition that:

H2: Older workers will have more positive attitudes towards women as managers

Historically, various studies have assessed the work-related attitudes of college students. The landmark study to assess the attitudes of college students toward women in general was done by Epstein and Bronzaft in 1972 [11]. They found that first year college students at the time of their study expected to become more career oriented rather than the 'traditional' housewife. Throughout the 1980s, a number of research studies also found support for more positive attitudes toward women in traditionally male-dominated occupations including the presidency of the United States [3]. In 1993, a national survey of

first year college students [12] found support for women to be more career oriented and less involved in traditional roles like child rearing and house-keeping. In the current study, we focused on students and professionals as a way to investigate the potential delineating effects of life stage on the attitudes towards women as managers. We therefore propose:

H3: Professionals will have more positive attitudes towards women as managers than non-professionals

H3a: Professional women will have more positive attitudes towards women as managers than non-professional women

H3b: Professional men will have more positive attitudes towards women as managers than non-professional men

METHOD

Procedure

The primary source of data for this study was collected through opinion survey. Participants were guaranteed that their responses would be kept strictly confidential and that under no circumstances would anyone be able to individually identify them in any way. Participants in this study were 430 Chinese undergraduate business administration students and 365 Chinese working professionals for a total sample of 795 respondents. Overall, respondents were comprised of 315 males and 480 females. The student participants consisted of 215 males and 215 females whereas the working professional participants were comprised of 100 males and 265 females. On average, the student participants were 22.04 years old whereas the working professional participants were 34.19 years old.

Measures

Women as Managers Scale (WAMS). Participants' responded to a set of twenty-one attitudinal statements concerning different views of women holding managerial positions known in the literature as the Women as Managers Scale (WAMS) [18, 23]. The measure included 11 favorably worded items and 10 unfavorably worded items (reverse coded for scale construction) and were assessed on a 7-point Likert scale (7=Strongly Agree to 1= Strongly Disagree). Higher scores on the WAMS were associated with more favorable attitudes towards women in managerial roles whereas lower scores were associated with less favorable attitudes towards women in managerial roles. Sample items included "Men and women should be given equal opportunity for participating in management training programs," "It is acceptable for women to compete with men for top executive positions," and "Women are not competitive enough to be successful in the business world," (reverse coded). The reliability and construct validity of WAMS has been detailed in numerous studies [13].

Since questions regarding attitudes and opinions may be more abstract and certain concepts may not be relevant throughout the world, this study followed a regimented process of forward-translation and back-translation, despite the fact that its respondents already maintained a "good command of English." First, the questionnaire was translated

from English to Chinese (i.e. Mandarin) by one of the co-authors of this study (who is bilingual). To validate the translation, assistance was solicited from another bilingual Chinese professor from a regional university in the United States to translate the survey back into English. This allowed for identification of questionnaire items that may have posed difficulties for this study's Chinese sample. The Chinese professor in the U.S. was then asked to make any modifications that were necessary on those potentially problematic questions identified through the back-translation, given the English language-based original. Subsequently, a bilingual Chinese professor in the UK was asked to translate the revised questionnaire in Chinese back into English. After this iteration, researchers were satisfied with the correspondence between the English and Chinese-based versions of the questionnaire. This measure demonstrated satisfactory reliability overall (α=.86).

RESULTS

Tests for Group Differences

A series of Univariate Analysis of Variance (ANOVA) tests were performed to determine whether statistically significant differences existed between sex and working status on the overall WAMS measure. Table 1 lists the mean scores and standard deviations for the 100 youngest respondents ($\bar{x}$ age = 19.72) and the 100 oldest respondents ($\bar{x}$ age = 43.47), Chinese male and females overall, Chinese student and working professionals overall, as well as Chinese males and females and working professional males and females individually, on the WAMS measure.

Results showed that there were significant effects for the age grouping variable (i.e. Hypothesis 2; the 100 youngest respondents vs. the 100 oldest respondents: (F, 1, 198) = 39.15, p = < .001), sex grouping variable (i.e. Hypothesis 1; Chinese males vs. Chinese females overall: (F(1, 791) = 535.88, p = < .001), the working status grouping variable (i.e. Hypothesis 3; Chinese students vs. Chinese working professionals overall: (F(1, 791) = 73.13, p = < .001), as well as a significant interaction between the sex and working status grouping variables (i.e. Hypothesis 3a and 3b; Chinese male students vs. Chinese female students vs. Chinese male working professionals vs. Chinese female working professionals: F(1, 791) = 3.79, p = .05). Post-hoc analyses confirmed that Chinese female working professionals held more favorable attitudes towards women in managerial roles on the WAMS measure as compared to Chinese female students (Hypothesis 3a; p = < .001; 95% CI =.13, .41) and that Chinese working male professionals held more favorable attitudes towards women in managerial roles on the WAMS measure as compared to Chinese male students (Hypothesis 3b; p = < .001; 95% CI =.25, .62).

Insert Table 1 about here

Figure 1 illustrates the comparison of mean scores between the 100 youngest respondents and the 100 oldest respondents (i.e. Hypothesis 2). As shown, the 100 oldest respondents ($\bar{x}$ = 5.26) responded with the most favorable attitudes towards women in managerial roles on the WAMS measure as compared with the 100 youngest respondents ($\bar{x}$ = 4.41).

Insert Figure 1 about here

Figure 2 illustrates the comparison of mean scores between Chinese males overall (student males and working professional males combined) and Chinese females overall (student females and working professional females combined; i.e. Hypothesis 1). As shown, Chinese females ($\bar{x}$ = 5.42) responded with the most favorable attitudes towards women in managerial roles on the WAMS measure as compared with Chinese males ($\bar{x}$ = 4.37). Figure 3 illustrates the comparison of mean scores between Chinese student participants overall (Chinese student males and females combined) and Chinese working professional participants overall (Chinese working professional males and females combined; i.e. Hypothesis 3). As shown, Chinese working professional participants ($\bar{x}$ = 5.30) responded with the most favorable attitudes towards women in managerial roles on the WAMS measure as compared with Chinese student participants ($\bar{x}$ = 4.75)).

Insert Figure 2 about here

Insert Figure 3 about here

Figure 4 illustrates the comparison of mean scores between Chinese student males and females and Chinese working professional males and females individually (i.e. Hypotheses 3a and 3b). As shown, Chinese working professional females responded with the most favorable attitudes towards women in managerial roles on the WAMS measure ($\bar{x}$ = 5.54). Chinese student females responded with the second most favorable attitudes towards women in managerial roles on the WAMS measure ($\bar{x}$ = 5.27). Chinese working professional males responded with the third most favorable attitudes towards women in managerial on the WAMS measure ($\bar{x}$ = 4.67). Lastly, Chinese male students responded with the least favorable attitudes towards women in managerial roles on the WAMS measure ($\bar{x}$ = 4.24).

Insert Figure 4 about here

Table 1

Descriptives by Age, Sex, Working Status, and Overall for the WAMS Scale

	Mean	SD
Age Overall		
WAMS	5.00	.76
100 Youngest Respondents		
WAMS	4.41	.66
100 Oldest Respondents		
WAMS	5.26	.78
Chinese Males Overall		
WAMS	4.37	.54
Student Males		
WAMS	4.24	.47
Working Professional Males		
WAMS	4.67	.57
Chinese Females Overall		
WAMS	5.42	.59
Student Females		
WAMS	5.27	.55
Working Professional Females		
WAMS	5.55	.59
Chinese Students Overall		
WAMS	4.75	.73
Chinese Working Professionals Overall		
WAMS	5.31	.70

Figure 1

Graph Illustrating Comparison of Mean Scores between 100 Youngest Respondents and 100 Oldest Respondents on WAMS

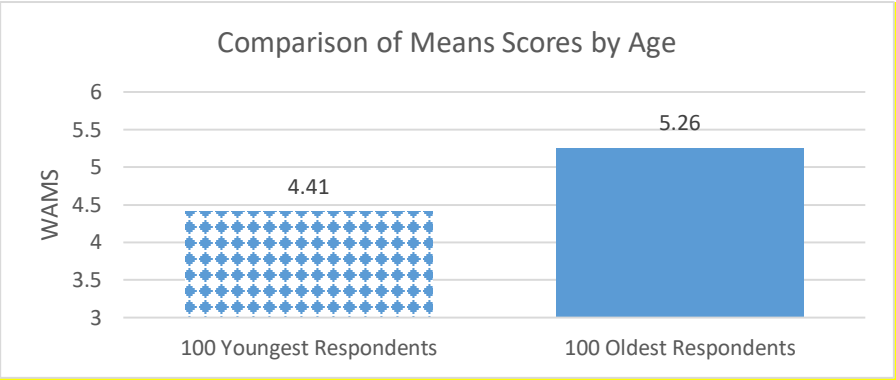


Figure 2

Graph Illustrating Comparison of Mean Scores between Chinese Males and Females Overall on WAMS

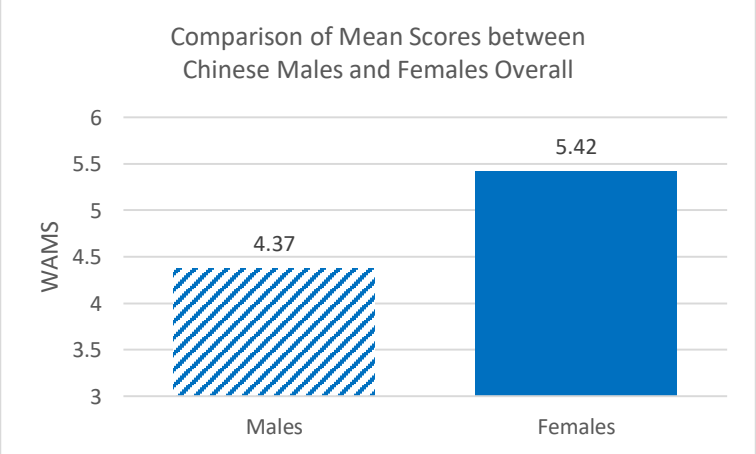


Figure 3

Graph Illustrating Comparison of Mean Scores between Chinese Students and Working Professionals Overall on WAMS

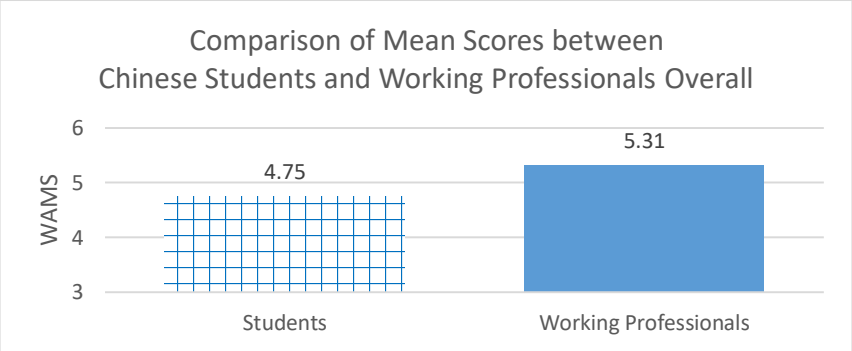
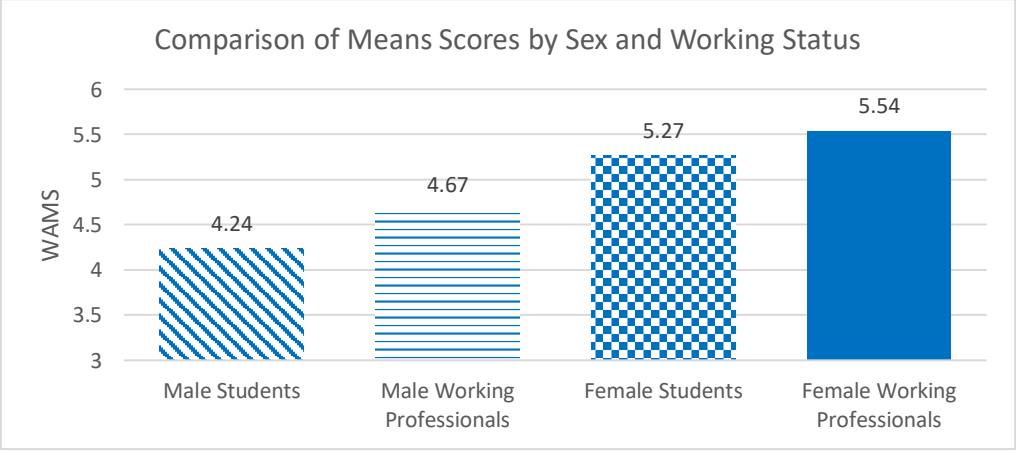


Figure 4

Graph Illustrating Comparison of Mean Scores between Chinese Male Students, Female Students, Male Working Professionals, and Female Working Professionals on WAMS



CONCLUSION

The results of this study indicate that, consistent with previous studies, the attitude towards women as managers in China, is influenced by gender. Chinese men typically have less favorable attitude toward women as managers. Nevertheless, some progress has been made over the past few decades as more Chinese women have invested in higher educational and training consistent with the focus of the All-China Democratic Women's Foundation. Life stage also affects the attitude toward women managers in China to the extent that professionals have more positive attitude toward women as managers. This finding is especially important since it was not influenced by gender. This is in line with Ng and Feldman's (2008) conclusion that longer-tenured employees tend to exhibit more organizationally positive behaviors. Perhaps the most disappointing finding is that the attitude of 'professional men' toward women as managers was less than for female college students. More research is needed to explore and confirm these findings.

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STRATEGIC CAPABILITIES, MARKET AND NONMARKET STRATEGIES, AND FINANCIAL AND NON-FINANCIAL PERFORMANCE IN GHANA

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ABSTRACT

This paper investigates factors associated with strategic capabilities, market and nonmarket strategies (NMS), and firm performance in Ghana. Different capability-strategy "paths" to financial and non-financial performance were identified. Technology capabilities, cost leadership, and political NMS were linked to financial performance, whereas management capabilities, differentiation, and social NMS were linked to non-financial performance. Marketing capabilities contributed to both financial and non-financial performance. Directions for future research are presented.

INTRODUCTION

An effective market-oriented, competitive strategy is critical to financial success in most firms. Amid heightened regulations, increasing political influence, and greater emphasis on government-business partnerships in many nations, nonmarket concerns have risen in prominence as well. An effective nonmarket strategy (NMS) can be crucial as well (Martinez & Kang, 2014).With the rapid development of emerging markets, the notion of nonmarket strategy (NMS) is now widely viewed as a key component of a firm's overall strategic orientation, and has been investigated within several research traditions (Aplin & Hegarty, 1980; Parnell, 2015).

The rise of nonmarket considerations notwithstanding, the shortage of scholarly work in Ghana and other African nations presents a challenge for scholars, particularly as it pertains to such constructs as NMS (Agyapong, Osei, & Akomea, 2015; Agyemang & Castellini, 2015; Coffie & Owusu-Frimpong, 2014; Obeng, Robson, & Haugh, 2014; Saffu, Walker, & Hinson, 2007). Recently, there has been an influx of foreign firms into Ghana from the Americas, Europe, Asia and other neighboring countries such as Nigeria. Coupled with the multicultural nature and weak political systems in the country, this accentuates the challenges faced by both local businesses and new entrants as they strive to compete with savvy, market-oriented firms that are also well-connected politically. Ghanaian firms typically combine market and nonmarket strategies to address global competition, but business performance is also directly linked to capability development in many instances (Acquaah, Adjei, & Mensa-Bonsu, 2008; Parnell, 2017). Indeed, business success in Ghana can hinge on multiple indigenous and imported market and nonmarket strategies.

This paper investigates the factors associated with strategic capabilities, market and nonmarket strategies (NMS), and how they influence performance of firms in Ghana. It

distinguishes between the social and political dimensions of NMS, and between the financial and non-financial dimensions of performance.

NONMARKET STRATEGY

The notion of NMS can be viewed as an extension of, or as an alternative to, a market-oriented approach. NMS can be applied at industry, strategic group, and organization levels (Doh, Lawton, & Rajwani, 2012). Industries frequently seek to influence and manage government regulations in such areas as product safety, environmental protection, and working conditions (Porter & Kramer, 2002, 2006; Vázquez-Maguirre & Hartmann, 2013). Individual firms often develop resources and capabilities that align with legislation and agency enforcement protocols. Executives in large firms regularly collaborate with government officials as well (Aplin & Hegarty, 1980; Capron & Chatain, 2008; Holburn & Vanden Bergh, 2008; Oliver & Holzinger, 2008; Rival, 2012). Select firms in an industry—including large or small rivals—may cooperate to pursue nonmarket objectives as well (Frynas, Mellahi, & Pigman, 2006; Mahon, Heugens, & Lamertz, 2004).

Scholarly interest on NMS has increased in the past two decades and has been examined in several streams of literature. CPA refers to the efforts made by firms to manage political institutions and/or influence political actors in ways that are favorable to them (Hillman, Keim, & Schuler, 2004; Lux, Crook, & Woehr, 2011). Strategic political management (SPM) is more exclusive than NMS and refers to strategic actions that firms plan and execute to obtain profits directly or indirectly from political entities (Hillman & Hitt, 1999; Hillman et al., 2004; Hillman & Zardkoohi, 1999; Oliver & Holzinger, 2008). Each of these constructs underscores the pursuit of superior performance through nonmarket means (Doh et al., 2012; Henisz & Zelner, 2012; Kingsley, Bergh, & Bonardi, 2012; Sawant, 2012).

Political legitimacy, gained through the firm's adaptation of nonmarket initiatives as required by local institutional norms (Kamel Mellahi, Jędrzej George Frynas, Pei Sun, & Donald Siegel, 2016a), is critical to organizational performance in emerging countries (Guo, Xu, & Jacobs, 2014), where restrictive institutional conditions pressure firms to ensure that their actions are deemed suitable within norms and values recognized by institutional actors (Liedong, Ghobadian, Rajwani, & O'Regan, 2015; Zheng, Luo, & Maksimov, 2015). Legitimacy can result in positive outcomes such as regulatory leniency for the organization (Hong & Liskovich, 2015) and also help minimize risk (Stevens, Xie, & Peng, 2016).

Two broad streams of NMS research have emerged, political corporate social responsibility (PCSR) and corporate political activity (CPA) (Kamel Mellahi, Jedrzej George Frynas, Pei Sun, & Donald Siegel, 2016b). Strategic or political corporate social responsibility focuses on organizational activity that seeks to advance both social and financial goals (McWilliams, Siegel, & Wright, 2006). Corporate political activity (CPA) accentuates political institutions and actors in ways beneficial to the firm (Hillman et al., 2004). Efforts to integrate these two streams have been limited (den Hond, Rehbein, de Bakker, & Kooijmans-van Lankveld, 2014; Hadani & Coombes, 2015).

The role of NMS in Ghana is intriguing. A recent analysis of economic freedom ranked Ghana 19 out of 47 nations in Sub-Saharan Africa. The ease of doing business has steadily improved in recent years, encouraging many local start-ups and an influx of foreign firms with diverse market and political nonmarket strategies. Nonetheless, the bureaucratic processes coupled with the heavy burdens of state regulation and political favoritism has the potential to undermine overall industry competitiveness and performance. A cumbersome governmental

bureaucracy dissuades potential entrepreneurs and impedes optimal economic performance (Miller, Kim, & Roberts, 2018).

The Ghanaian business environment is relatively strong when compared to its neighbors in the region and includes a general trend toward privatizing SOEs (White, 2017). Ghana's current regime seeks both further economic liberalization and reduced complexity for doing business in the country. The current "one district, one factory" policy aims to leverage national resources by identifying strong industries in each district of the nation and crafting a regulatory regime to support them. Ghana enjoys several cost reducing factors including a general lack of regulatory enforcements cheap labor, and rlower advertising and marketing costs that can lower operational expenses and enhance organizational performance through cost leadership. NMS plays an important role for market-oriented firms as well by providing opportunities to leverage the success of their market strategies. Nonmarket power can promote competitive advantage and global performance through strategic utilization of knowledge and political influences (Suder, 2015).

The contributions of market and nonmarket strategies to firm performance typically vary across nations (Mellahi et al., 2016b). Overall, the Ghanaian market is open; most prices are market-driven, with some exceptions for government subsidies. A firm's market strategy is a key performance driver, but political considerations are also important. Given the challenges of a developing economy, survival is the primary goal for many domestic and multinational firms (Goodman, 2014). Conforming products to local tastes and demonstrating cultural awareness are critical success factors.

A Ghanaian firm's political affiliation can be beneficial or detrimental over the long term, heightening the importance of NMS. Ghana is a politically polarized society, so organizations

that collude with one political group typically alienate other groups. Moreover, many firms in the Ghana Club 100 have performed well when their goals have been aligned with those of the prevailing government (Parnell, Mensah, & Oppong, 2017).

HYPOTHESES

This empirical study tests two broad sets of hypotheses, one that considers strategic capabilities as drivers of market and nonmarket strategies, and a second that addresses links between these strategies and both financial and non-financial performance. These are considered in kind.

Strategic Capabilities and Strategy

Strategic capabilities are skills and knowledge that firms use to leverage assets and coordinate activities (Assudani, 2008; Teece, Pisano, & Shuen, 1997). Capabilities form the foundation for competitive strategies (Berchicci, Dowell, & King, 2012; Peteraf, Di Stefano, & Verona, 2013; Vogel & Güttel, 2013) and drive firm performance directly and through strategies. (Boohene, 2009) empirically supports this link among Ghanaian firms.

Several categories of capabilities should be distinguished. Marketing capabilities include market learning and advance warning systems to identify demand, serve customers, and leverage new media and social networks (Day, 2011). Contributors to marketing capabilities include effective market research, adaptive leadership and a responsive, market-oriented business culture. Technology capabilities include the effective use of appropriate technology to enhance manufacturing, product, innovation, and cost reduction (Song, Di Benedetto, & Nason, 2007), and are critical in unstable and competitive industries such as biotechnology, aviation, and healthcare. Management capabilities include competencies and skills that leaders bring to bear in the design and execution of organizational strategy. Cronyism and nepotism, particularly in the

public sector, appear to erode managerial capabilities in Ghana. The nation's president customarily appoints senior executives and board members of state-owned enterprises (SOEs), thus aligning their visions and missions with those of the government and the ruling political party.

The strategic value of capabilities in both the private and public sectors in Ghana is clear. Indeed, organizations without effective management capabilities often decline even if they are afforded government support. Effective leadership and management can quickly yield astounding returns, as demonstrated with the Ghana Institute of Management and Public Administration (GIMPA). In 2000, GIMPA was just another state-owned educational institute teetering on the edge of extinction and bankruptcy. Nine years later, the institute had achieved a student increase of over 2000% and was financially independent and self-sustaining. GIMPA's success has been attributed to leadership (Ebenezer & Adei, 2014). Of course, ineffectively leadership can contribute to organizational demise, such as occurred with SOE Ghana Airways (Amankwah-Amoah & Debrah, 2010). The airline was the premier Pan-African state-owned national carrier established in 1958 prior to its collapse in 2004.

Another example also highlights the importance of capabilities as drivers of market strategies. MTN Ghana pioneered mobile money services and still leads technological development in the industry through $2.5 billion in capital investment spanning 2006-2015 and new product introductions (e.g., 4G technology to increase Internet speed in 2016). Its 46% market share (Telecom Space, 2016) is almost twice that of its closest rival, Vodafone Ghana, suggesting a strong market strategy based on innovation. NMS did not appear to be central to MTN's success.

Industry characteristics influence firm performance in Ghana as they do in other nations. However, market strategies tend to be more prevalent and diverse in developed economies, whereas cost leadership is more common in lesser developed economies like Ghana's. The prominence of cost leadership strategies in less developed nations does not suggest that differentiation-based approaches cannot be successful as well (Agyapong et al., 2015). NMS can be employed as a separate undertaking or as a complement to market strategy (Deng, Tian, & Abrar, 2010).

NMS in Ghana is predominant in SOEs and private organizations and may be associated with limited managerial capabilities and superior political connections. Organizations reliant on NMS may place less emphasis on management capabilities (Parnell, 2017). Nonetheless, the volatile business environment can compel relationships with governments, non-governmental entities, and interest groups, so the coupling of MS and NMS in developing nations like Ghana with weak political environments is often critical to survival.

Ghana's domestic firms are typically small to medium scale and lack the resources to compete against well-equipped and well-connected foreign-owned firms who lobby the local polity for contracts. Even so, multinational enterprises (MNEs) struggle to gain legitimacy with indigenous consumers and institutions (Ioannou & Serafeim, 2012). For instance, they must localize NMS rather than transplant their home nonmarket practices within their networks of subsidiaries (Aguilera-Caracuel, Aragón-Correa, Hurtado-Torres, & Rugman, 2012). Localizing the NMS of foreign firms can impact organizational outcomes, as adaptation enhances legitimacy and improves performance (Mellahi et al., 2016b). This may be applicable to Ghana where firms exploit both market and nonmarket strategies concomitantly to outwit their rivals. Domestic firms mimic MNEs' market strategies while maintaining their own nonmarket

strategies, and MNEs adopt locals' nonmarket strategies while leveraging their own market strategies to improve their margins. These possibilities illustrate the complex mix of political, social and diverse strategies employed by firms in Ghana.

Consider the higher education industry. In the late 2000s and early 2010s, it was common place to have American and European universities advertising for students through the educational units of their embassies. As the global market for tertiary education became more competitive, recruiters began to fly from their home campuses to target markets in emerging economies in Asia, South America and Africa. Today, distance education programs and satellite campuses are common, sometimes augmented by visiting faculty. This is generally consistent with Okyireh (2016), who identified reputation, location, price and courses being offered as the primary university marketing factors in Ghana. Hence, institutions like the China-Europe International Business School (CEIBS) and Lancaster University have experienced success. U.S.-based Webster University has campuses throughout the world, including sites in Ghana, Austria, Switzerland, China, Greece and Thailand (Webster University, 2018), enabling the institution to access local markets with attractive degree offerings. With over 149 tertiary institutes, 65,000 students in private institutions, and 228,000 students in public institutions in Ghana (Ghana National Accreditations Board, 2014), managers in the higher education industry must be innovative if they are to survive; developing effective managerial and technological capabilities are critical to success.

Although there are clear, contextual differences between firms in Ghana and those in other nations, links between capabilities and strategies are clear. Hence, we hypothesize below that technology, managerial and marketing capabilities and will be positively associated with cost leadership, differentiation and political and social NMS:

H1(a,b,c,d): Technology capabilities will be positively associated with an emphasis on cost leadership (differentiation, political NMS, and social NMS).

H2(a,b,c,d): Management capabilities will be positively associated with an emphasis on cost leadership (differentiation, political NMS, and social NMS).

H3(a,b,c,d): Marketing capabilities will be positively associated with an emphasis on cost leadership (differentiation, political NMS, and social NMS).

Strategy and Performance

Research addressing links between market-oriented strategies and firm performance is well developed (Blackmore & Nesbitt, 2013; Dess & Davis, 1984; Parnell, 1997; Yu, Liu, Zhu, & Li, 2015). Nonetheless, the debate continues over the exclusive use of market strategies versus the integrative market-nonmarket approaches, especially in under-researched nations. For example, an analysis of 179 Ghanaian firms finds that CSR initiatives reduced institutional risk exposure whereas managerial political ties do not, challenging the appropriateness of integrating political and social NMS particularly in developing economies with weak institutional environments (George, Corbishley, Khayesi, Haas, & Tihanyi, 2016; Liedong, Rajwani, & Mellahi, 2017).

African firms have recently become more interdependent and vulnerable to external pressure related to political, social and regulatory factors. To be competitive, managers must understand cost structures, technology, management and marketing capabilities, and how NMS support market strategies. Indeed, a firm's nonmarket performance is influenced by regulatory and political environments, especially rivalry among interest groups or politicians, and by internal abilities to mitigate political transaction costs (Bonardi, Holburn, & Vanden Bergh, 2006). By assessing and exploiting their internal and external capabilities, firms can thwart

competition and perform well. Thus, private wealth creation in regimes of rapid technological change depends on honing internal technological, organizational, and managerial processes inside the firm (Teece et al., 1997). To augment their marketing strategies and capabilities, Ghanaian firms often pursue nonmarket strategies to enhance their financial and non-financial performance.

Firm survival can be linked to an effective NMS at the firm or industry level. Consider the Ghanaian poultry industry. For decades, local farmers have struggled to compete with importers of frozen poultry due in part to the high cost of feed (Aryee, 2016; Haligah, 2017). This concern could have been addressed through tax incentives and/or government subsidies. The government took a different approach in 2006 when it raised import tariffs on poultry from 20% to 40%, resulting in intense pressure from the International Monetary Fund (IMF) IMF and an ultimate recension. Today, imported poultry still accounts for over 90% of consumption in Ghana (Kusi, Agbegblewu, Anim, & Nyarku, 2015). Local farmers can still pursue market-based options (e.g., more effective branding, promotion, or marketing), but many believe that competition with foreign producers is not possible without an effective NMS that includes direct government intervention.

There is a sound rationale for a positive association between nonmarket strategy and organizational performance from the stakeholder, institutional perspectives as well (McWilliams & Siegel, 2011; Mellahi et al., 2016a). Just as evidence links market strategies to superior performance, it indicates that nonmarket strategies drive performance (Bach & Allen, 2010; Parnell, 2018). Buffering the organization against unfavorable outcomes is important in emerging economies where political power is less constrained by legal frameworks, and the balance of power between a firm and its political connections favor the latter (Dieleman & Boddewyn, 2012); Mellahi et al. (2016b) evaluated 163 studies and found that 102 identified a

positive nexus between NMS and performance. Therefore, we posit our second set of hypotheses for Ghanaian firms as follows:

H2a: Emphasis on cost leadership will be positively associated with financial performance.

H2b: Emphasis on cost leadership will be positively associated with non-financial performance.

H2c: Emphasis on differentiation will be positively associated with financial performance.

H2d: Emphasis on differentiation will be positively associated with non-financial performance.

H2e: Emphasis on political NMS will be positively associated with financial performance.

H2f: Emphasis on political NMS will be positively associated with non-financial performance.

H2g: Emphasis on social NMS will be positively associated with financial performance.

H2h: Emphasis on social NMS will be positively associated with non-financial performance.

METHODS

Previously validated measures were employed in the present study. Scales developed by Desarbo, Benedetto, Song, and Sinha (2005) were employed to assess strategic capabilities. Market strategy—cost leadership and differentiation—was assessed with items identified by Nayyar (1993) and emphasis on NMS was assessed via items based on the Deng et al. (2010) taxonomy, but with new items added to delineate distinct political and social dimensions. Relative performance was measured with items adopted from multiple sources, but were modified to emphasize financial and non-financial dimensions (Harris & Mongiello, 2001; Kaplan & Norton, 1992, 2001, 2004; Madanoglu, Okumus, & Avci, 2014; Norreklit, 2000;

Phillips & Moutinho, 1999; Venkatraman & Ramanujam, 1986). Seven-point Likert scales were utilized for all items, and hypotheses were tested via SmartPLS (version 3) software (Hair, Sarstedt, Pieper, & Ringle, 2012).

A survey containing the strategy, capability, and performance items was completed by 166 middle and top managers in the Accra-Tema metropolitan district of Ghana. The Accra-Tema metropolis is Ghana's most populated and culturally diverse region, an economic hub and a core location for major industries. Proximity to ports and major government centers attract both foreign and local businesses into the region, making it well-suited for collecting a representative sample for the study.

Surveys completed by individuals employed in micro businesses at the time were discarded and not included in the sample (see table 1). Extending the focus beyond top managers informs our inquiry, as they play a greater role in both strategy formulation and implementation than they have in past decades (Balogun & Johnson, 2004; Raes, Heijltjes, Glunk, & Roe, 2011).

Table 1. SAMPLE CHARACTERISTICS.

Variable	n	%
Respondent Management Level		
Middle	136	81.9
Upper	30	18.1
Respondent Functional Background		
Accounting/Finance	33	19.9
General Management/HR	61	36.7
Marketing/Sales	31	18.7
Production/Engineering	20	12.0
Other	21	12.6
Industry		
Manufacturing	43	25.9
Hospitality	15	9.0
Healthcare	12	7.2
Services	69	41.6
Other/Not Provided	27	16.3
Firm Size		
Small (11-50 employees)	66	39.8
Medium (51-250 employees)	50	30.1
Large (251+ employees)	50	30.1

FINDINGS

Hypotheses were tested via SmartPLS (version 3) software (Hair et al., 2012). Coefficient alphas ranged from .733 to .899. The lowest composite reliability score was .832, depicting adequate reliability for all constructs and measures (see table 2). The Fornell-Larcker matrix was supportive and heterotrait-monotrait (HTMT) scores ranged from .328 to .859, suggesting discriminant validity in all instances. VIF scores for all constructs and individual measures indicated that collinearity was not a critical concern.

Table 2. ASSESSMENT OF CONSTRUCT RELIABILITY

Scale	Number of Items	Coefficient Alpha	Composite Reliability
Cost Leadership	4	.733	.832
Differentiation	4	.825	.844
Political NMS	7	.899	.919
Social NMS	7	.865	.896
Management Capabilities	6	.843	.883
Marketing Capabilities	4	.823	.883
Technology Capabilities	6	.861	.896
Financial Performance	4	.841	.893
Non-Financial Performance	4	.820	.882

The first set of hypotheses was partially supported, as summarized in table 3. Technology capabilities were significant drivers of cost leadership and political NMS, but not of differentiation and social NMS. Management capabilities were significant drivers of social NMS, but not political NMS or either market strategy. Marketing capabilities were significant drivers of cost leadership, differentiation, and social NMS, but not political NMS.

Table 3. SUMMARY OF HYPOTHESIS TESTS

Hyp	Link	Original Sample	Sample Mean	Standard Deviation	t-stat	p-value	support
H1a	Technology Cap. -> Cost Leadership	0.224	0.231	0.091	2.457	0.014	yes
H1b	Technology Cap. -> Differentiation	0.134	0.135	0.102	1.319	0.187	no
H1c	Technology Cap. -> Political NMS	0.321	0.326	0.099	3.234	0.001	yes
H1d	Technology Cap. -> Social NMS	0.162	0.170	0.100	1.625	0.104	no
H2a	Management Cap. -> Cost Leadership	0.057	0.059	0.081	0.705	0.481	no
H2b	Management Cap. -> Differentiation	0.144	0.149	0.105	1.376	0.169	no
H2c	Management Cap. -> Political NMS	0.022	0.031	0.095	0.231	0.817	no
H2d	Management Cap. -> Social NMS	0.197	0.205	0.095	2.068	0.039	yes
H3a	Marketing Cap. -> Cost Leadership	0.487	0.483	0.089	5.448	0.000	yes
H3b	Marketing Cap. -> Differentiation	0.410	0.407	0.097	4.204	0.000	yes
H3c	Marketing Cap. -> Political NMS	0.113	0.102	0.106	1.073	0.283	no
H3d	Marketing Cap. -> Social NMS	0.337	0.326	0.095	3.538	0.000	yes
H4a	Cost Leadership -> Financial Perf.	0.373	0.385	0.102	3.667	0.000	yes
H4b	Cost Leadership -> Non-Financial Perf.	0.055	0.063	0.092	0.596	0.551	no
H4c	Differentiation -> Financial Perf.	0.004	0.000	0.102	0.044	0.965	no
H4d	Differentiation -> Non-Financial Perf.	0.265	0.259	0.115	2.300	0.022	yes
H4e	Political NMS -> Financial Perf.	0.177	0.174	0.101	1.751	0.080	no
H4f	Political NMS -> Non-Financial Perf.	0.098	0.096	0.095	1.029	0.304	no
H4g	Social NMS -> Financial Perf.	0.073	0.078	0.123	0.595	0.552	no
H4h	Social NMS -> Non-Financial Perf.	0.305	0.315	0.118	2.585	0.010	yes

The second set of hypotheses was partially supported. Cost leadership was associated with financial performance, differentiation with non-financial performance, and social NMS with non-financial performance. Political NMS was not associated with either financial or non-financial performance.

Based on these findings, insignificant links and those with effect sizes below 0.02 were eliminated individually one by one to develop a composite model. Effect sizes were assessed and

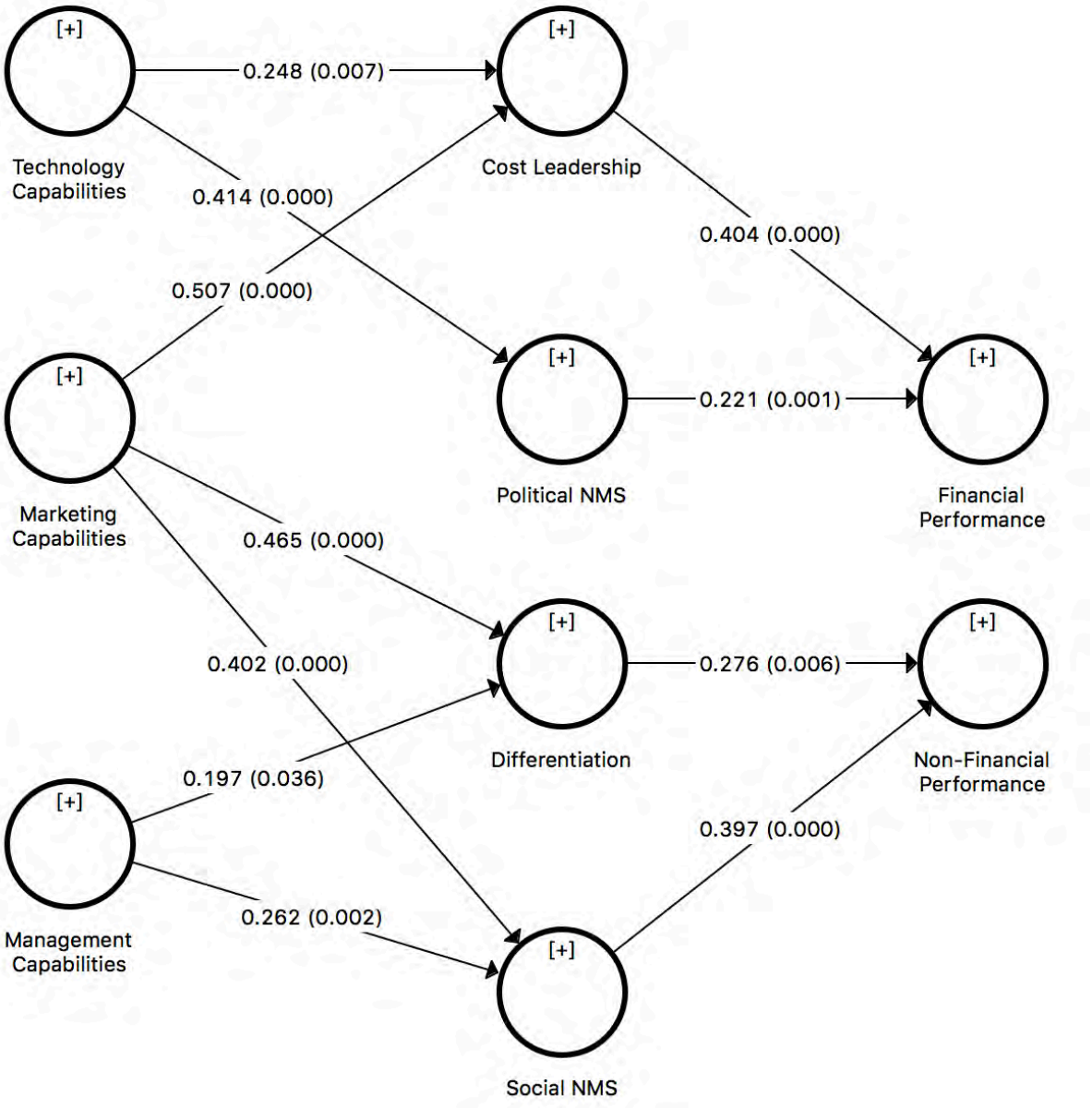
interpreted following Cohen's benchmarks of .02 (small), .15 (moderate), and .35 (large) (Hair et al., 2012). As a result, two additional links (management capabilities with differentiation, and political NMS with financial performance) emerged as significant at the .05 level. The composite model is presented in Figure 1, with supporting statistics in table 4.

Table 4. COMPOSITE MODEL

Link	Original Sample	Sample Mean	Standard Deviation	t-stat	p-value	f^2 value
Technology Cap. -> Cost Leadership	0.248	0.251	0.092	2.691	0.007	0.066
Technology Cap. -> Political NMS	0.414	0.424	0.062	6.684	0.000	0.207*
Management Cap. -> Differentiation	0.197	0.204	0.094	2.103	0.036	0.036
Management Cap. -> Social NMS	0.262	0.272	0.085	3.070	0.002	0.063
Marketing Cap. -> Cost Leadership	0.507	0.507	0.089	5.682	0.000	0.276*
Marketing Cap. -> Differentiation	0.465	0.463	0.092	5.035	0.000	0.200*
Marketing Cap. -> Social NMS	0.402	0.398	0.082	4.886	0.000	0.147
Cost Leadership -> Financial Perf.	0.404	0.408	0.067	6.041	0.000	0.203*
Differentiation -> Non-Financial Perf.	0.276	0.275	0.099	2.779	0.006	0.091
Political NMS -> Financial Perf.	0.221	0.226	0.067	3.305	0.001	0.061
Social NMS -> Non-Financial Perf.	0.397	0.404	0.072	5.521	0.000	0.189*

* Effect size (f^2) was moderate.

Figure 1. COMPOSITE MODEL



An evaluation of effect sizes in the composite model provides insight into the most substantial drivers. Moderate strength (i.e., f^2 greater than 0.15) was identified with the links between technology capabilities and political NMS, between marketing capabilities and both market strategies, between cost leadership and performance, and between social NMS and non-financial performance.

DISCUSSION

Several key findings warrant further discussion. First, two distinct paths to performance were identified in the composite model. Following figure 1, financial performance was linked to technology capabilities, cost leadership, and political NMS, while non-financial performance was linked to management capabilities, differentiation, and social NMS.

Cost leadership has been found to promote firm performance in a number of studies (Acquaah & Yasai-Ardekani, 2008; Dadzie, Winston, & Dadzie, 2012; Li & Li, 2008; Zahra & Covin, 1993). While most of this work has focused on more stable economies, our findings in Ghana are similar. This outcome, however, could be attributed to the degree of freedom in Ghana's economy compared to its sub-Saharan counterparts the existence of uncontrolled, porous borders, and the ease of implementing political NMS (Acquaah, 2011; Acquaah et al., 2008; Agyapong & Muntaka, 2012). Like most developing countries, the regulatory system in Ghana can be both cumbersome and lax.

Finally, capabilities in the marketing realm appear to be the most critical to Ghanaian firms. Specifically, marketing capabilities were significant drivers of cost leadership, differentiation, and social NMS, but not of political NMS.

The absence of a link between management capability and NMS in the study is also noteworthy. In Ghana, as in most developing economies, obtaining government support is a

precondition to NMS, and such support is tied to the ruling political party. Although managerial capability is important, an effective NMS is equally essential to competitive advantage and firm performance (McWilliams & Siegel, 2001; Sun, Mellahi, & Wright, 2012). As a result, firms in Ghana value, and pursue socio-political connections to shore-off competition and maintain profit margins. Managerial political ties through CPA are thus common and undoubtedly well understood by businesses in Ghana.

Political NMS can boost financial performance (Liu, Yang, & Augustine, 2018). However, political affiliation alone does not assure a firm's survival in the country; due to the complexity of the Ghanaian business environment, lack of clear ownership and the protection of property rights. Formal systems exist amid layers of traditional (semi-formal) systems and expectations regulated by traditional chiefs. And, these nonmarket structures tend to impose external demands and institutional norms that firms must observe for sociopolitical legitimacy (Mellahi et al., 2016b) and survival.

Conducting political and social NMS in Ghana is therefore complicated. Organizations endure only if they acknowledge the chieftaincy system, and the need to offer appointments, money and/or some social benefits to relevant stakeholders. This is broadly true in Ghana, especially, in the acquisition of prime property—the alternative is endless litigation despite securing government approvals. Smooth relationships with these primary stakeholders (Hillman et al., 2004)are essential as preferential political access (Frynas et al., 2006). Managerial capability notwithstanding, NMS that ignores socio-cultural checkpoints is detrimental to the organization's performance and survival. Hence, the impact of the nexus of activities with government agencies and traditional chiefs that help sustain a company's competitive edge in a given industry in Ghana cannot be underestimated.

Our empirical findings revealed that political NMS was not associated with either financial or non-financial performance. Acquaah (2012) reached a similar conclusion using data from 106 Ghanaian organizations, noting that enhanced political ties improved the performance of family-owned businesses as opposed to non-family owned firms. This provides support for our findings since the organizations sampled in our study were not family-owned. While the NMS-performance link in Ghana is unclear, it does not fully negate the argument that several nonmarket approaches have elevated higher firm performance in Ghana. For instance, bulk distribution companies (BDCs) in Ghana benefit significantly by influencing government decisions in the petroleum and energy sector. In 2015, when deregulation commenced, BDCs persuaded Ghana's government to end price stabilization margins of ¢0.3720 and ¢0.2812 per liter of super gasoline and diesel, respectively (Obeng-Okon, 2015). Oil prices in Ghana, are largely determined by the National Petroleum Authority (NPA) in consultation with BDCs and other stakeholders (Amponsah & Opei, 2017)which gives oil marketing companies (OMCs) and BDCs some advantage in the oil industry.

This notwithstanding, firms' margins in a given industry may be adversely impacted if they depend solely on NMS and fail to hone their MS to maintain competitiveness. Thus, while public corporations and SOEs may enjoy state protection, political will (or its lack) may affect growth and productivity. Where political ties are excessive, government entities actively influence corporate policy, and consequences can be devastating. The African Peer Review Mechanism (APRM) report notes that some of the greatest challenges facing SOEs across Africa include unformed regulatory systems, politicized board appointments, and unclear mandates (Corrigan, 2014).

All senior executives and board members of Ghana's SOEs are government appointees. Consequently, a change in government prompts mass resignations or terminations of appointments. The swearing-in of Ghana's president in 2017 brought resignations of CEOs and directors of several SOEs who had served in the erstwhile government; the same occurred in 2009 and 2001. This situation creates tension between management and government that bodes ill for business.

Paradoxically, NMS might necessitate MS. The media industry is among Ghana's most competitive sectors and until1995, Ghana Broadcasting Corporation (GBC) dominated the industry. Liberalization spurred a number of media outlets. As of 2016, the national communications authority had licensed 75 TV stations, and 451 FM radio stations (Ghana, 2016a, 2016b). State-owned GBC's audience and patronage have declined continuously through managerial ineffectiveness. To augment dwindling revenues, GBC introduced the GBC television license under an act of Parliament. Despite aggressive marketing viewers do not pay the fee. TV license fees were intended to insulate the state broadcaster from government's control and losses despite the market distortions and the anti-competitive practices it could introduce (Park, 2015). This notwithstanding, GBC continues to struggle to survive in the media industry.

Conversely, private media have enjoyed significant growth driven by managerial capabilities and creativity. Although apparent, synergy between management capabilities and NMS begs the question of the complementarity between them in the developing country context.

CONCLUSIONS AND FUTURE DIRECTIONS

The analysis presented in this paper suggests distinct paths to financial and non-financial performance among Ghanaian firms. Our empirical results link financial performance was to

technology capabilities, cost leadership, and political NMS. In contrast, non-financial performance was linked to management capabilities, differentiation, and social NMS. Marketing capabilities were significant drivers of cost leadership, differentiation, and social NMS, but not of political NMS.

Two key limitations should be noted. First, the sample included managers from multiple industries at a single point in time. The cross-industry design does not incorporate prospective industry-level influences; assessing constructs in different time periods can provide a deeper insight into presumed causal relationships. Second, the present study employs self-typing scales to measure performance (Ramanujam & Venkatraman, 1987; Venkatraman & Ramanujam, 1986). While this approach offers advantages for cross-industry studies, assessing objective performance measures would inevitably provide a complementary perspective.

Numerous questions remain, particularly for developing nations like Ghana. First, the links between capabilities and NMS, and between NMS and performance require elaboration. It is unclear whether Ghanaian firms emphasize NMS to survive or merely to complement market efforts. Moreover, firms seeking to integrate NMS and MS, must overcome potential stakeholder conflicts. Nonmarket strategies often seeks to satisfy politicians, interest groups, and other nonmarket participants (Bach & Allen, 2010; Henisz & Zelner, 2012; Lux et al., 2011; Rui, 2010), many of which pursue agenda at odds with those of shareholders and customers (Bach & Allen, 2010; Parnell & Dent, 2009; Sakakibara & Dodgson, 2003; Singer, 2013).

Second, the extent to which the MS and the NMS can be integrated remains unclear, particularly in developed and emerging economies. While some degree of integration is plausible, the MS and the NMS also represent alternative paths to firm performance (Bach & Allen, 2010; Cavazos & Rutherford, 2012; dos Reis, Meyer, & Meyer, 2012; Henisz & Zelner,

2012; Lux et al., 2011; Vázquez-Maguirre & Hartmann, 2013). Indeed, MS and NMS can be used to address different types of challenges (de Figueiredo & de Figueiredo, 2002a, 2002b).

Finally, additional work on economically similar nations—particularly those in sub-Saharan Africa—is required. Because multinational enterprises must address multiple, increasingly complex political and regulatory requirements simultaneously, a different set of capabilities is required (Boddewyn, 2016; Frynas et al., 2006; Kobrin, 2015; Oliver & Holzinger, 2008; Shirodkar, Konara, & McGuire, 2017; van Kranenburg & Voinea, 2017). Such complexity renders cross-border NMS impractical and ineffective without multilaterally accepted norms, processes and rules (Kobrin, 2015).

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Technology Readiness and Adoption at Kenosha Harbor Market

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Abstract

Technology is an increasingly important force in the world today, pervading everyday life in many ways. This is no less true in the field of retail than elsewhere. However, farmers' markets may represent an unusual case because of their cultural associations. Moreover, the nature of technology adoption in general often follows patterns similar to those of the fashion industry, where a new concept has an initial surge in popularity only to be abandoned with similar relative speed (Sun, 2013). This process may be driven by opinion leaders or especially prominent and influential "anchor vendors" who occupy a special position in the establishment of shared market spaces (Gatzlaff, Sirmans, & Diskin, 1994). In order to understand the role of technology in the context of the modern farmer's market and what drives this role, we did a pilot study of farmers' market vendors to determine their technology usage and possible drivers of this technology usage

Introduction

Technology adoption amongst farmers is an ongoing subject of research, but results suggest it is often not as high as it might be (Kumbhare & Singh, 2016) even when it affords clear benefits to the farmers (Dhaka & Chayal, 2016). Therefore, farmers' markets—which have grown from 1,755 markets in 1994 to 8,669 in 2016 (USDA, 2016)—represent a context in which there is reason to expect technology adoption and use may be relatively low. In general, technology adoption often follows herd behavior patterns where adopters imitate others (Sun, 2013). This suggests an explanation for why technology use may or may not have caught on in farmers' markets.

In order to understand the drivers of technology in the context of modern farmer's markets, this study piloted a quantitative analysis of a cross-section of farmers' market vendors using the Kenosha Harbor Market (KHM). Although farmers' markets exist in both rural and urban areas (Cohen et al., 2018) this market is in an urban context.

Background

Farmers' markets are small, local markets in which farmers or their employees can sell produce or other items directly to consumers. A broad generalization of the products that are offered in most farmers' markets can be categorized as Agricultural Products, Processed Foods, Prepared Foods, Arts/Crafts, Services, or Miscellaneous (Hinrichs, Gulespie, & Feenstra, 2004). These markets are not a new development, but they have become considerably more prominent in recent years than they were in the past. In 1994, the USDA reported that there were 1,755 farmers' markets in the United States. Over the course of the next 22 years, this number almost quintupled; in 2016, the USDA reported that the number had increased to 8,669 farmers' markets. One of the driving factors behind this staggering explosion of the farmers' market has likely been the rise of the organic food movement (Guthman, 2014). The measurable nutritional

advantages of organic food are negligible but the lack of synthetic pesticides may offer real health benefits (Rock, Suriyan, Vijay, Thalha, & Elango, 2017). Beneficial or not, organics remain a popular part of the modern imagination (Lee & Yun, 2015) and many small farmers have taken advantage of the organic movement (Feldmann, & Hamm, 2015). Even without organic labels, many consumers perceive locally grown foods to be advantageous.

In general, the prominence of technology in farming is a complex issue. Many of the high-end industrialized parts of the agricultural sector rely heavily on technology and automation in the modern era (Enyedi & Volgyes, 2016). For smaller, independent farmers technology adoption tends to be lower (Kumbhare & Singh, 2016). This is true even when there is evidence that greater technology use would have a pronounced advantage for the farmer (Dhaka & Chayal, 2016), a phenomenon that can be explained by unfamiliarity, traditionalism, or a lack of resources to obtain and employ technology.

As a result of this, the specific status of technology in farmers' markets is hard to determine, and what little evidence exists suggests conflicting ideas. For example, a study of patronage of farmers' markets in Detroit (Cohen et al., 2018) reported that recordkeeping still used handwritten records, when electronic recordkeeping is one of the simplest forms of technological use. By contrast, a case study on a farmers' market by Chi (2016) found that the overall market made strong use of the Facebook social media platform in terms of connecting with customers, organizing events, and other administrative functions. There are several possible explanations for this type of disconnect. It is possible, of course, that the two specific markets under study simply had different characteristics. Given the small and personalized nature of the farmers' market, it is possible that the specific markets are considerably heterogeneous in technology adoption. Another possibility, however, is that the market's administration or the more influential vendors make use of technology while the average vendor does not. It is also possible that the nature of technology adoption is skewed to the customer base for specific markets. For example, the Facebook's popularity skews older than other technology (Yu, Ellison, & Lampe, 2018).

Any of these possibilities would represent an interesting situation from a scholarly perspective. However, the state of the existing research simply does not give adequate consideration to technology in the modern farmer' market to draw any meaningful conclusions. This suggests a problematic gap in the literature relevant to a real, practical problem because the over 8,000 farmers' markets in the US today are a context clearly worthy of study, and Chi's (2016) result is illustrative of one of the many benefits that technology adoption can provide to farmers' market vendors. Therefore, further research is needed to bridge this gap in the literature and understand the role of technology in the farmers' market context today.

Purpose of the Study

The purpose of this quantitative, cross-sectional, non-experimental correlational design is to determine the level of technology adoption and factors influencing technology adoption at the Kenosha Harbor Market (KHM). Furthermore, this pilot study is intended to provide a methodology that can be extended to other markets, first throughout Wisconsin and the throughout the US. The study pursued two primary research questions.

- What is the current state of technology adoption on the part of vendors in the Kenosha Harbor Market?
- What demographic factors influence the adoption of technology on the part of vendors in the Kenosha Harbor Market?

Research Methods

Methodology

The methodology for the proposed study is quantitative. As per Parasuraman and Colby (2015), a simple, validated instrument exists to measure and segment the technology adoption of a population, whereas demographic variables and anchor vendor status are somewhat naturally quantifiable.

Population and Sample

While the population of interest incudes urban farmers' markets throughout Wisconsin, the sampling frame was KHM vendors. No specific demographic characteristics were used to delimit the study's population because demographics as a whole are one of the potential predictive factors being employed by the study. The researchers obtained permission of KHM's management and provided management with a copy of the survey questionnaire (Appendix A). Then researcher distributed the questionnaires in physical, printed form to market vendors across three Saturdays. While participation was optional, very few vendors declined participation. Physical surveys were chosen due to the technology issues inherent in the nature of the study. Vendors returned surveys on the same day. Useable surveys were returned by 83 vendors.

Instrumentation

The specific survey instrument contained two sections. The first section was the existing, validated Technology Readiness Index 2.0 (TRI 2.0). The TRI 2.0 is a 16-item index developed by Parasuraman and Colby (2015) as a condensation and refinement of the original Technology Readiness Index, a 36-item scale. Both versions of the TRI use Lickert scale questions to measure the readiness of the members in a specific population to adopt new technology, and the smaller, 16-item scale has comparable validity to the full scale while offering greater ease-of-use. Table 1 lists the 16 items grouped by the broader characteristic. Each was answered on a five level ordinal scale from Strongly Disagree (1) to Strongly Agree (5). The survey had these items in random order.

Table 1: TRI 2.0 Questions

[OPTIMISM STATEMENTS]

a. New technologies contribute to a better quality of life [OPT1]
b. Technology gives me more freedom of mobility [OPT2]
c. Technology gives people more control over their daily lives [OPT3]
d. Technology makes me more productive in my personal life [OPT4]

[INNOVATIVENESS STATEMENTS]

e. Other people come to me for advice on new technologies [INN1]

f. In general, I am among the first in my circle of friends to acquire new technology when it appears [INN2]
g. I can usually figure out new high-tech products and services without help from others [INN3]
h. I keep up with the latest technological developments in my areas of interest [INN4]

[DISCOMFORT STATEMENTS]
i. When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do [DIS1]
j. Technical support lines are not helpful because they don't explain things in terms I understand [DIS2]
k. Sometimes, I think that technology systems are not designed for use by ordinary people [DIS3]
l. There is no such thing as a manual for a high-tech product or service that's written in plain language [DIS4]

[INSECURITY STATEMENTS]
m. People are too dependent on technology to do things for them [INS1]
n. Too much technology distracts people to a point that is harmful [INS2]
o. Technology lowers the quality of relationships by reducing personal interaction [INS3]
p. I do not feel confident doing business with a place that can only be reached online [INS4]

The second section consisted of a simple demographic questionnaire. This included items measuring participants' age, gender, race/ethnicity, years of farmers' market experience, highest level of educational attainment, occupational status, frequency of attendance, and involvement in other markets. Respondents also classified their stock into one or more of the following categories: Agricultural Products, Processed Foods, Prepared Foods, Arts/Crafts, Services, Miscellaneous. We did not directly address the anchor vendor concept. Instead, the questionnaire included a section on influences in technology adoption. This included "Adoption by other vendors". If this was found to be a significant influence, then further questions would be developed to operationalize the anchor vendor concept.

Data Analysis

To answer the first research question, "What is the current state of technology adoption on the part of vendors in the Kenosha Harbor Market?" the results of the TRI 2.0 technology adoption index were evaluated. The four questions behind each characteristic of the TRI 2.0 were averaged as shown in Table 2. These means put the vendors in the "Neutral" to "Somewhat Agree" range.

Table 2

	Mean
Innovativeness	3.14
Insecurity	3.68
Discomfort	2.84
Optimism	3.84

We found three significant correlations between these characteristics as shown in Table 3. It seems reasonable that Optimism would negatively correlate with Insecurity and Discomfort. It also seems reasonable the Discomfort would negatively correlate with Innovativeness.

Table 3

	Innovativeness	Insecurity	Discomfort	Optimism	Age
Innovativeness	1.000				
Insecurity	0.014	1.000			
Discomfort	**-0.443**	0.294	1.000		
Optimism	0.364	**-0.450**	**-0.463**	1.000	
Age	-0.193	0.058	**0.484**	-0.169	1.000

There was only one demographic item that had any significant relationships with TRI characteristics. Age and Discomfort had a significant positive correlation, 0.484. This fits the stereotype that older individuals are less comfortable with technology. However, the fact that there was no relationship between Education Level and **any** TRI characteristic seems to defy stereotypes.

The only other significant relationships were with influences in technology adoption.

- Optimism was significantly higher (4.03 versus 3.74) for those who included "The technology appears or is fun to use" as an influence in selecting technology than for those who did not include this factor.
- Discomfort was significantly lower (2.71 versus 3.12) for those who included "It will likely improve business performance" as an influence in selecting technology than for those who did not include this factor.
- Innovativeness was significantly lower (2.74 versus 3.27) for those who included "Harbor Market guidelines" as an influence in selecting technology than for those who did not include this factor.

"Adoption by other vendors" is notably absent from significant relationships with TRI characteristics. However, this could be due to the sample size (n=83) or the small number of vendors, 8 out of 83, who said that adoption by others was an influence. Given our interest in the possibility of "anchor vendors", this is not an encouraging result. However, since this pilot study was an attempt to refine methodology, we refrain from interpreting too much from this outcome.

Summary and Next Steps

While farmers' markets (USDA, 2016) and technology (Nortion et al., 2014) are both increasingly important today, little is known about how technology is or could be used in the farmers' market context. Accordingly, this pilot study of a quantitative, cross-sectional, non-experimental was an attempt to refine tools for studying technology adoption in the farmers' market context. Two primary research questions guided the study: (a) What is the current state of technology adoption on the part of vendors in the context of farmers' markets? and (b) What factors influence the adoption of technology on the part of vendors in the context of farmers' markets? In particular, we were looking for evidence of "anchor vendors" as leaders in technology.

While the pilot study did not reveal anchor vendors, the process worked and we identified some significant relationships. The next steps in this research are twofold. First, we intend to draw data from additional urban farmers' markets located within Wisconsin. Second, we would like to administer the TRI 2.0 to small business entrepreneurs outside of farmers' markets but in similar geographic regions to compare their use of technology.

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Appendix – Survey Used

(starting on next page)

THE MYTH OF BIG-DATA: MISINTERPRETATION OF CONSUMER INSIGHTS WITHOUT THE HUMAN ELEMENT

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ABSTRACT

The value of emotional intelligence has long been documented in research on consumer behavior. In today's Digital Age, many researchers are relying on Big Data in order to predict how their consumer's will behave in the marketplace. Big Data allows insights into almost every level of the consumer journey and then uses complicated algorithms to predict what behavior the consumer is most likely to engage in. Amazon is the leading company who has built an industry on using Big Data to identify what their consumers would also be interested in or likely to purchase. Although many companies try to emulate their success, they are doing so in a vacuum. Amazon sells everything from A to Z, so we buy everything from A to Z. That allows their algorithms to provide more accurate insights. Most companies, though, only sell a consumer a product/service for a specified function (clothes, personal products, food, etc.), so they have a very limited snapshot of their consumer's behavior. This research will look at the need for using both quantitative and qualitative data to ensure that consumer insights are captured and interpreted in a holistic manner.

Measurement scales of customer satisfaction (ACSI, CSAT, NPS, etc.) are well established in the marketing literature and will be utilized in this study. While this is useful information for marketers and brands, it only reflects a quantitative score and does not tell the full story. In measuring satisfaction, we often assume the attributes companies deem as important are truly what is important to the customer, which is often not the case. In order to assure reliability of these attributes, we must first ask the customer what *they* deem as important so that the data can be used as an effective measurement. This research will examine the relationship of attributes as a measurement of customer satisfaction using both traditional and holistic scales that are derived directly from qualitative insights. In order to examine a consumer's intention to purchase, the Theory of Reasoned Action will be utilized and compared across attribute scales to determine which is the most reliable predictor of future behavior. Both managerial and theoretical implications will be discussed and future research identified.

THE SCRUM MANAGEMENT: EXAMPLES FROM MICROSOFT GLOBAL AND MICROSOFT TURKEY

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ABSTRACT

A scrum management is a new team oriented management in software development sector. The purpose of this paper is to explain a scrum management and present examples related to a scrum management in Microsoft Global and Microsoft Turkey to attract attentions of management scholars to this new team oriented management approach. Microsoft has engaged its development journey to reduce release cycles down to respond the changing business demands. Learning its experiences can make contributions to software development sector to expand and enhance applications of a scrum. It is also expected that management scholars can figure out adaptations of a scrum in different sectors as well.

INTRODUCTION

Organizations have been influenced by management trends which lead them to adapt to their environments, meet and exceed customer demands, and grow continuously. Performing an agile management and forming scrum teams are new management trends to achieve a customer oriented management and sustain competitive advantages in software development sector. A scrum is a way of being an agile to survive and succeed in dynamic sectors such as software development. It is considered worthwhile to give insights about a scrum management to attract attentions of management scholars to this new a team oriented management approach. The purpose of this paper is to explain a scrum management and present examples related to a scrum management in Microsoft Global and Microsoft Turkey to attract attentions of management scholars to this new team oriented management approach. First of all, a scrum and scrum teams will be explained. Secondly, stages of software product management will be acknowledged. Thirdly, examples from Microsoft Global and Microsoft Turkey about scrum management will be presented. Finally, the paper will end with the conclusion**.**

A SCRUM AND SCRUM TEAMS

The scrum methodology was introduced by Schwaber (1995) based on these principles: (1) transparency (software should be visible to people in a process), (2) inspection (experienced developers should inspect software), and (3) adaptation (suggestions of reviewers should be implemented) (Amir et al., 2013) (Crişan et al., p. 64).

A scrum is a process framework for delivering products with the highest value and handling complex situations. A scrum focuses on an experience, knowledge, and a decision making based

on current knowledge (Schwaber and Sutherland, 2011). It uses incremental and iterative approaches for developing products by using cross-functional teams (Deemer et al., 2010) (Campanelli and Parreiras, 2015, p. 86).

Sutherland and Schwaber believe that a scrum is an incremental and an iterative project management approach providing an "inspect and adapt" framework (Hossain et al., 2009, p. 175).

It has been one of the most effective method for an agile project management. It is both an incremental and an iterative development method and an adaptive development process (Genxing et al., 2002; Zhihai, and Guoxian, 2010). An objective of a scrum is to deliver high quality software products after defined periods called sprints. A development cycle consists of demand, analysis, design, iteration, and production stages (Yang et al., 2010, p. 889).

Components of a scrum team are a scrum master, a product owner and a development team. They have different roles and importance in the performance of a scrum team.

The scrum master supports and promotes a scrum by teaching a scrum theory, values, rules and practices (Schwaber and Sutherland, 2017, p. 7). The scrum master facilitates a daily stand-up, a sprint planning and a retrospective; protects a team, and removes impediments (https://www.scribd.com/document/385806389/CSMjsv20, 27.8.2018, p. 62)

The product owner tries to maximize a product value and manages a product backlog (Schwaber and Sutherland, 2017, p. 6). A product owner delivers the following (https://www.scribd.com/document/385806389/CSMjsv20, 27.8.2018, p. 64):

- The right product set to excite customers at the right time to maximize the business value
- Responds to a change faster than competitors
- Clarifies customer needs to a development team so that there won't be any uncertainty and the velocity of developers is maximized
- Responsible for winning the market

The development team has professionals who can deliver a potentially releasable increment of "done" product at the end of a sprint (Schwaber and Sutherland, 2017, p. 7). It is a cross-functional, a self-organizing, a self-managing, a collaborative team which has up to 9 members (https://www.scribd.com/document/385806389/CSMjsv20, 27.8.2018, p. 67).

Artifacts of a scrum which are a sprint, a product backlog, a sprint backlog and a user story should be applied in an appropriate way to satisfy customers.

Potineni et al. (2013) state that a sprint is a basic scrum unit used for developing and implementing a product release which can last up to one month. They (2013) add that a sprint outcome is an implementation of a user requirement as the form of a usable, a functional, and a visible release (Alsalemi and Yeoh, 2015, p. 189).

A product backlog which is one of the central document in a scrum includes a prioritized list of items of a certain product including requested enhancements, bugs, technology upgrades, competitive product functionality, and competitive edge functionality (Schwaber, 1995). Teams

which participate in software development process can maintain their development sprint backlogs. Requirements from a development team are on its development sprint backlogs. Each requirement is decomposed into tasks assigned to its members (Vlaanderen et al., 2009, p. 2).

A sprint backlog is a product backlog item for a sprint and a plan to deliver a product increment and realize a sprint goal (Schwaber and Sutherland, 2017, p. 16).

A user story is a story explained by a user to specify how the system should work. It is written on a card and its complexity permits an estimation of a duration to implement (https://www.scribd.com/document/385806389/CSMjsv20, 27.8.2018, p. 114).

Scrum events which are a daily scrum, a sprint review, and a sprint retrospective are as follows:

Events of a scrum minimize meeting needs in a scrum and create regularity. These events are time-boxed events which have maximum durations. The duration of a sprint is fixed. Remaining events may end when an event achieves its purpose to ensure that an appropriate time is used in a process. A daily scrum which is a 15-minute time-boxed event of a development team is held each sprint day to plan the work for the next 24 hours. The development team applies a daily scrum to inspect a progress of a sprint goal to complete the work of a sprint backlog. A sprint review is applied at the end of a sprint for inspecting an increment and adapting a product backlog. Stakeholders and a scrum team collaborate about an achievement in a sprint during a sprint review. A sprint retrospective helps a scrum team for inspecting itself and preparing a plan for improvements during a next sprint. It happens after a sprint review and before a next sprint planning. It is a meeting that lasts at most three hours for one month sprint (Schwaber and Sutherland, 2017, pp. 9-14).

STAGES OF SOFTWARE PRODUCT MANAGEMENT

Stages of software product management starts with a vision which initiates a product backlog which is an input of a product management sprint backlog with bugs. A product management sprint backlog is an input of a product management sprint which forms a retrospective knowledge and an updated product backlog.

A process's input is in an idea for a new functionality to intiate a process as a vision form. During sprints, this vision is redefined many times. Software product management teams choose product backlog items and add them on their product software backlog (PSB), after PSB tasks are performed during a sprint. A product backlog's updated version is used to develop software. Sprint review meetings are held at the end of each sprint, new knowledge is gathered for improving a process. The figure includes bugs of earlier versions. These form another way to generate product backlog items and are placed on a product backlog instead of following a path through the requirements refinery. Everyday starts with a scrum meeting where a previous day is discussed. This session is done for improving an effectiveness and a productivity of software product management team. Some of potential improvements can be discussed to avoid problems in the future. The end result of an agile software product management sprint which lasts between two and six weeks includes definitions of requirements used by development teams. The lengths of a sprint and development sprints are same to synchronize a product management and a

development process. A structuring of a workflow into sprints and scrums facilitates an agile software product management to handle customer demands. New items can not be added to the PSB when it is finalized at the beginning of a sprint. Thus, software product management team may focus on its work without being disrupted (Vlaanderen et al., 2009, p. 3).

AN EXAMPLE FROM MICROSOFT GLOBAL AND MICROSOFT TURKEY ABOUT SCRUM MANAGEMENT

Aaron Bjork who is a program manager (PM) of Microsoft is working on the Team Foundation Server Process Team, asks and answers the question as follows: "Why would anyone consider an agile approach? It's clear the rules of engagement around building software have fundamentally changed in the last 10-15 years. Many activities look similar, but the landscape and environments where we apply them are noticeably different." As he has stated, the rules have changed and companies in the world adapt their approaches to develop software. Agile methods and practices may not solve every problem but they establish an organizational environment and a culture where solutions emerge through continous learning, planning, collaboration and desire to develop high quality software more often (Bjork, 2017). As Bjork (2018) mentioned, the following key changes were decided to make the development and shipping cycles healthy and efficient: Changing the culture, changing the approach to teams, changing the planning and learning approach, and creating new ways to stay healthy (Bjork, 2018A).

Lori Lamkin who is the Director of Program Management for Visual Studio Cloud Services explains that Microsoft perceives the agile transformation as a journey of continuous evolution and learning on the way. It wasn't a straight line to get from A to B, nor is B the end. This is changing the responsibilities, rules for developing, testing and ops (Lamkin, 2017).

Changing the Culture

Since the key motivators for people are autonomy, mastery and purpose, Microsoft targets to bring them to PM's, developers and designers to make them feel empowered to build right things. The company considered two specific items for an approach (Bjork, 2018A):
Alignment: It happens from the top to the bottom, ensures people understand what Microsoft is going to do and why people are lined up on business goals, aspects, and try to do what is being done.
Autonomy: It happens from the bottom up, ensures people come to work every day and feel that they have a big impact on day-to-day activities and decisions

Lamkin (2017) highlights the importance of a team autonomy and an organization alignment by mentioning "letting go" which means letting the teams run with their own backlogs and plans and align them.

Changing the Approach to Teams

Microsoft started to think about teams more than individuals in visual studio team software and organized people and teams in two groups as PMs and engineers (Bjork, 2018A):
PMs: Responsible for what the company is building and why it is building this.
Engineers: Responsible for how the company is building and committing the quality.

The general characteristics of teams are as follows (Bjork, 2018A):

- Cross discipline
- 10-12 people
- Self-managing
- Clear goals for 12-18 months
- Physical team rooms
- Own features in production
- Own deployment of features

The critical point here is delivering and shipping features continuously (Lamkin, 2017).

Microsoft implements guidelines in certain tiers to ensure a uniformity across the product among teams and then let teams own their areas end-to-end in the product. Almost every 18 months, Microsoft practices the "yellow sticky exercise" which is an activity in which developers can choose product areas they are interested in and would like to work for the next planning periods. This exercise provides teams with autonomy to choose what they work on and helps the organization with an alignment as it makes sure there is a balance among teams. At the end of an every sprint, all teams send mails explaining what they have accomplished in the previous sprint and what they have planned to do in the next sprint (Bjork, 2018A).

Changing the Planning and Learning Approach

Engineers and PMs are responsible for sprints and plans while the leadership is responsible for seasons and strategies. This planning structure helps to maximize learning while doing planning. Team members can get feedback, deploy, find out expectations of customers and implement them quickly and efficiently (Bjork, 2018A). Planning is broken down as follows (Bjork, 2018A):

- Sprints (3 weeks)
- Plans (3 sprints)
- Seasons (6 months)
- Strategies (12 months)

Creating New Ways to Stay Healthy

Before, team members would let code bugs build up until the end of a code phase (the "code complete). Then, they discover them, fix them, rinse and repeat. This created a "roller coaster" of bugs, and as the number of bugs dropped, so did team morale as they did nothing but worked on bug fixes instead of implementing new and fun features. Microsoft implemented the approach “bug cap”, which means if a team's bug count exceeds the bug cap at the end of a sprint, team members stop working on new features until they are back down under their cap. Teams can focus and assist with an interrupt culture in the form of bugs and live-site incidents. Teams will self- organize itself each sprint into two teams: Features (F-team) and Shielding (L-teams). The F-team works on committed features and the L-team deals with live site issues and interruptions. The rotating cadence is established by the team and allows members to plan activities outside work easier (Bjork, 2018A). Bjork (2018A) summarizes what Microsoft accomplishes after applying agile practices to its workflow in Table 1:

Table 1. Microsoft Performance Before and After Agiler Practices

Before Agile Practices	After Agile Practices
4-6 months milestones	3-week sprint
Horizontal teams	Vertical teams
Personal offices	Team rooms
Long planning cycles	Continual planning and learning
PM, development, test	PM and engineering
Yearly customer engagement	Continual customer engagement
Feature branches	Everyone in master ?
20+ person teams	8-12 person teams
Secret roadmap	Publicly shared roadmap
Bug debt	Zero debt
100 pages spec documents	Specs in power point
Private repositories	Open source
Deep organization hierarchy	Flattened organization hierarchy
Success is a measure of install numbers	User satisfaction determines success
Features shipped once a year	Features shipped every sprint

Resource: Bjork (2018A)

Senior Program Manager Hellem (2017) gives examples how agile practices improve the team learning cycle:

- A team delivers value to the customer, receives feedback, and modifies its backlog based on it.
- Team members know that their automated builds are missing key tests to include work in their next sprint to address it.
- They realize that some features perform poorly in production and plan to increase performance.
- A team member learns a new practice and the team tries it for a few sprints.

Microsoft has taken a bigger step on its agile journey by changing the physical environment for supporting the process changes. Individual rooms have been moved in most of the divisions into a building which has team rooms. Microsoft redesigned the building to express the agile mindset as 10 to 15 people can be physically together to work across disciplines-program management, development and test-in one space. Standups are made in the room instead of gathering in a hallway or a conference room. Desks are on wheels, so teams can re-organize without overhead. The space fits the team. Team rooms have conference rooms and focus rooms for private conversations (Bjork, 2018B)

The President of Turkey Software Quality Association Koray Yitmen acknowledges that 63% of companies in the software development lifecycle (SDLC) methodology selects the scrum approach based on Turkey Software Quality Report 2018 published by Turkey Software Test and Quality Association. He mentions that the most popular software development

methodology scrum is preferred by finance, e-commerce, telco and hi-tech companies whereas traditional models such as waterfall is preferred by finance, insurance and defense companies (Computerworld Turkey, 2017). Right conditions for an agile for Bain and Company are summarized in Table 2.

Table 2. The Right Conditions for an Agile

Conditions	Favorable	Unfavorable
Market Environment	Customer preferences and solution alternatives change frequently.	Market conditions are predictable and stable.
Customer Involvement	Close collaboration and fast feedback are feasible. Customers know better what they want and when the process progresses.	Requirements are clear and remain stable. Customers are not available for constant collaboration.
Innovation Type	Problems are complex, solutions are not known, and the scope isn't defined. Product specifications can change. Creative breakthroughs and time to market are critical. Cross-functional collaboration is essential	Similar work is done before and innovators think solutions are clear. Specifications and plans can be forecasted with confidence and should be applied. Problems are solved sequentially in functional groups.
Modularity of Work	Incremental developments have value and customers may use them. Work can be broken into parts and conducted in iterative and rapid cycles. Late changes can be managed	Customers don't start testing product parts until everything is done. Late changes are impossible or expensive.
Impact of Interim Mistakes	They may provide valuable learning.	They can be catastrophic.

Resource: Rigby, Sutherland, and Takeuchi (2016)

Burak Yavuz who is a Certified Scrum Master since 2014 and works as the Digital Architecture Advisor at Microsoft Turkey Services shares his experiences about why and how the enterprises decide to start agile transformation. There is an increasing competition in a sector. Products and services offered to customers and technologies used are changing very quickly. It is more critical to adapt this change with new approaches. Yavuz highlightes that companies are driven by more requirements and quality and that's why they need to improve their efficiency and productivity. An innovation is associated with the meaning of an agility for a company. Companies need to make innovations not only in new services and products, but also in functional processes. Creating an environment to apply an agile approach accelerates innovations is the reason why a global trend exists in sectors to adopt an agile approach. The Agile Manifesto intervenes in processes and tools, works on a comprehensive software, a customer collaboration on negotiations, and individuals changing their plans. Agile strategies help to accelerate a profit growth by putting individuals in self-directed and customer-oriented multidisciplinary teams after taking them from their functional groups. An agile is more than a software development approach due to providing capabilities to respond customer needs quickly, and adapt to changing and unexpected market conditions. Yavuz explains an example where customers and project members work closely together on a daily basis, deliver their projects in an incremental way rather than a big-bang format as long as critical designs are decided earlier and design elements are evolved during the project life cycle. Yavuz mentions

the importance of starting with minimal viable products such as transformational approaches to increase the learning curve's speed. Yavuz explains basic subjects about changes companies have with agile transformations such as having experiences to do business differently, increasing awareness about an agile, gaining value-oriented perspective to understand products, business teams and technology teams much better and form common goals to have a better project visibility, increase a team efficiency, accelerate a delivery and manage changing priorities. Yavuz highlights that discrete and focused product features should be decomposed further. Product backlog items can be implemented in sprints which are few weeks. Yavuz emphasizes that a minimal viable product can be implemented in 10-12 weeks at the beginning if a customer focus is retained and a small but an efficient autonomous team can be established. It is important to define specific needs in simple situations to create innovative products or solutions. He mentions defining a problem or a requirement includes having metrics quantifying the scope, magnitude and impact, classifying how users perform a mission where challenges exist for enabling technology and process and determining real problems. A customer, a product owner and developers work collaboratively to design, implement and ship a minimum viable product in 10-12 weeks parallel to the vision. These approaches allow a company to create a pipeline of challenges to be addressed in the long term and implemented iteratively. Yavuz shares his experiences about how this rapid implementation creates measurable quick values instead of spending too much time, money and effort; and how it helps leadership to make decisions quickly about where, when and how to apply. Finally, Yavuz indicates the importance of a continuous learning in innovation and transformational strategies. Learning about own problems, which solution is working and which is not, which technique can be engaged, which can not be, how operational environment is processing, and how it is adapting are important steps to satisfy the company growth (Yavuz, 2018).

CONCLUSION

The purpose of this paper is to explain a scrum management and present examples related to a scrum management in Microsoft Global and Microsoft Turkey to attract attentions of management scholars to this new team oriented management approach. Microsoft which is a leading company in software development sector has applied a scrum for many years successfully. Learning its experiences can make contributions to software development sector to expand and enhance applications of a scrum. It is expected that management scholars can figure out adaptations of a scrum in different sectors as well. Thus, this paper is expected to make contributions to both scholars and companies to understand and get the advantage of a scrum.

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Public Sector, Not for Profit, and Healthcare Management

A COMPARISON OF HUMAN TELEMEDICINE AND ANIMAL TELEMEDICINE

Oral

Mr. Jason Jacoby [1]***, Dr. Gary Hackbarth*** [1]

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Videoconferencing has long been used as an effective tool in Healthcare to betterserve both patients and doctors in order to be able to provide higher qualitycare when face-to-face communication is difficult or time critical. Video conferencing is now being used by Veterinariansto lower costs and provide higher levels of care to their animal patients. We found that companies tend to focus ontheir specific markets without overlap using similar technologies.

Adolescents' Exercise Motives Impact on Use Adherence of Wearable Technology

Regular Session

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Wearable technology devices have become extremely prevalent, however sustained long-term use and adoption is still an issue. Furthermore, adoption and use vary by age group. Understanding age characteristics associated with adoption and use of wearable technology devices is key. This study investigated exercise motives and their influence on sustained use of wearable technology amongst adolescents. Sixty-five high school students (juniors and seniors) took part in the study. Participants received Fitbit activity trackers as a means of exercise persuasion. At the beginning of the study, participants completed an Exercise Motivation Inventory (EMI-2; Markland & Ingledew, 1997) and baseline exercise behaviors and motives were established. Use of the Fitbit enabled the electronic collection of participants' daily activities. A web-portal tracked and captured participants' compliance to use and wear the Fitbit device. Via a dashboard, or downloaded file, a "last sync" date provided evidence regarding participant use and compliance. Data gathering occurred for a duration of three months. The research team was in frequent contact with participants to encourage sustained involvement. Two statistics tests were used to analyze the data in the study; an Anderson-Darling Normality Test and Pearson Correlation. The results revealed that sustained usage was not consistent amongst adolescent participants and that a correlation existed between exercise motives and the sustained use of wearable technology.

DO PROPERTY OWERS LACK A FEDERAL REMEDY FOR ALLEGEDLY BEING DEPRIVED OF EQUAL PROTECTION, BECAUSE THE LOCAL ASSESSMENT CHARGED BY THE TOWN IS A "TAX" FOR PURPOSES OF THE TAX INJUNCTION ACT?

Oral

Dr. Brad Johnson [1]

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"It is abiding truth that 'nothing can destroy a government more quickly than its failure to observe its own laws, or worse, its disregard of the charter of its own existence.' " *Oregon v. Hass,* 420 U.S. 714, 724-25, 43 L. Ed. 2d 570, 95 S. Ct. 1215 (Brennan, J., dissenting (quoting *Harris v. New York*, 401 U.S. 222, 232, 28 L. Ed. 2d 1, 91 S. Ct. 643 (1971) (Brennan, J., dissenting))).

The primary purpose of this article is to enhance the awareness of property owners that they may not have a federal remedy for an unconstitutional local assessment or fee, illegally charged by a local government, because such local assessment or fee is a "tax" for purposes of the federal Tax Injunction Act. In this instance, pursuant to the federal Tax Injunction Act, the federal District Court lacks subject matter jurisdiction to hear the case of said property owners, even though such property owners have been deprived of Equal Protection as guaranteed by the Fourteenth Amendment to the U.S. Constitution. As such, these property owners are precluded from having a federal remedy by the federal Tax Injunction Act, having been relegated to whatever state remedy exists, even if thin or insubstantial.

In this regard, the instant article has significant public interest.

In a case study approach, the three primary objectives of this article are to:
(1) establish the facts of the case study, i.e., *Cashwell et al. v. Town of Oak Island, et al.*(Case No. 7:18-cv-109 E.D.N.C.), wherein the Town of Oak Island, N.C. effectively charges a Sewer Treatment Fee to only owners of undeveloped property;
(2) establishthe clearly established law at issue, i.e., the federal Tax Injunction Act; and
(3) apply the law at issue to the facts of the case studyfor the purpose of identifying the U.S. constitutional implications for owners of undeveloped property being charged an illegal fee.

This article argues that if these objectives are met, the facts of the case study will have revealed that there are exceptions to the application of the federal Tax Injunction Act. In this regard, the instant article has significant public interest not only for **property owners facing an illegal local assessment or fee**, but also for any person associated with the legal or educational community.

Impact of HCAHPS Scores on Hospital Readmission Rates

Oral

Dr. Christie Chen [1], ***Dr. Tommy Cates*** [1], ***Mr. Christopher Cates*** [2], ***Mr. Clint Taylor*** [1]

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In 2013, the Centers for Medicare and Medicaid Services (CMS) began withholding a percentage of revenue received by lower-rated hospitals. CMS ties hospital reimbursement rates to quality metrics thus forcing hospitals to improve their service or risk financial penalty. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient satisfaction survey is an instrument developed by the CMS and the Agency for Healthcare Research and Quality (AHRQ) as part of a standardized process for reporting of patients' perception of care. HCAHPS results have been publicly available since 2008. Moreover, hospital value-based purchasing (VBP) is designed to financially incentivize acute-care hospitals to improve their performance on several quality measures. The hospital VBP program utilizes the HCAHPS survey nationally as a key measure of patient satisfaction. Almost 20% of Medicare recipients who are discharged are readmitted within 30 days. Since 2012, the Medicare Hospital Readmissions Reduction Program (HRRP) has sought to decrease the 30-day readmission rates for Medicare patients. Hence, the information provided by patients on the HCAHPS survey directly affects provider revenue. The objective of our study is to determine if the HCAHPS survey impacts readmission rates and payments as originally intended to improve patient quality. Moreover, excessive readmission rates may negatively impact reimbursement payment to healthcare providers. Our results indicate that data provided from the Hospital Compare database for acute-care hospitals indeed reflects quality outcomes. Thus, higher HCAHPS scores led to lower readmission rates. Nevertheless, when patients reported lower quality service measures via HCAHPS scores, the hospital reimbursement did not reflect financial incentives or penalties.

Predicting Midterm Election Results

Oral

Dr. Ajay Aggarwal [1], ***Dr. Frank Smith*** [2]

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News anchors often suggest the outcome of US presidential elections based on gallop poll data. Many researchers have offered their predictions based on economic, political, financial and other factors. Compared to the significant research efforts devoted to forecasting presidential elections, models for midterm elections have been largely ignored. Using 36 years of stock market data, coupled with key economic performance data, midterm-election results, presidential and congressional ratings, the authors suggest a modeling approach for predicting midterm elections, and use it forecast 2018 results.

Procurement Auctions with a Cost Disadvantaged but Information Advantaged Bidder

Oral

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1. *University of South Carolina*

We conducted laboratory experiments to compare the bidding behavior and profitability of two types of procurement auction bidders: 1. Bidders with high costs but more information about their competitors, and 2. Bidders with low costs but less information about their competitors.

A COMPARISON OF HUMAN TELEMEDICINE AND ANIMAL TELEMEDICINE

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ABSTRACT

Video conferencing has long been used as an effective tool in Healthcare to better serve both patients and doctors in order to be able to provide higher quality care when face-to-face communication is difficult or time critical. Video conferencing is now being used by Veterinarians to lower costs and provide higher levels of care to their animal patients. We found that companies tend to focus on their specific markets without overlap using similar technologies.

INTRODUCTION

Technology is advancing day by day to make communication and connectivity between various places more and more efficient. Telemedicine is a big technological advancement within the healthcare field that opens up more opportunities for patients and healthcare providers. Telemedicine is essentially the use of multiple types of technology for patients to interact with physicians and physicians to interact with each other from separate locations. With the spreading of telemedicine, access to medical care is created in rural areas throughout the world, more specifically, the southeast United States. Increasing the distribution of services throughout all areas, will increase accessibility and the overall quality of healthcare.

The healthcare industry is made up of not only human medicine, but veterinary medicine. Veterinary medicine is not far behind with technological advancements in monitoring and diagnosing illnesses and injuries in animals. With the human telemedicine market growing, the veterinarian telemedicine market is following in its footsteps. Trends and technological advancements within each division can be observed and compared. In this paper we look at the similarities between human telemedicine and animal telemedicine.

Future sections provide a background discussion, data collection of company information, analysis, results, and conclusions. We conclude with limitations and future directions.

BACKGROUND

Telemedicine dates all the way back into the early 1900s with the development of equipment like the telephone and the radio. Both radios and telephones were used during the world wars for doctors to communicate back and forth between bases about casualties and illnesses on the battlefields [1]. This was then brought back over to the United States and used in states like Alaska in order to transmit medical info back and forth between rural areas. The radio was a way that epidemic outbreaks could be broadcasted to people around the nation.

The first use of telemedicine in a clinical setting as we know it today came around the 1950s with the invention of the television. Video telecommunications began being used shortly after, and the first telemedicine communication system via television was established in 1967 [1]. Once the link between medicine and telecommunications was established, the government stepped in and provided funding to implement, research and develop telemedicine programs throughout the country. It is estimated that over 900 rural health care facilities in 40 states are involved in telemedicine projects [7]. The Medical College of Georgia has grown one of the largest telemedicine programs that connects over 60 locations [24].

The growth of these programs was associated with multiple factors. The main one being that it is hard for elderlies or disabled to get to appointments [18]. When patients are no longer able to drive themselves to and from appointments, organizing transportation becomes a hassle. Not only is it a burden, but the transportation can often be unreliable. This leaves patients frustrated because they may be late for appointments causing them to have to wait longer or even getting hit with no show fees depending on the time they arrive. Other factors include overcrowding and convenience.

Some patients have a negative connotation associated with seeing doctors. They dread going which causes them to have bad attitudes when they arrive. This can easily escalate a situation if the patient is frustrated with waiting times or results of why they are there. The average wait time at a primary care office is around 33 minutes before the patient is called to a room and then an average of 24 minutes until they see the physician [19]. With telemedicine, the patient never has to endure the troubles of going to the office, waiting in the waiting room, then sitting in the room waiting on the doctor to come in. The appointment times are set and the patient just needs to be sitting by their computer or communication device waiting on the doctor to join.

The goal of these early programs was to connect physicians to not only patients, but also to other physicians and health care facilities in remote areas. This made rural areas the main focus of telemedicine when being developed. The first program mainly focused on radiologists in rural hospitals. The x-rays would be transmitted to a radiologist over thirty miles away through telephone wires. The radiologist would examine the x-rays, make a diagnosis and then report that diagnosis over the phone to physicians at the original facility. The time in which these services were performed through the telemedicine system was equivalent to the same amount of time if a

radiologist was on premises.

Much like human telemedicine, animal telemedicine is traced all the way back to the beginning days of the telephone. Rural farmers and veterinarians were trying to find easier ways to keep an eye on cattle and increase their overall well-being. Though this technology was started to be used on cattle, there were no real established projects with veterinary telemedicine until the 1980s when electrocardiogram transmitters were used to connect veterinarians across the nation to cardiologists at the Animal Medical Center in New York [8]. Since then, more projects are being developed and research is being done to improve animal telemedicine across the globe.

The evolution in technology in telemedicine is comparable between animals and humans. Telemedicine in both human and animal sectors began with just the basic radio, telephone and television. The components of any area of telemedicine involves a sender, person sending the information or signal, the medium, transmits the signal, and then the receiver, receives the information [8]. Information such as patient demographics, diagnoses, imaging and even prescriptions can be sent via various mediums to create an infrastructure between health care providers and facilities. With technology advancing, more mediums and monitoring devices are being used. For example, sensors are being used for constant monitoring, tools with real time data are used for consultations and data is being analyzed for patterns of certain illnesses.

TELEMEDICENE TECHNOLOGIES

Most of the monitoring devices involved in Telemedicine are sensors. Specifically, for animals, a new branch of science called Animal-Computer Interface is being developed to focus on bridging the gap of communication between animals and humans. The Animal-Computer Interface or ACI is a fancy way of describing the use of technology to connect animals to a database for continuous monitoring [3]. Kansas State University is developing a monitoring system in order to improve the technology infrastructure and improve the health of livestock on remote or rural farms [2]. A wireless infrastructure is a challenge to make in order to track and monitor animals, but it is being worked on by engineers as we speak. In order to achieve this feat, a real-time Bluetooth sensor is attached to animals in order to send data to an off-site server for analysis. The sensors are able to monitor the animals' body temperatures, heart rates, blood oxygen saturations, and also the animals' movements and respiratory rates [4]. Through these numbers, the animals can be monitored around the clock in order to study behavior patterns, illnesses and overall health of the farm animals. With this data, veterinarians can study the numbers and find patterns or behaviors that correlate with certain illnesses and diseases. These can then be used for preventative measures and early diagnosis.

Through the use of these Bluetooth-compliant sensors, veterinarians are able to monitor and track the animals from separate locations and do not need to be there in person to check on them. Cattle and livestock can now have a better overall health with 24/7 surveillance. Disease onset

can be picked up at a faster rate by tracking the animals' numbers. Veterinarians can detect the issues faster and be able to travel to these farms in time to save lives or treat something before it's too late. Veterinarians do not have to waste trips to farms and can just travel on an as needed basis.

Some other technology paired with the sensors includes accelerometers on the heads of farm animals. The accelerometer is used to detect head positioning. Through the use of this technology, data can be gathered about feeding patterns of farm animals. It has been proven that the length of feeding time and frequency of feeding, has a positive link to the health of the animals [4]. If an animal is moving less and eating less, it is most likely getting ill if it isn't ill already. The data sent to the offsite tracking system could be used to detect the behavioral changes immediately. This cuts down the diagnosis time down from days or weeks to just hours. The proper steps for the animals to be seen by a vet can be activated immediately and a disease outbreak may be reduced or even prevented all together.

Data collected by individual farms can also be sent to a larger scale and shared nationally [4]. These numbers can be sent out for study and possibly used to create protocols for future outbreaks. Farmers can be educated on what to look for so veterinarians can be notified immediately. Numbers from other areas of the nation can be compared and contrasted in order for health providers and farmers to better understand certain behaviors and patterns.
In humans, sensors of various forms can be used to track the same parameters as animals. Holter monitors can send doctors an ECG in real time. Bracelets can be used to track respiratory rates and activity levels. Sensors placed on a finger of your hand can detect your blood oxygen saturation. Bluetooth technology has now also allowed scientists to create pacemakers that can send doctors alerts if a patient's heart needs to be shocked back into rhythm. All of this data gets collected electronically and placed into the patients' medical files. It is reported that 34 percent of healthcare organizations use remote monitoring as compared to 31 percent use video-based [7].

Smart home technology is being established in rural homes where the needed health attention is sometimes not that convenient. Smart home technology is the same concept as animals with the Bluetooth sensors [18]. The house is equipped with multiple different types of sensors. The doorways have magnetic switches that pick up entry and exit of the patient. Accelerometers are used on chairs and flooring in order to pick up a fall of the patient. Microphones are spread throughout the house to pick up cries for help. Grab bars with pressure sensors to measure balance. Video cameras are even placed strategically in the house as to not disrupt privacy, but to still monitor the patient enough in case a situation happened such as a fall.

The patient wears sensors to pick up the overall health by monitoring vitals. The data collected includes heart rate, electromyogram for muscle activity, blood pressure and even GPS for location of the patient [18]. The data can then be compared between the house sensors and the patient to detect patterns in vitals, mobility and behavior. Like animals, these can be examined to

find any problems in their early stages. The data is analyzed and compared between patients with the same diseases so that patterns can be picked up and saved. These patterns can be useful in the help of diagnosing patients just by reading their vitals and sensor data [20].

Telemedicine was also implemented into the space program through NASA so that doctors could monitor the astronauts in training and on missions in space [1]. The Space Bridge Project was developed specifically for astronauts on missions [20]. Satellite technology was used to provide consultations when needed. Physiological functions that were monitored when the astronauts were in space included blood pressure, heart rate, temperature and respiration rate. Emergency diagnoses and treatments could be relayed from the ground into space if needed. Showing that distances are not an issue for telemedicine can give scientists and researchers confidence that the wireless infrastructure of medicine is growing towards a better quality of life for even the most remote patients and healthcare clinics in rural areas.

Veterinarians who use telemedicine need to make sure that they are complying with laws and regulations. The biggest aspect of these rules and regulations is the formation of a veterinarian client patient relationship or a VCPR. The VCPR is basically the first meeting between the veterinarian and the animal., the initial exam The federal government turned the decisions over to state law to decide. Many states like Texas, Tennessee, Utah, Georgia, Illinois, Iowa, Mississippi and Washington will not allow the VCPR to be formed over electronic means. States that do not require a VCPR before an animal can be treated are Washington DC, Alaska and Delaware [6]. Practicing on an animal in a state where a VCPR is required for telemedicine can land the veterinarian in serious trouble.

In human medicine, the doctor-client relationship is the equivalent of the VCPR. 48 states approve that this relationship may be established digitally [9]. The only two states that are opposed are Alabama and Arkansas. With human telemedicine advancing faster than animal telemedicine, many states are beginning to wonder why they can’t establish a VCPR digitally like their human counterparts. Human telemedicine used to not be this way. A few decades ago when telemedicine was still becoming established, all 50 states were opposed to a digitally established doctor-client relationship.

The biggest indicator of whether the doctor-client relationship is effective is through patient satisfaction. Satisfaction can be defined as the patients’ views of the processes and results of their overall experiences [11]. Through multiple studies done using qualitative surveys between patients using a telecommunications method and a face to face method, data can be reviewed and compared [10]. The results showed the advantages and disadvantages of using telecommunications for consultations. Some of the reported advantages were that it saves travel and wait times and also increased networks to specialists. The only disadvantages reported were with communication which related back to the communication medium used [10].

The University of California Davis Telemedicine Program did a similar study within the UC Davis Health System to examine rural hospitals and their use of telemedicine. There were 2,472 hospitals surveyed and only 499 used some classification of telemedicine. Of the 499 rural hospitals that used telemedicine, UC Davis randomly selected 1,000 consultations to be done digitally. The satisfaction rates were higher for the patients that had more of an interview-based consultation than a consultation that involved the use of other medical equipment [12].

Overall, the patients were satisfied with their teleconsultations with the various physicians. The data studied showed that telemedicine consultations were possible which changed the views of the doctor-client relationship being established digitally. While most patients said that they would continue to use telemedicine in the future, some stated that they preferred a face to face visit with a physician [11].

While human telemedicine tends to grow with doctor-client relationships, animal telemedicine must get around state legislators and the wording of the practice acts. Key words like “face to face”, “examined the animal” and “has seen… within 12 months” are preventing VCPRs to be established digitally [6]. The wordings from state to state would need to be modified to have the words digital or electronic included. Once a few states adapt their practice acts, the FDA would most likely conform and evolve their rules with animal prescriptions as well.

There are many different settings where telemedicine takes place in both animal and human telemedicine. In human telemedicine, there are various settings and locations where telehealth is used. The main locations are hospitals, physician offices, rural health clinics, dialysis centers and mental health centers [13]. Within these locations, the parties involved, physicians and health care providers, must remain within their scope of practice and follow all legal aspects. Apps and software platforms have been developed to allow patients to be seen from home through certain insurance based programs.

Animal telemedicine originated in rural farms such as cattle farms and equestrian stables with a veterinary office receiving the data to monitor the animals. The vet would examine the numbers to get a good read on the animals’ states of health. Not only can livestock and cattle be monitored, but normal house pets too. Like humans, through the use of video, audio and Bluetooth technology, apps are being created in order to help household pets get 24/7 care and monitoring when needed [5].

DATA COLLECTION

In order to better understand the video conferencing industry, we searched the internet for videoconferencing companies. We tried to list and categorize categories of services and capabilities with the intent to identify services and capabilities that might be shared or common to both human providers and animal providers of videoconferencing services.

RESULTS

Table 1

Televet	VetSource	Anipanion
Vet Capabilities	**Vet Capabilities**	**Vet Capabilities**
Price flexibility	ePrescribing	Appointment Notification System
Appointment Notification System	Medication reccommendations	Video/audio capabilities
Phone/computer app	Petmail marketing program	Electronic Medical Records
Instant Messaging	Prescription delivery	Clinic Marketing
After-hours care	Nutrional Products	Diagnosis and treatment plans
Remote diagnosis and treatment plans	Video/audio capabilities	Phone/computer app
Video/audio capabilities		
Pet Owner Capabilities	**Pet Owner Capabilities**	**Pet Owner Capabilities**
Sets appointment time	Find a vet	Easy scheduling
Adds explanation of illness	Request Prescription Refills	Video/audio capabilities
Can upload pictures of issues	Check Order Status	No payment due until appointment is completed
Video/audio capabilities	Reminder of heart medications	24/7 tech support
Instant Messaging	Update Payment Information	
Upload medical records	Video/audio capabilities	

There are various telehealth software providers that sell their platforms to various physicians and healthcare facilities around the nation. Most of them all have the same general features. If you look above at table 1, you can see a few of these veterinary telemedicine platforms and the capabilities of each for the vet and the pet owner. Most of the platforms and dashboards have the same capabilities such as video and audio, instant messaging, easy scheduling and access to medical records. The basics of the platforms involve the patient or pet owner to set an appointment time. They are then able to log in at that set time and speak with a veterinarian. For Televet and Anipanion, the veterinarian gets a notification when the pet owner logs in, so they can remember to join the appointment.

The company in the chart above that stands out is VetSource. VetSource allows for access to prescriptions and nutritional products. In order to stand out in the market of veterinary telemedicine, VetSource developed a niche. Another cool feature on the pet owner side of the platform is that it reminds you when to order or renew your prescriptions. This is very useful for pet owners who have a habit of being forgetful.

Table 2

Secure Telehealth	Avizia	AdvancedMD
Physician Capabilities	**Physician Capabilities**	**Physcian Capabilities**
Secured Connections	Phone/computer app	Phone/computer app
Video/Audio capabilities	Multiway video/audio capabilities	Video/audio capabilities
Virtual Waiting Room to see patients	EMR accessible	Instant Messaging
Note taking	Instant Messaging	EMR accessible
Appointment Notifications	Can snap photos	Billing portal
Mac/PC capable	Can invite more patients to meeting	Schedule Management
Cloud-based storage		Prescriptions
Patient Capabilities	**Patient Capabilities**	**Patient Capabilities**
Sets appointment time	Set appointment time	Video/audio capabilities
Video/Audio capabilities	Co-pay Management	Prescription Renewal
Waits in virtual waiting room	Ability to review physicians	Online Bill Pay
	Image Sharing	Set Appointments
	Pharmacy selection	Instant Messaging
	Medical History editing	Fill out patient forms

Table 2 displays some of the human based platforms and their capabilities. Like the veterinary platforms, these all have very similar components that are utilized for the physicians and the patients. The video and audio capabilities allow physicians and patients to communicate in an efficient manner. The patients' records and medical history are accessible for doctors to view and patients to edit. Instant messaging is available if the video and audio is down. When appointments are scheduled, the patients can log on and wait in a virtual waiting room. The doctor can then see the patients in the waiting room and select the patient when the physician is ready.

AdvancedMD is by far the most advanced and easiest portal to use. The components that set them apart from the rest are the billing portal, schedule management, patient forms and even a more advanced instant messaging system. The billing portal allows the patient to pay online when the bills come through. Instead of waiting for it to come through the mail and then the long process beginning of paying and processing, you can just type your card information into your account and it pays. The schedule component is all done online. You are able to log in and pick the most convenient time for you. Most of the other softwares make you call into the office in order to schedule. Another component is the easy ability to fill out or edit your patient forms. Once you make an account, your portal will display all your patient forms which can be edited within seconds. Lastly, the messaging system. If you have a question, but do not feel the need that it is worth making an appointment for, you can just message the doctor a question. The question will then show up on his portal and he can answer it when most convenient.

If you compare both the animal and human platforms, they cross over the same capabilities. For example, the video and audio capabilities, instant messaging, access to medical records,

prescription management, billing, abilities to send pictures for questions and scheduling. There are more similarities than differences between these platforms. These are just a few of the platforms available.

If you look at table 3, you will see a breakdown of some of the other platforms. Looking at the human providers, TelaDoc was founded the earliest back in 2002. They have over 3100 employees, which includes licensed physicians. The second biggest size is iCliniq which has over 2500 employees. All of these human options are easily accessible and have platforms that check insurance eligibility for coverage. In the animal industry, the laws and practice acts are still squeezing vets and patients to tighter standards. That is why some of these apps are limited for use. They are also slowly developing behind the human industry, which is why the companies are still smaller than human companies. The price ranges for the animals is a lot cheaper than the humans.

Table 3

	Animal	People	Size	Year Founded	Average Cost/visit		Location
CareClix		X		2006	Varies		Washington, DC; McLean, VA
TelaDoc		X	3100+	2002	Varies		Lewisville, TX; Purchase, NY
MeMD		X	250	2010	$57.95		Scottsdale, AZ
iCliniq		X	2500+	2011	$19.99		Walnut, CA; India
Mdlive		X	320+	2009	$59.99		Sunrise, FL
Fuzzy Pet Health	X		50+	2015	$10/month	Imited to 3 states	San Francisco, CA
WhiskerDocs	X		50+	2013	$29.99		Skokie, IL
LiveDVM	X				$49.95		Unknown

The veterinarian telemedicine companies that are in table 2 still have to follow all the laws of the VCPR. The way around this is for owners to find a veterinarian that is registered on one of the apps. They then need to go see that veterinarian for an initial, in-person, consultation to establish the VCPR. According to the AVMA, the VCPR cannot be established solely through the use of electronic means [15]. Once the VCPR is established, the pet can be seen through telecommunication devices. Exceptions to this rule are only tolerated in emergency situations [17]. This includes calls to poison control or other life threatening situations that may arise without warning.

CONCLUSIONS

In order for patients to use telehealth at home, there are certain guidelines that need to be followed. These guidelines consisted of three sections which are generic guidelines, interactive home telehealth guidelines and telemonitoring guidelines [16]. The generic guidelines consist of the patient selection criteria, confidentiality, patient/caregiver education and performance

satisfaction. Within the interactive home guidelines, the patient plan of care is discussed. This basically just states that the physicians must stay within their scope of practice and document all treatments. Lastly, the telemonitoring guidelines include how the consultations will be made and the frequency of them. This would be based off of the patients' needs and the ability of the patient to use technology.

Telemedicine is even being implemented into emergency situations like natural disasters. Banfield Pet Hospitals around the southeast used a text system after Hurricane Harvey and Irma [17]. The communication gap between owners and veterinarians was closed during the rough times when owners could not leave their houses or when strays were found. This system implemented also allowed for medical records to be accessed for shelters to check immunizations or update the conditions of newly found animals that may have been abandoned or displaced by the horrific storms that passed through.

NASA was the first company to develop telecommunication technology to aid victims in natural disasters. NASA was out to develop the most advanced natural disaster telecommunications system possible. The system had to be wireless due to the fact that disasters usually not out telephone and electrical infrastructures. Satellites offered the most effective and reliable long-distance connectivity by passing all the mock disaster tests. During the earthquake in Mexico City in 1985, NASA built a telecommunications system using a satellite that allowed the American Red Cross and the Pan American Health Organization to communicate back and forth between each other to coordinate emergency rescue operations of the most critical patients [21]. This same technology is being utilized globally for unforeseen disasters that have struck. Telemedicine Instrumentation Packs or TIPs are small tools that get delivered during rescue missions. Doctors can then be connected in and instruct the victims on medical care with the necessary tools. The TIPs is about the size of a brief case and can provide basic medical services to any location. This technology is even ready to be used in the event of a war breaking out without warning.

FUTURE DIRECTIONS

In today's world, satellites are still used, but many countries have developed web-accessible networks in order to be able to retrieve patient files and information through their respected medical platforms [21]. The U.S. Military is developing watches that can be used to monitor victim statuses during rescue mission. The Personnel Status Monitor or PSM combines GPS with physiological sensors to monitor vitals non-stop. The PSM only sends out alerts if the patient's signs diminish significantly. The PSM would then transmit a signal to a medic who could then come up with a plan for stabilizing the victim.

This same technology could potentially be used for animals too. Most natural disaster plans do not include the health and saving of pets [22]. If veterinarians took the same approach to

disasters as normal physicians, many animals could be saved. The same satellite technology has the potential to treat and take care of displaced and vulnerable animals. The PSM technology could be placed on animals before natural disasters strike in order to track down distressed animals. The signal would be sent out with the location of the distressed animal so that rescue measures could be initiated [21].

Human telemedicine is not only used in the United States, but it is used internationally. The fastest growing markets seem to be the publicly funded countries such as Canada. In the United States, government funding is pushed heavily to the underserved populations for more telemedicine based systems [23]. This includes rural areas, prisons and school medical facilities. The government is regulating the funding through grants and contracts so they decide which projects get funded. It all comes down to them seeing a "need" or demand for the systems. Telemedicine is a global market, but many issues still need to be addressed in order to work out the kinks in the system. Most of the issues that arise are with the advancement in technology [23]. Some countries are currently not capable of developing telecommunication systems. Other issues deal with the size of the programs. Some countries want to connect to other countries, while others are more interested in helping those within their own population.

The World Health Organization is actively promoting telemedicine and the development of the overall healthcare of the world. Other international places that are promoting telemedicine include Malaysia, Australia, Ireland, Kuwait, Saudi Arabia, Africa and the European Union. Growth to these other countries was made possible through the cheaper and more efficient equipment, more advanced software platforms and reimbursement opportunities. Some countries have even partnered with United States based telemedicine companies to develop their telecommunication based systems. Saudi Arabia and South Africa have adopted the services of United States physicians [24]. The rules and regulations vary by country which makes the international market a risky play.

Veterinary telemedicine is not far behind in the international scene. If you look at table 4, the table shows a variety of which international countries, including all of Europe, use both human telemedicine and animal telemedicine. With the United States and Canada leading the way with technology in telemedicine, many international programs will model themselves after these two countries [24]. The Australian Veterinary Association or AVA almost mimics and works directly with the American Veterinary Medical Association or AVMA [25]. Dr. Claire Jenkins, co-founder of Vetchat, believes that many more telemedicine opportunities will arise as technology advances.

Table 4

	Humans	Animal
United States	X	X
Canada	X	X
Malaysia	X	
India	X	X
Australia	X	X
Ireland	X	X
Kuwait	X	
Saudi Arabia	X	
South Africa	X	X
Europe	X	X

Other countries like Malaysia, Kuwait and Saudi Arabia, are so new to the telemedicine industry that they have not explored the options of veterinary telemedicine yet. The resources are just not available to certain countries for them to advance in their healthcare fields [26]. More and more private investors seem to be flocking toward the middle east so the resources will slowly be developed for telemedicine to advance. Investors seem to be more interested in the telemedicine field then the development of physical hospitals [26].

LIMITATIONS

All of the telemedicine companies that are available were not examined. The companies that were researched were not interviewed about crossing over into either the human or animal markets of telemedicine. The research was retrieved through all written articles from various resources and then compared. No field or physical research was collected in person. Lack of veterinary telemedicine research plays into the results due to the fact that it is understudied and such a new field so far.

When examining the research, there are many similarities between the human telemedicine and animal telemedicine divisions. The technology used between the two records the same data which includes the same vitals such as body temperatures, heart rates, blood oxygen saturations, and also movements and respiratory rates. The data collected is sent off for analysis so that further studies can be done to find patterns that represent certain illnesses. This can be used for further prevention and identification. The rules and regulations have developed and become more lenient for the human side. With animal telemedicine following within the trend of human

telemedicine, we can expect to see changes with the VCPR within the next few years.The software platforms between the two can easily be swapped in and out for one another. They both include all the patients' information, previous history and current treatments. The companies between the two do not overlap though which raises the question of could they provide for both sides.

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ADOLESCENTS' EXERCISE MOTIVES IMPACT ON USE ADHEARENCE OF WEARABLE TECHNOLOGY

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ABSTRACT

Wearable technology devices have become extremely prevalent, however sustained long-term use and adoption is still an issue. Furthermore, adoption and use vary by age group. Understanding age characteristics associated with adoption and use of wearable technology devices is key. This study investigated exercise motives and their influence on sustained use of wearable technology amongst adolescents. Sixty-five high school students (juniors and seniors) took part in the study. Participants received Fitbit activity trackers as a means of exercise persuasion. At the beginning of the study, participants completed an Exercise Motivation Inventory (EMI-2) [6] and baseline exercise behaviors and motives were established. Use of the Fitbit enabled the electronic collection of participants' daily activities. A web-portal tracked and captured participants' compliance to use and wear the Fitbit device. Via a dashboard, or downloaded file, a "last sync" date provided evidence regarding participant use and compliance. Data gathering occurred for a duration of three months. The research team was in frequent contact with participants to encourage sustained involvement. Two statistics tests were used to analyze the data in the study; an Anderson-Darling Normality Test and Pearson Correlation. The results revealed that sustained usage was not consistent amongst adolescent participants and that a correlation existed between exercise motives and the sustained use of wearable technology.

Keywords: Activity monitoring, adoption challenges, exercise motives, fitness trackers, wearable technology, adolescent participation

INTRODUCTION

This paper presents an experimental study that investigates if exercise motives affect the sustained use of wearable technology devices amongst adolescents. This study is of importance because of the increasingly high rate of obesity amongst adolescents. While wearable technology has increased in popularity, it can only enhance health and wellness if used for a sustained timeframe. Therefore, the aim of the researchers was to ascertain if adolescents' inclination towards particular exercise motives influenced their commitment to the sustained use of a wearable device. Theoretical research purports the belief that individuals' exercise goals or objectives are a central determinant of participation in exercise regimes [5] [6]. Understanding if these same motives affect an adolescents' likelihood to commit to wearing a device, to enhance health and wellness, is the aim of this study. The remainder of this section provides an overview of the studies that influenced the design and motivation of this research.

In recent times, there has been a growing interest in the development of devices that can be used to track health information, including fitness trackers. Fitbit is perhaps among the most popular in this category and considered as a leader in the health and fitness industry [3]. These devices can track the number of steps, distance traveled, and similar measures of physical activity.

Minimal research to date has investigated the underlying motivations that can lead to sustained use and adherence of wearable technology. This is especially true amongst adolescents (also referred to as generation Z), since they grew up in an age where much of their social interaction depended on technology. This paper addresses this problem and seeks to understand if exercise motives influence adolescents' propensity for sustained use of the wearable devices. The expectation is that sustained use of wearable technology is an indication that can eventually lead to increased health and wellness. To the best of our knowledge, the issues of adherence and sustained use from a motivation based perspective related to using wearable devices amongst adolescents remains uninvestigated. Reports from commercial studies state that 50% of new users of wearables and 74% of new users of health apps stop using them within two weeks [4].

Emphasizing user perception and adoption potential [2], researchers have noted that individuals may stop using the wearable devices if they are not convinced that they are useful (usefulness) in terms of meeting their goals [1]. Focusing on what youngsters like to do (usefulness), will enhance the motivation for change [7] and the sustained use of wearable technology will be more probable if it the device is considered "user friendly" from the perspective of adolescents (ease of use).

This research study has adopted and applied the EMI-2 scale developed by [6] to measure and assess a range of exercise participation motives of an individual. In this paper, the aim of the researchers was to ascertain if adolescents' inclination towards particular exercise motives influenced their commitment to the sustained use of a wearable technology device.

METHODOLOGY

Participants

The research team collaborated with a local high school to solicit student participation in the study, specifically upper classmen (e.g. adolescents between the ages of 16 and 18). Participation was voluntary and dependent on student interest. The study limited participation to the total number of Fitbits that could be purchased (n=65).

As a condition for participation, since the students were all minors (i.e. under the age of 18), they needed to have their parents read and complete a parental consent form. Students also needed to complete an assent form, containing much of the same information, personally acknowledging their full understanding of the study requirements.

Materials

A primary component of this research was access to wearable technological devices to track individual exercise behavior for the study duration. The research team purchased Fitbit devices (Fitbit HR model) for use by the participants during an extended timeframe. The Fitbit includes a lithium-polymer battery that takes up to 2 hours to charge. A fully charged battery can last up to 5 days before a recharge is necessary.

The Fitbit device allows users to track their health and wellness progress using an online portal via a dashboard display. For the duration of the study, only the research team had access to the participants' portals via the web and their e-mail account.

Response variables

The study uses two primary variables; exercise motives and compliance (e.g. usage). Exercise motives, the independent variable, refer to the forces that drive each participant engagement or withdrawal from physical activities. Compliance, the dependent variable, reflects the consistency with which participants use the Fitbit throughout the study. The exercise motives derived from the EMI-2 [6] model sub-divide healthy behaviors into 14 different exercise motives; stress management, revitalization, enjoyment, challenge, recognition, affiliation, competition, health pressures, ill avoidance, positive health, weight management, appearance, strength & endurance, and nimbleness.

The research team derived the total number of days the participants did not use the device throughout the study as a measure of compliance/non-compliance.

Data capture tools

An on-boarding survey collected participant demographics and data associated with participants' exercise motives across 14 dimensions. A seven point Likert scale gauged participants' motivational tendencies from Strongly Disagree (1) to Strongly Agree (7).

A web-portal tracked and captured participants' compliance to use and wear the Fitbit device. Via a dashboard, or downloaded file, the "last sync" date provided evidence regarding participant use and compliance.

Design

Over the course of several months, participants wore a Fitbit device allowing health and wellness metrics to be captured, indicating their compliance trends towards device usage. A pre-survey was administered to provide insight into their exercise motives. The objective was to see if compliance towards the use of wearable technology for adolescents differed across exercise motives.

Statistical tests

Two statistics tests were used to analyze the data in the study: (1) Anderson-Darling Normality Test and (2) Pearson Correlation.

The Anderson-Darling Normality Test provides insight into the distribution of the data. Specifically, the Anderson-Darling statistically analyzes if the data in question meets the assumption of normality for a t-test at a specified level. A p-value below .05 implies rejection of the null hypothesis postulating the data is normally distributed.

Pearson correlation coefficient (r) value can range from positive 1 to negative 1. A value greater than 0 is indicative of a positive association, with the inverse indicating a negative association. Correlations are typically classified as follows: between 0 and 0.19 (very weak), between 0.2 and 0.39 (weak), between 0.40 and 0.59 (moderate), between 0.6-0.79 (strong) and between 0.8 and 1 (very strong) correlation.

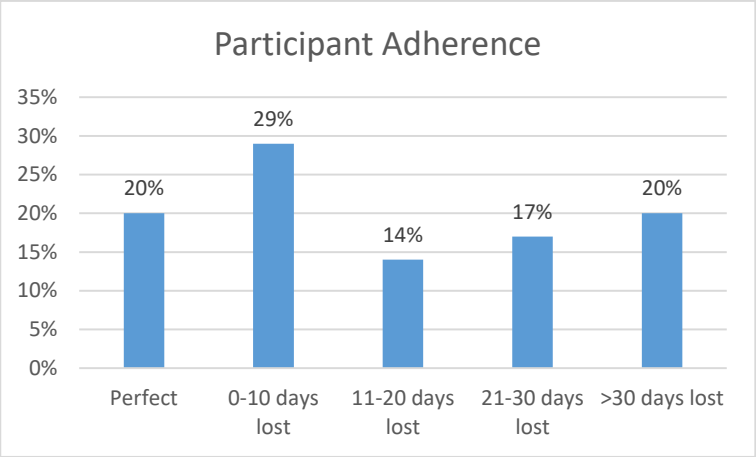
RESULTS

Participant adherence

The research team monitored adherence through analyzing the data collected through the portal. Only 20% of participants followed the charging and synching criteria set forth ensuring the collection of 100% of the tracking device data. Due to non-adherence, 29% of participants lost data associated with 0-10 days of the study, 14% of participants lost data associated with 11-20 days of the study, 17% of participants lost data associated with 21-30 days of the study, and an overwhelming 20% of participants lost data associated with more than 30 days (Figure 1).

The research team distinguished participants as either – compliant (missed wearing Fitbit device 25% or less of the time in any month) or non-compliant (missed wearing Fitbit device >25% of the time in any month). Thirty-three of the participants (56%) were classified as compliant, and the remaining 26 participants (44%) were classified as non-compliant.

Figure 1 - Participants' Adherence



Data distribution

Exercise motives across 14 dimensions were assessed using the Anderson-Darling Normality Test that provides insight into the distribution of the data. The Anderson-Darling test analyzed if the data met the assumption of normality. The null hypothesis was rejected ($p < .05$) suggesting the use of non-parametric tests to analyze the data.

Data Correlation

The Pearson Correlation coefficient was used to assess the correlation between days missed per participant and their respective Likert scale responses at the item level across exercise motives. Pearson Correlation was conducted to find a relationship between compliance (device usage) and the underlying exercise motives. Out of the 14 dimensions (i.e. exercise motives), at least 60 % of the items associated with the exercise motives of challenge (3 of 5), affiliation (3 of 4), health pressures (2 of 3), and nimbleness (4 of 4) showed evidence of being correlated (See the Appendix). Comparatively, 50% of items associated with the exercise motive of strength and endurance (2 of 4) were correlated, 25% of items associated with the exercise motive of stress management and positive health (1 of 4) were correlated, and 0% of the items across the remaining exercise motives were correlated.

Group Comparison

Related to exercise motives, seventy percent of non-compliant (B) participant responses associated with the four exercise motives of challenge, affiliation, health pressures, and nimbleness fell in the Likert-scale categories of 6 and 7, indicating they were driven by those specific exercise motives. Whereas, compliant (A) participants seemed relatively less motivated by these same exercise motives.

DISCUSSION

On reviewing the results and further reflection, we see some interesting findings from our study. Our research objective was to explore if certain exercise motives of adolescents can influence their commitment to the sustained use of wearable devices.

If greater than 50% of indicators within an exercise motive correlated with sustained usage, the assumption was made that the exercise motive impacted participants' compliance. Our results suggest that participants were most significantly impacted by challenge, affiliation, health pressure, and nimbleness. Individuals positively influenced by these exercise motives are less likely to be compliant in the sustained use of wearable devices.

Further investigating of these exercise motives is necessary to understand if the motive itself can allow an individual to sustain their exercise routine without the intervention of technology. This leads us to enquire further into the possibility whether evidence of consistent use of wearable devices is truly an indicator of adherence to exercise participation.

We suggest that adolescents need to be guided from controlled settings (such as using wearable tracking devices) eventually to stages where they will continue exercise activities and remain physically active (Ryan and Deci, 2002). Use of such resources might be effective in preventing the decline in physical activity commonly seen in this age group and make the experience of engaging in physical activities enjoyable for them.

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APPENDIX

First order construct	Indicator	Pearson
Stress management	Because it helps to reduce tension.	0.1003
	To give me space to think.	0.3224
	To help manage stress.	0.2012
	To release tension.	0.2206
Revitalization	Because after exercising I feel refreshed.	0.1147
	Because I find exercise invigorating.	0.0377
	Because it makes me feel good.	0.1183
	To recharge my batteries.	0.1513
Enjoyment	Because I enjoy the feeling of exerting myself.	0.1000
	Because I feel at my best when exercising.	-0.0061
	Because I find exercising satisfying in and of itself.	0.1186
	For enjoyment of the experience of exercising.	0.1962
Challenge	To develop personal skills.	0.2211
	To give me goals to work towards.	0.3461
	To give me personal challenges to face.	0.3881
	To help me explore the limits of my body.	0.3901
	To measure myself against personal standards.	0.2488
Recognition	To accomplish things that others are incapable of.	0.0774
Undecided	To compare my abilities with other peoples'.	0.0525
	To gain recognition for my accomplishments.	0.2154
	To show my worth to others.	0.1601
Affiliation	To enjoy the social aspects of exercising.	0.4056
	To have fun being active with other people.	0.3028
	To make new friends.	0.1890
	To spend time with friends.	0.2657
Competition	Because I enjoy competing.	-0.0328
	Because I enjoy physical competition.	0.0760
	when competition is involved.	0.1202
	Because I like trying to win in physical activities.	0.0636
Health pressures	Because my doctor advised me to exercise.	0.0456
	To help prevent an illness that runs in my family.	0.4146
	To help recover from an illness/injury.	0.3260
Ill health avoidance	Because I feel I have to exercise to stay healthy.	-0.0730
	To avoid heart disease.	0.1096
	To avoid ill-health.	0.0812
	To prevent health problems.	0.2255
Positive Health	Because I want to maintain good health.	0.0946
	To feel healthier.	0.2629
	To have a healthy body.	0.0203
	To help me live a longer, healthier life.	0.1202
weight management	Because exercise helps me to burn calories.	-0.0021
	To help control my weight.	0.0091
	To lose weight.	0.0083
	To stay slim.	-0.0663
appearance	To have a good body.	0.0660
	To improve my appearance.	0.0257
	To look more attractive.	0.0055
Strength & endurance	To build my strength.	0.2838
	To develop muscles.	0.1291
	To get stronger.	0.2751
	To increase my endurance.	0.7280
Nimbleness	To get faster.	0.1519
	To maintain flexibility.	0.4592
	To stay/become flexible.	0.3848
	To stay/become more agile.	0.2755

IN THE CASE OF *CASHWELL, ET AL. V. TOWN OF OAK ISLAND*, ET AL., DO THE PLAINTIFFS LACK A FEDERAL REMEDY FOR ALLEGEDLY BEING DEPRIVED OF EQUAL PROTECTION, BECAUSE THE SEWER TREATMENT FEE CHARGED BY THE TOWN IS A "TAX" FOR PURPOSES OF THE TAX INJUNCTION ACT?

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ABSTRACT

> "It is abiding truth that 'nothing can destroy a government more quickly than its failure to observe its own laws, or worse, its disregard of the charter of its own existence.'"
>
> *Oregon v. Hass,* 420 U.S. 714, 724-25, 43 L. Ed. 2d 570, 95 S. Ct. 1215 (Brennan, J., dissenting (quoting *Harris v. New York,* 401 U.S. 222, 232, 28 L. Ed. 2d 1, 91 S. Ct. 643 (1971) (Brennan, J., dissenting))).

The primary purpose of this article is to enhance the awareness of property owners that they may not have a federal remedy for an unconstitutional local assessment or fee, illegally charged by a local government, because such local assessment or fee is a "tax" for purposes of the federal Tax Injunction Act. In this instance, pursuant to the federal Tax Injunction Act, the federal District Court lacks subject matter jurisdiction to hear the case of said property owners, even though such property owners have been deprived of Equal Protection as guaranteed by the Fourteenth Amendment to the U.S. Constitution. As such, these property owners are precluded from having a federal remedy by the federal Tax Injunction Act, having been relegated to whatever state remedy exists, even if thin or insubstantial.

In this regard, the instant article has significant public interest.

In a case study approach, the three primary objectives of this article are to:
(1) **establish the facts of the case study**, i.e., *Cashwell et al. v. Town of Oak Island, et al.* (Case No. 7:18-cv-109 E.D.N.C.), wherein the Town of Oak Island, N.C. effectively charges a Sewer Treatment Fee to only owners of undeveloped property;
(2) **establish the clearly established law at issue**, i.e., the federal Tax Injunction Act; and
(3) **apply the law at issue to the facts of the case study for the purpose of identifying the U.S. constitutional implications for owners of undeveloped property being charged an illegal fee.**

This article argues that if these objectives are met, the facts of the case study will have revealed that there are exceptions to the application of the federal Tax Injunction Act. In this regard, the instant article has significant public interest not only for property owners facing an illegal local assessment or fee, but also for any person associated with the legal or educational community.

In a case study approach, this article accomplishes its primary purpose and objectives in a stepwise fashion as follows.

- In Part I, **the facts of the case study are presented**, i.e., the factual background surrounding the imposition by the Town of Oak Island, N.C. of a Sewer Treatment Fee/Tax.

- In Part II, **the law at issue is identified,** i.e., the federal Tax Injunction Act.
- In Part III, the law at issue in Part II is applied to the facts of the case study in Part I for the purpose of **identifying U.S. constitutional implications for the owners of property being charged an illegal local assessment or fee.**
- In Part IV, based upon the implications of the findings in Part III for the owners of property being charged an illegal local assessment or fee, **planning opportunities are presented**.

I
THE FACTUAL BACKGROUND SURROUNDING THE IMPOSITION BY THE TOWN OF A SEWER [TREATMENT] FEE/TAX

A.
THE TOWN OF OAK ISLAND, N.C. ("THE TOWN")

1.
The Town is a Governmental Agency

The Town is a municipal corporation that was duly created and chartered by the N.C. General Assembly for administrative purposes, where the N.C. General Assembly retains control and supervision over the Town as a municipal corporation, limited only by N.C. Const. Art. VII, § 1 (2014).[1] The Town has those powers expressly granted by legislative enactment under N.C. Const. Art. VII, § 1 (2014) and those powers implied therefrom.[2] In particular, N.C. Const. Art. VII, § 1 (2014) does not prohibit local legislative enactments, where particular powers may be conferred upon the Town.[3] However, **if there is reasonable doubt with regard to the existence of the Town's power in a particular instance, such doubt must be resolved against the Town, where said power is denied.**[4]

2.
The Town has no Inherent Power of Taxation

In particular, the Town has no inherent power of taxation.[5] Accordingly, all power of taxation must be derived by the Town from legislative enactment under N.C. Const. Art. VII, § 1 (2014).[6] Furthermore, all power of taxation derived by the Town from legislative enactment is subject to further restriction and regulation by legislative enactment under N.C. Const. Art. VII, § 1 (2014).[7] Because the Town derives its power of taxation from the legislature, the Town cannot argue that certain enabling legislation is 'lacking in breadth.'[8] Specifically, **the N.C. General Assembly has the power under N.C. Const. Art. VII, § 1 (2014) to control the finances of the Town in terms of the nature and amount of particular revenue appropriations.** More

[1] Town of Saluda v. County of Polk, 207 N.C. 180, 176 S.E. 298 (1934).
[2] Town of Grimesland v. City of Wash., 234 N.C. 117, 66 S.E. 2d 794 (1951).
[3] In re Annexation Ordinances, 253 N.C. 637, 117 S.E. 2d 795 (1961).
[4] Bold added. In re Indian Hills, 280 N.C. 659, 186 S.E. 2d 909 (1972).
[5] Greensboro-High Point Airport Auth. v. Johnson, 226 N.C. 1, 8-10, 18, 36 S.E.2d 803 (1946).
[6] Id.
[7] Purser v. Ledbetter, 227 N.C. 1, 40 S.E. 2d 702 (1946).
[8] In re Martin, 286 N.C. 66, 74, 209 S.E. 2d 766 (1974).

specifically, the N.C. General Assembly has the power under N.C. Const. Art. VII, § 1 (2014), **to direct that certain revenues derived by municipal enterprise funds be applied against the principal of outstanding enterprise bonds [as well as current operating enterprise expenses, e.g., interest expense and expenses of sewer services provided by the county].**[9]

In North Carolina, the legislative body (i.e., the N.C. General Assembly) passes "general laws" and "local acts." A "general law" affects the public at large and applies "to all units of local government."[10] A "local act" applies to a limited number of municipalities or counties.[11] "'Local act' is interchangeable with the terms 'special act,' 'public-local act,' and 'private act'"[12] Specifically, a "'local tax' is defined as 'one laid upon property in the locality, by the governing body thereof for an amount fixed by it, and for local governmental uses declared by it…." Cooley, Taxation, Vol. 1, 4th Ed., Sec. 54, p. 145.'[13]

3.
The Town has constructed a Sewer System Financed by Sewer Assessments Paid by All Parcels within the Boundaries of the Sewer District

The construction of the Town's sewer system was financed, in part, with sewer assessments (i.e., a tax for a local benefit) levied and collected from benefitted parcels, including those developed and undeveloped parcels within the boundaries of the Sewer District. In the instant case, the amount of the sewer assessment was $4200 for each tax parcel. Here, it is important to note that the recurring, annual Sewer [Treatment] Fee/Tax is separate from the initial, one-time sewer assessment imposed for the special benefit of potentially increasing parcel values resulting from the construction of the sewer system.

B.
ENABLING LOCAL LEGISLATION
FOR THE TOWN'S IMPOSITION OF A SEWER DISTRICT FEE/TAX

The N.C. General Assembly has authority to pass enabling legislation, wherein a special district may be established, within which particular services are provided, e.g., sewer treatment services, where such enabling legislation delineates the powers, authority and responsibilities of the Town with regard to such district, including the authority to impose local assessments.[14] In particular, local assessments are a "**class of taxes**"[15] that:

> "**are imposed only upon those owners of parcel who in respect to such ownership are to derive a special benefit in the local improvements for which they are to be expended** . . . 'to warrant the levy of local assessments, there must not only exist in the case the ordinary elements of taxation, but the object must also be one productive of

[9] Bold added. George v. City of Asheville, 80 F.2d 50, 103 A.L.R. 568 (4th Cir. 1935).
[10] N.C. G.S. [hereinafter, "G.S."] § 160A-1(4).
[11] G.S. § 160A-1(5).
[12] Id.
[13] Hajoca Corp. v. Clayton, 277 N.C. 560, 178 S.E. 2d 481 (1971).
[14] N.C. Const. Art. VII, § 1 (2014).
[15] Bold added. Cain v. Commissioners of Davie County, 86 N.C. 8, 15-16 (1882).

> special local benefits, so as to make applicable the principles upon which special assessments have hitherto been upheld.' Cooley Tax., 428. . . '**When the assessment is made upon persons in respect of their ownership of a particular species of parcel which receives a peculiar benefit from the expenditure of the tax, it is valid**, although it does not operate upon all persons and parcel in the community.' Bold added. *Dargan* v. *Boston*, 12 Allen 223." *Cain v. Commissioners of Davie County*, 86 N.C. 8, 15-16 (1882).

Furthermore, they are imposed "**upon a limited class in return for a special benefit**."[16]

> "[T]here is a distinction between local assessments for public improvements and taxes levied for purposes of general revenue. It is true that local assessments may be a species of tax, and that the authority to levy them is generally referred to the taxing power, but they are not taxes within the meaning of that term as generally understood in constitutional restrictions and exemptions. They are not levied and collected as a contribution to the maintenance of the general government, but are made **a charge upon parcel on which are conferred benefits entirely different from those received by the general public.** They are not imposed upon the citizens in common at regularly recurring periods for the purpose of providing a continuous revenue, but **[imposed] upon a limited class in return for a special benefit**." Bold added. *Raleigh Cem. Ass'n v. City of Raleigh*, 235 N.C. 509, 70 S.E.2d 506 (1952).

As an example, in S.L. 2004-96, the N.C. General Assembly enacted a local act to allow the Town of Holden Beach (and later the Town of Oak Island, pursuant to S.L. 2006-54) (1) to create a "fee supported sewer treatment district" [hereinafter "Sewer [Treatment] District"] and (2) to impose an annual availability fee/tax [hereinafter "Sewer [Treatment] District Fee/Tax"] for the "**availability of sewer service**" upon owners of property within the boundaries of the Sewer [Treatment] District that "**could or [do] benefit from the availability of sewage treatment**" in order "**to pay the [recurring] debt service for the sewer system [as well as the current operating expenses of sewer services provided by the county]**."[17] . . .

Here, a "class of tax" (i.e., local assessment) is imposed upon those owners of tax parcels within the boundaries of the Sewer [Treatment] District who, with respect to such ownership, derive a special benefit (i.e., the availability of sewer treatment services provided by the Town) in the local improvement (i.e., sewer system) for which the expenditure (i.e., recurring payment of the debt service for the sewer system **[as well as the current operating expenses of sewer services provided by the county]**) of said tax is made.[18] In other words, the owners of tax parcels within the boundaries of the Sewer [Treatment] District, benefited by the "**availability of sewer [treatment] service**" provided by the Town, are annually charged with an aggregate amount up to the sum necessary to secure the sewer system's debt service for the year **[as well as the current operating expenses of sewer services provided by the county]**, where the **benefits conferred** upon such owners of tax parcels **are** "**entirely different from those received by the general public**."[19]

[16] Bold added. Raleigh Cem. Ass'n v. City of Raleigh, 235 N.C. 509, 70 S.E.2d 506 (1952).
[17] Bold added. Sections 1, 3, 4 & 6 of S.L. 2004-96 (as amended by S.L. 2006-54).
[18] Cain v. Commissioners of Davie County, 86 N.C. 8, 15-16 (1882).
[19] Bold added. Id.

1.
When do parcels benefit from the availability of sewage treatment?

Parcels "benefit from the availability of sewage treatment" when a connection with a "residential dwelling unit or commercial establishment" is possible. G.S. § 160A-317 provides a context for construing the meaning of the "availability of sewer [treatment] service" in S.L. 2004-96 (as amended by S.L. 2006-54). In particular, with regard to the imposition of a "periodic availability charge," G.S. § 160A-317 authorizes a municipality to:

> "**require an owner of developed parcel** on which there are situated one or more residential dwelling units or commercial establishments located within the city limits and within a reasonable distance of any water line or sewer collection line owned, leased as lessee, or operated by the city or on behalf of the city **to connect the owner's premises with the water or sewer line or both**, and may fix charges for the connections." Bold added. *Id*.

The statute further provides that

> "[i]n lieu of requiring connection under this subsection and in order to avoid hardship, the city may require payment of a **periodic availability charge**, not to exceed the minimum periodic service charge for parcels that are connected." Bold added. *Id*.

Specifically, the authority delegated to a municipality to impose a "periodic availability charge" under **G.S. § 160A-317 applies exclusively to developed *residential* or *commercial* properties located *within* the municipality.** Such delegated authority **does not apply to undeveloped properties *within* the municipality.**[20] Under **G.S. § 160A-317**, the exercise of the power of classification by the N.C. General Assembly in identifying what parcel is subject to the "periodic availability charge" (i.e., developed *residential* or *commercial* parcels located *within* the municipality) includes the exercise of the power of classification in identifying what parcel is not subject to the "periodic availability charge" (i.e., undeveloped parcels located *within* the municipality). The power of classification **to include** incorporates the power of classification **to exclude**. *Southern Ry. v. City of Raleigh,* 277 N.C. 709, 713, 178 S.E. 2d 422 (1971). By providing that G.S. § 160A-317 applies exclusively to developed *residential* or *commercial* parcels *within* the municipality (and not to undeveloped parcels), the N.C. General Assembly has exercised its power of classification **to exclude** undeveloped parcels from those parcels upon which a "periodic availability charge" may be imposed. *Id*., 86 N.C. at 17. Based upon the foregoing, G.S. § 160A-317 does not support the existence of the "availability of sewer service" as a condition precedent to the operation of a statute, in a case where the Town merely places sewer lines in the street bordering upon undeveloped property, because such phrase contemplates that a connection to 'a residential dwelling unit or commercial establishment' is possible.

Moreover, because the N.C. General Assembly, in enacting S.L. 2004-96 (as amended by S.L. 2006-54) has "declare[d] the policy of the law, fix[ed] legal principles which are to control in

[20] G.S. § 160A-317. Also, see Millonzi, K. "Water and Sewer Availability Fees." Coates' Canons: NC Local Government Law, February 10, 2012. Available online at: http://canons.sog.unc.edu/?p=6305/.

given cases, and provide[d] adequate standards for the guidance of the [Town] empowered to execute the law," S.L. 2004-96 (as amended by S.L. 2006-54) does not violate N.C. Const. art. II, § 1 (2014), which prohibits the N.C. General Assembly from unlawfully delegating a portion of its legislative power to the Town. *Foster v. North Carolina Medical Care Comm'n*, 283 N.C. 110, 119, 195 S.E. 2d 517 (1973). Furthermore, the N.C. General Assembly "**cannot vest in a subordinate agency the power to apply *or withhold* the application of the law in its absolute or unguided discretion**." Bold and italics added. *Id*. Specifically, under S.L. 2004-96 (as amended by S.L. 2006-54), the Town was "delegate[d] the power to find facts or determine the existence or nonexistence of a factual situation or condition on which the operation of a law is made to depend" (i.e., the identification of those tax parcels within the boundaries of the Sewer [Treatment] District for which there exists the "availability of sewer [treatment] service"). *Id*. Nevertheless, in general, **the determination by the Town, i.e., that the Town has complied with the conditions precedent to the exercise of its statutory authority in a specific instance, is the Town's determination of a question of law, where such determination is subject to a court's judicial review**. *Id*., 283 N.C. at 120. In particular, the determination by the Town that the Town confers a special benefit upon undeveloped parcels within the boundaries of the Sewer [Treatment] District (i.e., undeveloped parcels "**could or [do] benefit from the availability of sewage treatment**") is a question of law subject to a court's judicial review. *Id*.

2.
Undeveloped Parcels do NOT "benefit from the availability of sewage treatment" Because these Parcels are NOT Parcels to Which Sewer Services are "Available"

In addition, a string of cases originating in the State of Washington provide a context for construing the meaning of the "availability of sewer [treatment] services" in S.L. 2004-96 (as amended by S.L. 2006-54). In particular, in a case that parallels *Cashwell et al. v. Town of Oak Island, et al.* (Case No. 7:18-cv-109 E.D.N.C.), the Washington Supreme Court in *Holmes Harbor Sewer District v. Holmes Harbor Home Bldg., LLC*[21] held that owners of undeveloped properties within the Sewer District were not subject to charges for the "availability" of sewer services because undeveloped properties are not properties to which sewer services are "available."[22] Specifically, similar to the facts in *Cashwell et al. v. Town of Oak Island, et al.*, in *Holmes Harbor*, a special assessment (i.e., a tax for a local benefit) was levied upon all owners of parcels within the Sewer District to pay for the construction of the sewer system. *Id*. In *Cashwell et al. v. Town of Oak Island, et al.*, the amount of the special assessment was $4200 for each parcel. Also, similar to N.C. state law (G.S. § 160A-317), the Sewer District in *Holmes Harbor* could compel a parcel owner within said district to connect to the sewer system when a dwelling or other structure used by humans was situated on said parcel. *Holmes Harbor*, at 155 Wn.2d 860. In *Holmes Harbor*, again similar to N.C. G.S. § 160A-317, under Wash. Rev. Code § 57.08.081(1), sewer districts are authorized to fix rates and charges "for furnishing sewer and drainage service and facilities to those to whom service is available." *Holmes Harbor*, at 155 Wn.2d 862. "These charges are separate from the initial assessment imposed for the special benefit of potentially increased parcel values resulting from the construction of the sewer system." *Holmes Harbor*, at 155 Wn.2d 866 (footnote 5). In interpreting Wash. Rev. Code § 57.08.081(1), the Washington state supreme court held that "the language of the statute requires

[21] 155 Wn.2d 858, 123 P.3d 823 (2005).
[22] Holmes Harbor, 155 Wn.2d at 859.

districts to furnish some level of sewer and drainage service and facilities," which "requires more than an uncertain opportunity for an unimproved parcel to connect to the system, especially in this case where under the resolution the parcel owners have no right or duty to connect." *Holmes Harbor*, at 155 Wn.2d 865. More specifically, the Washington state supreme court held that sewer service is not "available" to a tax parcel that (1) is unimproved, (2) is not connected to the sewer system, and (3) for which there is no guaranteed right to connect upon improvement. *Holmes Harbor*, at 155 Wn.2d 866. Similar to the facts in *Cashwell et al. v. Town of Oak Island, et al.*:

> "[t]hough the District and parcel owners expect the District to maintain the sewer system's capacity and to approve connections when parcels assessed the special benefit are improved, neither of these events is guaranteed. Before authorizing connection, the District must approve the hookup application, and upon approval by the District, parcel owners must pay for the installation of on-site facilities and connection to the sewer system. In addition, unforeseen events may operate to reduce the District's ability to serve all assessed parcels.' *Id.*

Accordingly, in *Holmes Harbor*, sewer service was not "available" to undeveloped parcels within the Sewer District under Wash. Rev. Code § 57.08.081(1). *Holmes Harbor*, at 155 Wn.2d 859. Similarly, in *Cashwell et al. v. Town of Oak Island, et al.*, sewer treatment services are not "available" to undeveloped parcels within the boundaries of the Sewer District. Accordingly, such undeveloped parcels cannot and do not "**benefit from the availability of sewage treatment**" within the meaning of Section 4 [Fees] of S.L. 2004-96 (as amended by S.L. 2006-54). Bold added.

3.
In *Ricks v. Town of Selma*, the North Carolina Court of Appeals Holds that "by making sewer [treatment] service available, a city has furnished a service"

Finally, and most importantly, in *Ricks v. Town of Selma*, 99 N.C. App. 82, 392 S.E.2d 437 (1990), the North Carolina Court of Appeals provides a context for construing the meaning of the "availability of sewer [treatment] service" in S.L. 2004-96 (as amended by S.L. 2006-54). In addressing the issue as to **whether "making sewer [treatment] service available is 'furnishing a service'** within the meaning of N.C. Gen. Stat. § 160A-314(a), the court held as follows.

> **"**N.C. Gen. Stat. § 160A-314(a) grants cities the power to establish rates '**for** the use of or the **services furnished by any public enterprise**.' 'Public enterprise' includes . . . '[s]ewage collection and disposal systems of all types, including septic tank systems.' N.C. Gen. Stat. § 160A-311(2), (3). The question before us is specifically **whether making sewer service available is 'furnishing a service'** within the meaning of the statute. Plaintiffs argue that a city's power to set rates 'for the use of or the services furnished by' a water or sewer system should be limited to charging for actual use, not mere availability. We disagree and find that **by making sewer service available, a city has furnished a service**, thus authorizing it to set a rate for this service. We construe the statutory language in this way because of the powers granted to a city with regard to providing water and sewer service, and the policies involved, it is 'expedient,' *see* N.C.

> Gen. Stat. § 160A-4, to allow a city the supplementary power to charge for service available but not received.
>
> First, . . .
>
> Second, a city has the power to build, enlarge and operate a sewage system, N.C. Gen. Stat. § 160A-312, as well as to make special assessments against benefited property for building or extending a sewage system. N.C. Gen. Stat. § 160A-216(4).
>
> Further, a city has the power to require that owners of improved property within the city limits, and within a reasonable distance of a sewer collection line, connect their premises with the sewer line, and may set a charge for that connection. N.C. Gen. Stat. § 160A-317." Bold added. Appendix D - *Ricks v. Town of Selma*, 392 S.E.2d 437, 439-440 (1990).

With reference to the imposition of a "periodic availability charge" under G.S. § 160A-317, in *Ricks v. Town of Selma*, the North Carolina Court of Appeals stated that, "in 1989, the General Assembly passed an amendment to N.C. Gen. Stat. § 160A-317 granting cities the authority to require payment of a periodic availability charge as an alternative to requiring connection to a sewer collection line and to avoid hardship."

4.
In *Ricks v. Town of Selma*, the North Carolina Court of Appeals holds that in Setting Availability Charges, the Town must not Discriminate Among Customers

In *Ricks v. Town of Selma*, the North Carolina Court of Appeals holds that, in setting availability charges, the city must not discriminate amongst its customers, as follows.

> "Section 160A-314(a), which grants cities the authority to establish rates, also provides: 'Schedules of rents, rates, fees, charges, and penalties may vary according to classes of service . . . .' **A public utility, whether publicly or privately owned, may not discriminate in the establishment of rates**. *Town of Taylorsville v. Modern Cleaners*, 34 N.C. App. 146, 148, 237 S.E.2d 484, 486 (1977) (citations omitted). **The statutory authority of a city to set rates for its services and to classify its customers is not a license to discriminate among customers** of essentially the same character and services. *Id.* at 149, 237 S.E.2d at 486. Section 160A-314(a) must be read as a codification of the general rule stated in 12 McQuillin, *Municipal Corporations* § 35.37(b), at 621 (3d ed. 1986):
>
> > A municipality has the right to classify consumers under reasonable classifications based upon such factors as the cost of service, the purpose for which the service or the product is received, the quantity or the amount received, the different character of the service furnished, the time of its use or any other matter that presents a substantial difference as a ground for distinction.

> *See Taylorsville* at 149, 237 S.E.2d at 486. Rates may be fixed in view of dissimilarities in conditions of service, but there must be some reasonable proportion between the variance in the conditions and the variances in the charges. *Id.*, quoting *Utilities Commission v. Mead Corp.*, 238 N.C. 451, 465, 78 S.E.2d 290, 300 (1953). The burden of proof is on the party claiming that a rate-setting ordinance is unreasonable or discriminatory. 12 McQuillin § 35.37(a) at 617.
>
> . . . **Section 13.08.010 requires owners of improved property** near a sewer line to connect with the sewage system. **An availability charge**, according to the language of Section 13.20.020, **is designed as an alternative to mandatory connection** '[i]f due to economical, or physical limitations, a customer does not receive one of the above-mentioned services, (water/sewer) . . . .' Although the ordinance purports to recognize a customer's economic or physical limitations, the amount of **the availability charge virtually coerces a property owner to abandon their private waste disposal arrangement and connect to the municipal sewer system. Once a municipality has exercised its authority to set an availability charge as an alternative to requiring connection, it must set a reasonable availability charge, not one that is in effect a weapon to coerce connection.**" Bold added.

C.

PROCEDURAL HISTORY OF *CASHWELL ET AL. V. TOWN OF OAK ISLAND, ET AL.*

As observed by Defendants, Plaintiffs' First Amended Complaint (hereinafter "*Plaintiff's FAC* (DE 11)") consists of a claim (Count I) for damages and equitable relief (a declaratory judgment and permanent injunction), alleging a "regulatory taking of property without just compensation in violation of the Fifth (through the Substantive Due Process Clause of the Fourteenth) Amendment to the U.S. Constitution," in that Defendants unjustly determined, during property tax years 2015-2017, that sewer treatment services, in the present tense, were available to undeveloped parcels within the Sewer Treatment District, i.e., that the Town had furnished a service by **"making sewer [treatment] service available**," thereby causing the Town to charge Plaintiffs, as the owners of said undeveloped parcels, sewer treatment fees for the availability of sewer treatment services.

> "Count One of this Complaint is a civil rights claim for money damages and declaratory and permanent injunctive relief under the United States Constitution, particularly pursuant to the provisions of the Fifth and Fourteenth Amendments to the Constitution of the United States, and under federal law, particularly pursuant to Title 42 of the United States Code, Section 1983 and Title 28 of the United States Code, Sections 2201 and 2202, brought by each of the **Individual Plaintiffs**, individually and as representative of the class of undeveloped parcel owners within the Sewer Treatment District of the Town of Oak Island, N.C. during property tax years 2015-2017, against:
> (a) each of the **Individual Town Defendants** for money damages (actual and punitive),
> (b) Entity Defendant **TOWN** for actual damages, and
> (c) Entity Defendant **TOWN** to permanently enjoin said Defendant from prospectively levying the recurring, annual Sewer Treatment District Fee/Tax [a

> benefits-based tax established under Entity Defendant **TOWN** law pursuant to S.L. 2004-96 (as amended by S.L. 2006-54) for the 'availability of sewer service within the district'] against the class of undeveloped parcel owners within the Sewer Treatment District of the Town of Oak Island, N.C.,
>
> in that the Sewer Treatment District Fee/Tax [a benefits-based tax established under Entity Defendant **TOWN** law pursuant to S.L. 2004-96 (as amended by S.L. 2006-54) for the 'availability of sewer service within the district'] as applied by the **Individual Town Defendants** to the class of undeveloped parcel owners, including each of the **Individual Plaintiffs**, during property tax years 2015-2017, is confiscatory in nature and thereby a regulatory taking of property without just compensation in violation of the Fifth (through the Substantive Due Process Clause of the Fourteenth) Amendment to the U.S. Constitution, because, during property tax years 2015-2017, sewer treatment services, in the present tense, were not available to undeveloped parcels within the Sewer Treatment District, i.e., during property tax years 2015-2017, sewer treatment services, in the present tense, could not and did not provide a special benefit to undeveloped parcels within the Sewer Treatment District." *Plaintiff's FAC* (DE 11), para. 1.

Also, as observed by Defendants, *Plaintiff's FAC* (DE 11) consists of a claim (Count II) for damages and equitable relief (a declaratory judgment and permanent injunction), alleging that Defendants deprived Plaintiffs of Equal Protection, as guaranteed by the Fourteenth Amendment to the U.S. Constitution, in executing Entity Defendant **TOWN** law pursuant to S.L. 2004-96 (as amended by S.L. 2006-54), during property tax years 2015-2017, in that the Defendants established a tax classification scheme, based upon a tax parcel's status as developed or undeveloped, that discriminated against Plaintiffs in the charging of sewer treatment fees for the availability of sewer treatment services.

> "Count Two of this Complaint is a civil rights claim for money damages and declaratory and permanent injunctive relief under the United States Constitution, particularly pursuant to the Equal Protection Clause of the Fourteenth Amendment to the Constitution of the United States, and under federal law, particularly pursuant to Title 42 of the United States Code, Section 1983 and Title 28 of the United States Code, Sections 2201 and 2202, brought by each of the **Individual Plaintiffs**, individually and as representative of the class of undeveloped parcel owners within the Sewer Treatment District of the Town of Oak Island, N.C. during property tax years 2015-2017, against:
> (a) the **Individual Town Defendants** for money damages (actual and punitive),
> (b) Entity Defendant **TOWN** for actual damages, and
> (c) Entity Defendant **TOWN** to permanently enjoin said Defendant from prospectively levying a recurring, annual Sewer Treatment District Fee/Tax [a benefits-based tax established under Entity Defendant **TOWN** law pursuant to S.L. 2004-96 (as amended by S.L. 2006-54) for the 'availability of sewer service within the district'] against both developed and undeveloped parcel owners within the Sewer Treatment District of the Town of Oak Island, N.C. (hereinafter, 'Sewer Treatment District'), where Entity Defendant **TOWN** simultaneously issues a credit to the private owners of developed parcels in the amount of the Sewer Treatment District Fee/Tax on each year's property tax statement,

> in that, in executing Entity Defendant **TOWN** law pursuant to S.L. 2004-96 (as amended by S.L. 2006-54) during property tax years 2015-2017, each of the **Individual Town Defendants** intentionally and purposefully conspired to establish (and, in fact, established) a tax classification scheme, based upon a tax parcel's status as developed or undeveloped [where the **Individual Town Defendants** initially levied a recurring, annual Sewer Treatment District Fee/Tax of $803.82 against both developed and undeveloped parcel owners within the Sewer Treatment District, but where said Defendants simultaneously issued a credit in the amount of the recurring, annual Sewer Treatment District Fee/Tax of $803.82 to private owners of developed parcels on each year's property tax statement because undeveloped parcel owners paid less in prior years], that **facially** and **impermissibly** (as applied) deprived each owner of an undeveloped parcel, including each of the **Individual Plaintiffs**, of Equal Protection of the law, in violation of the Equal Protection Clause, U.S. Const. amend. XIV, § 1." *Plaintiff's FAC* (DE 11), para. 1.

II.
THE LAW AT ISSUE IS IDENTIFIED - THE FEDERAL TAX INJUNCTION ACT

A.
FRCP 12(b)(1) CHALLENGE TO A COURT'S SUBJECT MATTER JURISDICTION

A party may bring either a facial or a factual challenge to the Court's subject-matter jurisdiction pursuant to Rule 12(b)(1). *Gould Electronics, Inc. v. United States*, 220 F.3d 169, 178 (3d Cir.2000).

In considering a facial challenge under Rule 12(b)(1), all material allegations in the Complaint are taken as true. *See Taliaferro v. Darby Twp. Zoning Bd.*, 458 F.3d 181, 188 (3d Cir.2006) (summarizing the standard for facial attacks under Rule 12(b)(1) as "whether the allegations on the face of the complaint, taken as true, allege facts sufficient to invoke the jurisdiction of the district court"); *Mortensen*, 549 F.2d at 891 (explaining that, in ruling upon a facial attack under Rule 12(b)(1), "the court must consider the allegations of the complaint as true"). Indeed, the "standard is the same when considering a facial attack under Rule 12(b)(1) or a motion to dismiss for failure to state a claim under Rule 12(b)(6)." *Petruska v. Gannon Univ.*, 462 F.3d 294, 299 (3d Cir.2006).

"[A] factual challenge attacks the factual allegations underlying the complaint's assertion of jurisdiction, either through the filing of an answer or 'otherwise presenting competing facts.'" *Davis v. Wells Fargo*, 824 F.3d 333, 346 (3d Cir. 2016) (original alterations omitted) (quoting *Constitution Party of Pa. v. Aichele*, 757 F.3d 347, 358 (3d Cir. 2014)); *see also Berardi v. Swanson Mem'l Lodge No. 48 of the Fraternal Order of Police*, 920 F.2d 198, 200 (3d Cir. 1990) (holding that the factual basis for jurisdictional allegations in a complaint could be disputed before an answer was served). Where a motion to dismiss factually challenges the district court's jurisdiction, the court is not confined to the allegations in the complaint, but can consider other evidence, such as affidavits, depositions, and testimony, to resolve factual issues related to jurisdiction. *See Mortensen v. First Fed. Sav. and Loan Ass'n*, 549 F.2d 884, 891 (3d Cir. 1977)

(stating that because at issue is the very power of the trial court to hear the case, a court is free to weigh evidence beyond the allegations in the complaint). Furthermore, "no presumptive truthfulness attaches to plaintiff's allegations" and "the plaintiff will have the burden of proof that jurisdiction does in fact exist." *Id.*

B.
THE TAX INJUNCTION ACT (TIA) AND THE "TAX COMITY DOCTRINE"

THE TIA

The TIA provides that "[t]he district courts shall not enjoin, suspend or restrain the *assessment, levy or collection* of any **tax** under State law where a *plain, speedy and efficient remedy* may be had in the courts of such State." 28 U.S.C. § 1341. By its explicit terms, the TIA bars injunctive relief. Also, the Supreme Court has held that the TIA extends to declaratory relief. *See California v. Grace Brethren Church*, 457 U.S. 393, 408-11, 102 S. Ct. 2498, 2508-09, 73 L. Ed. 2d 93 (1982). The Supreme Court has not addressed whether the TIA bars the recovery of damages. However, principles of comity may apply in this case.

THE "TAX COMITY DOCTRINE"

Specifically, the Supreme Court has held that when a plaintiff challenges a **tax**, principles of comity (the "tax comity doctrine") prevent district courts from granting injunctive or declaratory relief **or awarding damages** when the state provides remedies that are "*plain, adequate, and complete*." *Fair Assessment in Real Estate Ass'n, Inc. v. McNary*, 454 U.S. 100, 116, 102 S. Ct. 177, 186, 70 L. Ed. 2d 271 (1981) (damages); *Great Lakes Dredge & Dock Co. v. Huffman*, 319 U.S. 293, 297-302, 63 S. Ct. 1070, 1072-74, 87 L. Ed. 1407 (1943) (declaratory relief); *Matthews v. Rodgers*, 284 U.S. 521, 525-26, 52 S. Ct. 217, 219-20, 76 L. Ed. 447 (1932) (injunctive relief).

Furthermore, there is no significant difference between whether a remedy is *plain, adequate, and complete* and whether a remedy is *plain, speedy, and efficient*. *See Fair Assessment in Real Estate Ass'n, Inc.*, 454 U.S. at 137 ("We discern no significant difference, for purposes of the principles recognized in this case, between remedies which are 'plain, adequate, and complete,' as that phrase has been used in articulating the doctrine of equitable restraint, and those which are 'plain, speedy and efficient,' within the meaning of § 1341."); *see also Rosewell v. LaSalle Nat. Bank*, 450 U.S. 503, 525, 101 S. Ct. 1221, 1235, 67 L. Ed. 2d 464 & n.33 (1981) (holding that not "every wrinkle of federal equity practice" addressing whether a remedy was *plain, adequate, and complete* was codified by Congress in the TIA, but further specifying that "prior federal equity cases" may be "instructive on whether a state remedy is '*plain, speedy and efficient*'"). Nevertheless, **the comity doctrine, unlike the TIA, may be waived by the states**. *Levin v. Commerce Energy, Inc.*, 560 U.S. at 432.

Unlike the TIA, "the tax comity doctrine" also prohibits federal courts from invalidating state tax provisions where such invalidation would increase, rather than decrease, state taxes. *See Levin v. Commerce Energy, Inc.*, 560 U.S. 413, 426, 130 S. Ct. 2323, 2332-33, 176 L. Ed. 2d 1131

(2010). But, in this case, **the comity doctrine, unlike the TIA, may be waived by the states**. *Levin v. Commerce Energy, Inc.*, 560 U.S. at 432.

A federal court weighs several factors:

> "in deciding whether to refrain, based upon comity, from deciding such a case, namely whether: (1) the challenged law concerned 'commercial matters over which' the state 'enjoys wide regulatory latitude;' (2) **the suit requires adjudicating 'any fundamental right or classification' to which heightened scrutiny applies**; (3) the state courts are 'better positioned than their federal counterparts to correct any violation' and provide a remedy; and (4) more than one potential remedy could adequately redress the alleged constitutional defect. Bold added. *Z & R Cab, LLC v. Philadelphia Parking Auth.*, 616 F. App'x 527, 531 n.8 (3d Cir. 2015)(citing *Levin*, 560 U.S. at 431-32, 130 S.Ct. 2323).

III.
THE LAW AT ISSUE IN PART II IS APPLIED TO THE FACTS OF THE CASE STUDY - U.S. CONSTITUTIONAL IMPLICATIONS FOR THE OWNERS OF PROPERTY BEING CHARGED AN ILLEGAL LOCAL ASSESSMENT OR FEE

A.
IN *CASHWELL ET AL. V. TOWN OF OAK ISLAND, ET AL.*, DEFENDANTS' 12(b)(1) MOTION (DE 22) TO DISMISS BRINGS A FACTUAL CHALLENGE TO THE FEDERAL DISTRICT COURT'S SUBJECT MATTER JURISDICTION

In *Cashwell et al. v. Town of Oak Island, et al.*, Defendants bring a factual challenge to the federal District Court's subject matter jurisdiction. "[A] factual challenge attacks the factual allegations underlying the complaint's assertion of jurisdiction, either through the filing of an answer or 'otherwise presenting competing facts.'" *Davis v. Wells Fargo*, 824 F.3d 333, 346 (3d Cir. 2016) (original alterations omitted) (quoting *Constitution Party of Pa. v. Aichele*, 757 F.3d 347, 358 (3d Cir. 2014)); *see also Berardi v. Swanson Mem'l Lodge No. 48 of the Fraternal Order of Police*, 920 F.2d 198, 200 (3d Cir. 1990) (holding that the factual basis for jurisdictional allegations in a complaint could be disputed before an answer was served). Where a motion to dismiss factually challenges the district court's jurisdiction, the court is not confined to the allegations in the complaint, but can consider other evidence, such as affidavits, depositions, and testimony, to resolve factual issues related to jurisdiction. *See Mortensen v. First Fed. Sav. and Loan Ass'n*, 549 F.2d 884, 891 (3d Cir. 1977) (stating that because at issue is the very power of the trial court to hear the case, a court is free to weigh evidence beyond the allegations in the complaint).

Accordingly, the threshold and potentially dispositive issue in *Cashwell et al. v. Town of Oak Island, et al.*, is whether the Town's Sewer Treatment Fee charge is a "tax" actionable under (1) the Tax Injunction Act and (2) comity concerns or a non-actionable "fee" NOT actionable under either. Because the resolution of this threshold question calls for a fact-specific inquiry, the question should be answered on a more complete record. *See*, e.g., *Cumberland Farms, Inc. v. Tax Assessor*, 116 F.3d 943, 946 (1st Cir. 1997) (noting that the determination of whether a

charge is a "tax" or a "fee," for purposes of the Tax Injunction Act and comity concerns, "presents a question of law appropriate for resolution on a properly developed summary judgment record").

B.
THE TOWN'S SEWER TREATMENT FEE CHARGE IS A PUNITIVE REGULATORY FEE, RATHER THAN A "TAX" FOR PURPOSES OF THE TIA AND COMITY CONCERNS

The TIA provides that "[t]he district courts shall not enjoin, suspend or restrain the *assessment, levy or collection* of any tax under State law where a *plain, speedy and efficient remedy* may be had in the courts of such State." Italics added. 28 U.S.C. § 1341. By its explicit terms, the TIA bars injunctive relief. Furthermore, the Supreme Court has held that the TIA extends to declaratory relief. *See California v. Grace Brethren Church*, 457 U.S. 393, 408-11, 102 S. Ct. 2498, 2508-09, 73 L. Ed. 2d 93 (1982). The Supreme Court has not addressed whether the TIA bars the recovery of damages.

With respect to comity concerns, the Supreme Court has also held that when a plaintiff challenges a tax, principles of comity (the "tax comity doctrine") prevent district courts from granting injunctive or declaratory relief or awarding damages when the state provides remedies that are "plain, adequate, and complete." *Fair Assessment in Real Estate Ass'n, Inc. v. McNary*, 454 U.S. 100, 116, 102 S. Ct. 177, 186, 70 L. Ed. 2d 271 (1981) (damages); *Great Lakes Dredge & Dock Co. v. Huffman*, 319 U.S. 293, 297-302, 63 S. Ct. 1070, 1072-74, 87 L. Ed. 1407 (1943) (declaratory relief); *Matthews v. Rodgers*, 284 U.S. 521, 525-26, 52 S. Ct. 217, 219-20, 76 L. Ed. 447 (1932) (injunctive relief).

In determining whether a charge is a "tax," which is subject to the TIA and the "tax comity doctrine," or a "fee," which is NOT subject to either, the Fourth Circuit Court of Appeals has indicated the following.

> "The 'classic tax' is **imposed** by the legislature **upon a large segment of society**, and is **spent to benefit the community at large**. The 'classic fee' is imposed by an administrative agency upon only those persons, or entities, subject to its regulation for regulatory purposes, or to raise 'money placed in a special fund to defray the agency's regulation-related expenses. Bold added. *DIRECTV, Inc. v. Tolson*, 513 F.3d 119, 125 (4th Cir. 2008).
>
> In adjudicating the issue of "tax" versus "fee," the Fourth Circuit Court of Appeals:
>
> "consider[ed] three factors: (1) *what entity imposes the charge*; (2) *what population is subject to the charge*; and (3) *what purposes are served by the use of the monies obtained by the charge*. When this inquiry places the charge somewhere between the 'classic tax' and the 'classic fee,' **it is the purpose behind the statute that imposes the charge, as reflected in the ultimate use of its proceeds**, that is the most important factor." Bold and italics added. *Id*.

Moreover, "[i]f regulation is the primary purpose of a statute, revenue raised under the statute will be considered a fee rather than a tax." South Carolina ex. rel. Tindal v. Block, 717 F.2d 874, 887 (4th Cir. 1983).

In *Cashwell et al. v. Town of Oak Island, et al.*, plaintiffs'case involves (1) declaratory and injunctive relief and (2) claims for damages in connection with the Town's Sewer Treatment Fee charges. As such, on their face, these claims fall within the scope of the TIA and the "tax comity doctrine," unless the Town's Sewer Treatment Fee charges are not determined to be "taxes." For a variety of reasons, Plaintiffs argue that the Town's Sewer Treatment Fee charges lie outside the scope of the TIA and comity concerns because said charges are punitive regulatory "fees" and not "taxes."

Primarily, while the Town's Sewer Treatment Fee charge bears some indicia of a tax (because said charge was adopted by the Town's Council), Plaintiffs argue that such feature is insignificant, as compared to other features of the Town's Sewer Treatment Fee charges. Instead, Plaintiffs argue that, for the following reasons, the Town's Sewer Treatment Fee charge is a punitive regulatory "fee," rather than a "tax," for purposes of the TIA and the "tax comity doctrine."

1.
The Town's Sewer Treatment Fee Charge is Part of a Comprehensive Statutory and Regulatory Scheme Designed to Provide Sewer Services to its Customers

First, the record establishes that the Town's Sewer Treatment Fee charge is part of a comprehensive statutory and regulatory scheme designed to provide sewer services to its customers, where the Town is using the Sewer Treatment Fee charge as a punitive measure against the owners of undeveloped parcels for not paying their fair share of the cost of operating the Town's sewer system, simply because said parcels are undeveloped.

THE LEGISLATIVE INTENT
OF ENTITY DEFENDANT TOWN LAW
IN THE TOWN'S EXECUTION OF
S.L. 2004-96 (AS AMENDED BY S.L. 2006-54)

In 2009, the Town purportedly executed the local legislation [S.L. 2004-96 (as amended by S.L. 2006-54)] enacted by the N.C. General Assembly. The Town Council determined, as follows, that it could execute said local legislation passed by the N.C. General Assembly to remedy the "inequity" that it found in undeveloped property owners not paying their fair share of the Town's Wastewater Project.

> "Let [me] make this clear for the people watching on T.V. The annual fees imposed on parcels of property within the district in the amount of $146.15 per parcel — everybody's gonna get it. The collection fees will be applied to debt service for the Town Wastewater Project; a credit will be applied to users of the Town system. So if you're buying water now, you're buying any kind of utility now, you're gonna get a credit for the amount that we're billing. This is so the parcels of property that don't have anything on it can help pay their share which they're not doing now. So don't let anybody tell you that you're getting billed $146.15

and that's the way it is. You're gonna get a credit for it. So let's make that clear." *Plaintiff's FAC* (DE 11), Exhibit II – Selected Minutes of the Special Meeting of the Oak Island Town Council on June 25, 2009, p. 20.

Specifically, in the Town Council meeting of June 25, 2009, the Town Council discussed the Sewer Treatment Fee, as follows.

"Mr. Walters explained the *Raftelis Financial Feasibility Study* proposed a 15% rate increase for FY 2009/10 in order to meet the debt service and operation/maintenance requirements of the sewer system, with the report conveying support for the 2009 Bond Issue. Mr. Walters reminded Council of the **primary methods and factors of financing the Wastewater Project, with those being property assessments and utility rates**.

Mr. Walters reported that via legislation passed in 2006, the Town may institute a Sewer Fee District that is basically a fee-supported district which could allow for some adjustments to the overall financing plan.

Mr. Walters gave the following recommendations regarding water and sewer rate adjustments:

1. Retain current water and sewer rate structure;
2. Addressing, and compensating for, the decrease in consumption, implementation of a 5% increase in water and sewer rates (about 1/3 of the rate recommended in the Raftelis Report) during FY 2009/10 and effective beginning with the August 2009 utility billing;
3. Establishment of a sewer fee district, which pursuant to the legislation must be done via resolution; with the rate set prior to July 1st of each year; and
4. Establishment of an annual sewer fee district rate for FY 2009/10 of $146.15, with this included with the property tax billing and applying to all property within the sewer district defined as the sewer limits in the Town to include the older wastewater system in the former Yaupon area, central Business District area, and Phase I / Phase I1 of the current Wastewater Project.

Mr. Walters gave the following in-depth explanation of the sewer fee district (verbatim):

While we would bill all properties we would credit developed properties which are customers of our system an amount equal to the $146.15; the rationale behind that is that when you look at the income that the rates generate, the income from the assessments that are pledged to the O&M and debt service for FY 2009/10, there is a substantial contribution to the debt service thru the rates beyond the assessments.

The fee that would be applied essentially to undeveloped property would tend to resolve an equity question, where the assessment rates do not pay for the full debt service of the collection and treatment system.

So, what I proposed will go toward meeting that in equity; it will also establish a formula so that we can apply that in future years and have equity among all the customers. It basically sets up a system which provides all the funding that we need to meet our O&M and debt service

requirements as required by the feasibility report, by the pledges made to the bondholders and meets our obligations.

It could be and seems to be, if let it, a fairly complicated system, but in all honesty ***this is the simplest way that we can resolve the true equity question that has been raised in the past*** *— and* ***that is the equity question between the developed lots that contribute debt service payments through both the assessment and the user fee versus the undeveloped lots where the assessment is their contribution to debt service****.*

. . .

Mayor Vereen commented that this was good in that Mr. Walters had figured out a way to equal the situation out with people on the system not being burdened nearly as much due to the vacant property owners contributing.

Councilor Royal made a motion to retain the current water and sewer rate structure, increase water and sewer rates by 5% for FY 2009/10 effective with the August 2009 billing, establish a sewer fee district by resolution, copy of which is included in our materials, and that we establish an annual sewer district fee for FY 2009/10 of $146.15. Councilor Ramsey seconded the motion. (Motion Carried 5 — 0)" Bold added. *Plaintiff's FAC* (DE 11), Exhibit II – Selected Minutes of the Special Meeting of the Oak Island Town Council on June 25, 2009, pp. 17-19.

Furthermore, the Town describes the Sewer District Fee/Tax, as follows

"Included on Town of Oak Island parcel tax bills is a Sewer District Fee. The Town established a Sewer District in 2009, which includes all parcel on the island where sewer service is capable of being provided by the Town (excludes mainland area where sewer service is provided by others). The Sewer District Fee is a part of the financing for sewer system improvements and expansion in the community. The fee is combined with sewer service rates and special assessments **to benefitted parcel** to finance and pay the obligations of the Town's utility system.
The purpose of the fee is to better equalize costs between developed parcel which pay utility system costs through rates, and undeveloped parcel whose contribution may be limited to payment of special assessments. This better distributes costs to all who benefit. All parcel in the Sewer District is charged a fee, but **developed parcel receives a credit for the fee** [hereinafter, 'Credit'] since developed parcel also contributes through rates. The fee will be evaluated on an annual basis." Bold and italics added. Town of Oak Island, Form 5482 SDF.

"According to the Town and Mayor Wallace, the Town issues the Credit against the Sewer District Fee/Tax charged to developed parcel owners because **undeveloped parcel owners were paying less than their fair share in previous years.**

> 'While all parcel owners are billed for the sewer district fee, *a credit is issued at the end of the year for parcel owners with developed lots* who are hooked into the system, Mayor Betty Wallace said in an email Monday. That's because they pay the fee in installments as part of their monthly bills.'

> **What the sewer district fee increase does is increase the debt service paid by undeveloped parcel owners, who were paying less into the system in previous years. Wallace noted the increase helps institute a fairer debt payment plan amongst all residents**.' Bold and italics added. Cantwell, S. 'Why did Oak Island raise the sewer tax for only vacant lots?" *Star News, MyReporter.com,* October 3, 2012. Available online at: http://www.myreporter.com/?p=16019.

Finally, as reported by the Star News (November 11, 2013):

> "Town officials have said all parcel owners pay the sewer district fee, but in different ways. Last year, the town increased the amount owners of undeveloped parcel pay because officials said that they had been paying less than their fair share.
>
> **While all parcel owners are billed for the sewer district fee, a credit is issued at the end of the year for parcel owners of developed lots who are hooked into the system. *That's because they pay the fee in installments as part of their monthly bills, town officials have said.***" Bold and italics added. Gonzales, J. "*Oak Island man files lawsuit over sewer fee*." Star New Online, November 11, 2013. Available online at: http://www.starnewsonline.com/article/20131111/articles/131119966."

As referenced above, the statutory and regulatory features of the Town's Sewer Treatment Fee charge support the conclusion that the charge is a punitive regulatory "fee" rather than a "tax."

2.

The Revenue from the Town's Sewer Treatment Fee charges is NOT used Solely to Fund (1) Principal Payments Due during the Year, (2) Non-Operating Interest Expense, and (3) Operating Expenses for County Services in the Treatment of Sewer Sewerage, as Required

Second, it is undisputed that all of the revenue from the Town's Sewer Treatment Fee charges is NOT used to fund (1) principal payments due during the year, (2) non-operating annual interest expense, and (3) annual operating expenses for county services in the treatment of sewer sewerage, as required by the enabling legislation [S.L. 2004-96 (as amended by S.L. 2006-54)]. All of the revenue generated from the Town's Sewer Treatment Fee charges does NOT flow into the Sewer District Fee Fund. Although such fund is separate and distinct from the Town's general fund, only a small percentage (less than 23%) of the total annual revenue generated from Town's Sewer Treatment Fee charges flows into the Sewer District Fee Fund and is used for the statutorily required purpose. The balance (over 77%) is used to pay back Sewer Treatment Fee revenue charges (in the form of a credit) to private owners of developed parcels. In the instant case, it is undisputed that the Town has utilized only a small portion of the Town's Sewer Treatment Fee revenue from charges for the statutorily required purpose. In fact, **Town officials intentionally and knowingly assessed Sewer Treatment Fee charges, during property tax years 2015-2017, that exceeded the Town's statutory ceiling limitation by over 86%, in VIOLATION of Section 4 of S.L. 2004-96 (as amended by S.L. 2006-54).** Clearly, revenue from the Town's Sewer Treatment Fee charges is not a vehicle for raising general revenue that could be used for any variety of government functions. Nor is any portion of the revenue raised by the Town's Sewer Treatment Fee charges placed in the Town's general fund.

3.
The Salient Features of the Town's Sewer Treatment Fee Charges Core Closely Resemble a Punitive Regulatory "Fee," as Opposed to that of a "Tax"

Third, the salient features of the Town's Sewer Treatment Fee charges more closely resemble that of a punitive regulatory "fee," as opposed to that of a "tax." For example, the Town's Sewer Treatment Fee charges effectively apply only against owners of undeveloped properties within the Town's Sewer Treatment District. The record establishes that out of approximately 11,000 parcels within the Town's Sewer Treatment District, approximately 2500 parcels (less than 23%) are undeveloped parcels. Furthermore, the record reveals that there is NO rational relationship between the amount of Sewer Treatment Fee charged and the services that were provided to undeveloped properties. Undeveloped property owners do not pay the Town's Sewer Treatment Fee charges simply because they own property within the Sewer Treatment District. Undeveloped property owners pay the Town's Sewer Treatment Fee charges because they own property that is undeveloped. The regulatory purposes served by features of the Town's Sewer Treatment Fee charges counsel in favor of characterizing these charges as punitive, regulatory fees. *See San Juan Cellular Telephone Co. v. Public Service Comm'n of Puerto Rico*, 967 F.2d 683 (1st Cir. 1992) (explaining that the "classic 'regulatory fee' . . . may serve regulatory purposes directly by, for example, deliberately discouraging particular conduct by making it more expensive") The basis of the Town's Sewer Treatment Fee charge calculation (raising the carrying cost of undeveloped property more than 450%) creates an incentive for owners of undeveloped parcels to develop (to avoid paying the Town's Sewer Treatment Fee charge altogether). Thus, the structure of the Town's Sewer Treatment Fee charge encourages development practices that result in increased sewer user fee revenue for the Town, and thereby a "fee" for purposes of the TIA and comity concerns. Cf. *GenOn Mid-Atlantic, LLC v. Montgomery County*, 650 F.3d 1021, 1025 (holding that a county carbon charge was a fee for purposes of the Tax Injunction Act because of its plainly regulatory purpose of discouraging greenhouse gas emissions). Also, *see Unified Gov't of Athens-Clarke Cty. v. Homewood Village, LLC*, 292 Ga. 514, 739 S.E.2d 316, 3138 (2013) (concluding that the fact that a stormwater ordinance enabled property owners to reduce the amount of their stormwater charge by maintaining stormwater management systems "further underscore[d] the notion" that the ordinance at issue imposed "a fee and not a tax").

IV.
BASED UPON THE IMPLICATIONS OF THE FINDINGS IN PART III, FOR THE OWNERS OF PROPERTY BEING CHARGED AN ILLEGAL LOCAL ASSESSMENT OR FEE, PLANNING OPPORTUNITIES ARE PRESENTED

A.
CONCLUSION

For the reasons set forth above, the Town's Sewer Treatment Fee charge at issue is a punitive regulatory "fee," rather than a "tax," and is therefore not actionable under either the Tax Injunction Act or comity concerns.

B.
PLANNING OPPORTUNITIES

For property owners facing an illegal local assessment or fee, this article demonstrates that said property owners will have a federal remedy if that can show that the illegal local assessment or fee is a punitive regulatory "fee," rather than a "tax," and is therefore not actionable under either the Tax Injunction Act or comity concerns.

IMPACT OF HCAHPS SCORES ON HOSPITAL READMISSION RATES

Hui-chuan Chen and Tommy Cates, University of Tennessee at Martin
Christopher Cates, Baptist Memorial Hospital, Union City, TN
Monty Taylor, University of Tennessee at Martin

ABSTRACT

In 2013, the Centers for Medicare and Medicaid Services (CMS) began withholding a percentage of revenue received by lower-rated hospitals. CMS ties hospital reimbursement rates to quality metrics thus forcing hospitals to improve their service or risk financial penalty. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) patient satisfaction survey is an instrument developed by the CMS and the Agency for Healthcare Research and Quality (AHRQ) as part of a standardized process for reporting of patients' perception of care. HCAHPS results have been publicly available since 2008. Moreover, hospital value-based purchasing (VBP) is designed to financially incentivize acute-care hospitals to improve their performance on several quality measures. The hospital VBP program utilizes the HCAHPS survey nationally as a key measure of patient satisfaction. Almost 20% of Medicare recipients who are discharged are readmitted within 30 days. Since 2012, the Medicare Hospital Readmissions Reduction Program (HRRP) has sought to decrease the 30-day readmission rates for Medicare patients. Hence, the information provided by patients on the HCAHPS survey directly affects provider revenue. The objective of our study is to determine if the HCAHPS survey impacts readmission rates and payments as originally intended to improve patient quality. Moreover, excessive readmission rates may negatively impact reimbursement payment to healthcare providers. Our results indicate that data provided from the Hospital Compare database for acute-care hospitals indeed reflects quality outcomes. Thus, higher HCAHPS scores led to lower readmission rates. Nevertheless, when patients reported lower quality service measures via HCAHPS scores, the hospital reimbursement did not reflect financial incentives or penalties.

Student Papers

Artificial Intelligence In Manufacturing

Regular Session

Mr. Hayden Jenkins [1]

1. *Anderson University*

Artificial Intelligence is being hailed as the fourth industrial revolution. It's power to be more efficient, precise, and cost effective than humans has large implications for our society. It was found that many manufacturing plants already incorporate A.I. into their processes and are seeing great benefits. This is expected to continue over the next decade. However, what will the human cost be? As humans become less and less necessary to manufacturing processes, their jobs disappear. While more jobs will open up for those that can create these machines, those who don't have these skills may be left behind.

Balanced K-Means Algorithm with Equitable Distribution of Power Ratings

Oral

Mr. Muthuraja Palaniappan [1], ***Mr. Ananthapadmanabhan Sivasankaran*** [1]

1. *Purdue University*

Traditional K-means clustering algorithm helps divide the data into clusters that are similar. Similarity is based on Euclidean distances. However it does not have limits on the minimum and maximum number of observations in each cluster nor accounts for the “power ratings” of the observations. The cluster-to-cluster similarity is ignored at the cost of within-cluster similarity. We overcome this problem by developing a modified K-Means algorithm where the minimum and maximum number of observations in each cluster and the power ratings of each observation are taken as constraints.

We have implemented a heuristic algorithm(Shunzhi Zhu 2010) to transform the size-constrained and clustering problem into Linear Programming approach and develop a modified K-Means. On top of this we have added power-ratings-constraints to make the algorithm solve the problem of similarity (rather than difference) among clusters based on a specified feature.

Though there have been attempts to include size constraints for K-means clustering problem our approach is unique because none of the previous papers have attempted to solve K-Means with external constraints such as power ratings. This method of Balanced K-Means with equitable distribution of power ratings is easy to interpret and has the advantage of wide acceptance.

Business case used for demonstration purpose is Division III Men’s Wrestling conference realignment problem, where schools should be geographically located as close as possible to one another so that their travel time and costs are reduced. Additional constraints are that each cluster should have a similar number of schools with equitable distribution of power-ratings per cluster.

Keywords:R, Linear Programming, Balanced K-Means, Constrained Clustering, Data Mining

Bridging individual and organizational resilience: A multilevel perspective

Oral

Ms. Melanie Hinterplattner [1]

1. *Georgia Southern University; University of Applied Sciences Upper Austria - Logistikum*

In order to manage disruptions effectively, emergent research focuses on the concept of resilience – i.e., the adaptive capability to operate in the face of disruptions. Whereas extant literature largely focuses on organization- and network-level resilience, few studies advance behavioral models of risk and resilience that include the individual level. Yet, employee behavior is critical to organization- and network-level resilience. Drawing from the psychology literature to inform our view of individual-level resilience, we use the case study methodology to identify the essential attributes of employee resilience and investigate how these attributes affect organizational resilience.

Keywords: employee resilience, organizational resilience, multi-level model

Factors that diminish the effect of Top Management on Lean Six Sigma

Oral

Mrs. Lakshmi Madarasu [1]

1. *GE*

Lean Six Sigma methodology is considered an excellent process improvement technique that is known for removing waste (non-value added activities) and variation in any process. The relationship between top management commitment in an organization and the success of implementing a process improvement technique has been widely explored in Operations Management research. While it is generally well known that top management commitment is needed to effectively implement Lean Six Sigma changes, the purpose of this paper is to investigate factors that could mitigate the influence of top management commitment towards the successful implementation of the Lean Six Sigma methodology in an organization. The novelty of the paper is in determining how an ambiguous scope, missing data and high implementation cost negatively moderate the relationship between top management commitment and the success of Lean Six Sigma implementation and how project duration positively moderates the relationship between top management commitment and the success of Lean Six Sigma implementation. The theoretical and managerial implications of the model have been discussed and also the implications for further research and theory development are presented in this paper.

Keywords: Top Management; Ambiguous Scope; Missing Data; Implementation
Cost; Project Duration ; Lean Six Sigma

Finding Solutions for MEGA SNACKS' Distributions

Oral

Mr. Justin Schwartz [1], ***Mr. michael womack*** [1], ***Ms. Ann Morris*** [1]

1. *Fayetteville State University*

The examination and optimization of a small section of the current route distribution for an international snack provider - MEGA SNACKS. This was done in an effort to improve the company's delivery times, reduce its overhead, and stream-line its fleets. Methods: Combinatorial optimization was utilized to determine a set of routes that satisfies all customer demands while satisfying all operational constraints and minimizing the global cost. ODL Studio 1.4.1 was used to process and overlay data points onto a local map of real world roadways. Results: Solving the CVRP for this subpopulation reduced the fleet by one vehicle, decreased the overall route time by over four hours, eliminated 161 kilometers of travel distance per day, and reduced gas emissions and cost by over 3000 gallons of fuel used each year. Conclusion: Application of this method to all routes will likely produce a synergistic effect as savings will be maximized across all routes and new savings may be acknowledged by the optimization of interregional distribution points.

FIRM'S REACTION TO COMPETITION AND FIRM PERFORMANCE

Oral

Mrs. Huiling Liu [1], ***Ms. Melanie Hinterplattner*** [1]

1. *Georgia Southern University*

Competition plays an important role in firms' competitive advantage generation and evolution. What competitors do and achieve affect a focal firm's strategies, operations and reactions, vice versa. The objective of this paper is to evaluate how a firm reacts to competition in order to keep competitive advantages and to achieve better performance. The main idea is that a firm's performance is a function of competitive actions between the firm and its competitors. These competitive actions and reactions from rival firms and focal firms lead them to co-evolve. We take the "Red Queen Effect" as our theoretical lens to describe a firm's reactions to both competitors' actions and business environmental changes within the industry. We use firm's rate of change of investment to represent firms' actions and reactions and argue that there are causal relationships among competitors' rate of change, focal firm's rate of change, and focal firm's performance. Our model takes the form of a spiral: while competitors' rate of change is positively related to a focal firms' rate of change, a focal firms' rate of change positively affects its performance. Subsequently, a focal firm's rate of change as well as its performance positively affect competitors' rate of change. This is an ongoing research, and currently we are in the process of analyzing data.

Key Challenges in Quantitative Research: Rationality, Consistency, and Application of Quantitative Measurement

Oral

Mr. Muhammad Hassan Bin Afzal [1], ***Dr. Larry "Daniel" Cravens*** [2], ***Dr. Karoly Bozan*** [3]

1. *Kent State University,* ***2.*** *Director, Bengal Solutions, College of Business, Idaho State University,* ***3.*** *Assistant Professor of Information Systems Management, Palumbo Donahue School of Business, DUQUESNE UNIVERSITY*

The shifting trends in the ideological changes in public are explained in two broader ways such as relative stability and absolute stability. Here, the relative stability focuses on the relative shifts in ideology over time and on the other hand, absolute stability focuses on the absolute shifts in ideology in a specific state [1]. Berry et al. criticize these two approaches and they provided a quantitative explanation in their research article why these two are flawed. They further comment that relative stability in public ideology is very difficult to measure, evaluate, and pinpoint a specific trend. If the basic measurement and assumptions are flawed and do not accurately represent the basic shifting trends in public perceptions and ideology then the further studies, policy implementation, and government decisions will be flawed too. These days, the citizens of a society are living in interesting times where their political opinions are polarized and continuously changing due to the settings and available information. Researchers and political scientists developed different frameworks and infrastructure to analyze, measure, and evaluate the shifting trends in public perceptions about public policies, political parties, and government expenditure on certain social issues. This critical synthesis article focuses on the rationality, consistency, and application of quantitative measures, and a mixed methodology, in determining the stability of public perception in political ideology over time.

Optimizing Drone Allocation and Coverage for Disaster Zones

Oral

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Victims of a flood disaster, or those that are inundated, are often in a critical situation that needs an urgent response. The most critical of these victims are those that are outside the reach of disaster response personnel. In this study, we consider the deployment of teams of UAVs (Unmanned Aerial Vehicle) to decrease the number of victims who are out of reach. To address this a mixed integer nonlinear optimization model has been proposed to optimize coverage of disaster areas, positioning of drone operators, and how their drones should be positioned with the most efficiency. To test the model, data from Hurricane Katrina is used as the target disaster area.

Optimizing Mail Courier Delivery Routes to Maximize Efficiency for Cumberland County Schools

Oral

Mrs. Linda Caesar [1], ***Mr. Mario Caesar*** [1], ***Ms. Deja Williams*** [1]

1. *Fayetteville State University*

Public Education is a vital foundation to the success of the world, starting in the early stages affording all children an equal opportunity of learning producing future accountants, presidents, doctors, entrepreneurs and so much more. This project is the result of trying to create optimal routes for the interlocal mail courier deliveries within the Cumberland County School System. This study presents a new solution for the department to deliver shipment to each school daily, reduce excessive mileage driven, save on gas usage, and increase overall efficiency. To accomplish this task, we used Open Door Logistics Studio 1.41(ODL) to provide vehicle routing & scheduling capabilities.

KEYWORDS: Vehicle routing, Optimization, Mail delivery, Cumberland County School system, Depot, Road Network, and GeoCoder

Perceived Personalization and Privacy Issues and Their Impact on Chinese Attitudes Toward Online Advertising

Oral

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1. *James Madison University*

Personalized online advertising affords marketers the power to draw in consumers' attention amid numerous competing ads; however, it may also give rise to more adverse privacy concerns. The intent of this paper is to study the impact of personalized advertising, perceived privacy concerns, irritation and trustworthiness on attitudes toward online advertising (ATOA) and behavioral intent. The survey was conducted in a large shopping mall in the Northern part of China. A total of 348 usable responses were analyzed. Factor analysis, independent t-tests, and regression methods were used in the analysis. This study indicates that personalized advertising, perceived privacy concerns, and trustworthiness significantly impact ATOA, and ATOA significantly impacts behavioral intent. This study also reveals that older, more educated, and female respondents were more concerned about privacy, predominantly those that were students, teachers, public servants, store staffs, professionals, and business persons.

SWOT/TOWS Analysis of Williams-Sonoma, Inc.: An Honors Adaptation of a Live Case Strategic Management Project

Oral

Ms. Alexandra Legut [1]

1. *c*

As an Honors student furthering my education at a public institute of higher education, I was tasked with applying an advanced level of critical thinking to a capstone class assignment. I worked to update an old version of the capstone assignment and further expanded my knowledge on the assignment by conducting a case study that would act as a question, the solution being the updated assignment. This case study reviews a scenario with CEO of Williams-Sonoma, Inc., Laura J. Alber and employee of Williams-Sonoma, Inc. Alex. Alex is assigned to complete a SWOT/TOWS analysis report using the data that is presented throughout the case study. The report overviews both the internal and external analysis of the company and identifies the top strengths, weaknesses, opportunities, and threats. It then provides a pairing analysis of all possible scenarios the company could experience while disregarding those that may seem unfeasible.Those scenarios that remain are then ranked and combined to create a final list of critical issues the company should assess for future reference.

The importance of writing this analysis is to evaluate all possible scenarios thatthe company could experience then rank them to determine the top criticalissues that the company has. Pulling all this information into one reportorganizes it and shows a strategic way that a company can form a decision basedoff previous references. This case study was designed forteachers to use as an assignment where students can apply firm dynamics tocraft a report that is like the one included in Appendix S2. The reportshould answer the following question; what scenarios are associated with thecritical issues facing the firm over the next few years? This case studyis replicating a good introduction to creating a real-time case wherethe information included must be gathered using extensive research.

The impact of information technology capability on production process variability under environmental uncertainty

Oral

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Operations managers are continually searching for ways in which they can improve the production process performance. Theory of swift even flow (TSEF), as a fundamental theory in operations management, suggests that the speed and consistency of the flow of material and information into, through, and out of any production process determines its productivity. Hence, an increase in the variability of flow of goods and information in a production process will cause lower productivity and vice versa. Today, as firms are moving towards globalization, they are operating in an uncertain environment, so the variability in production process will be enhanced which reduces production performance. Therefore, it is important to diagnose, manage, and reduce such variability in operations processes. We look at this issue through the organizational information processing theory (OIPT) lens. By recent improvements in information technology (IT), companies are able to better process the information and deal with uncertainties by improving their process management. This study develops a conceptual model that explains the linkage between IT capability, production process variability, environmental uncertainty, and operations performance. We empirically examined our model using secondary information collected from Compustat database and InformationWeek 500 ranking over a 9 years period. Structural equation modeling is used to evaluate the model. The results of this study indicate a positive relationship between IT capability and operating performance. In addition, a moderating role of IT capability on relationship between environmental uncertainty, process variability, and operating performance is supported. Accordingly, this study contributes to the literature by explaining the underlying mechanism in which IT capability improves the production process performance and its impact on process variability in an uncertain environment. In addition, it made a bridge between two big theories of TSEF and OIPT by looking at the impact of IT capability on process variability. Moreover, managers can consider IT capability as a tool to control process variability and its detrimental effects on operations performance.

Keywords: Process variability, IT capability, Swift even Flow, Information Processing Theory, Environmental uncertainty

The Impact of Parcel Carriers on the Healthcare Supply Chain

Regular Session

Ms. Marissa Black [1], ***Ms. Sara Walenceus*** [1]

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Logistics is a major theme in current research regarding healthcare supply chain management, and communication is a key component of supply chain efficiency. This case study summarizes interviews with four healthcare organizations regarding shipping issues with parcel carriers. This area of logistics represents an area of opportunity in the healthcare supply chain. In addition, a representative from a group purchasing organization (GPO) and a representative from a third-party logistics provider (3PL) were interviewed for further insight. Interviewees provided recommendations based on their industry experience. It was determined that planning, internal communication, relationship management, and the implementation of priority shipping options have the potential to decrease issues with parcel carrier shipments. The compilation of these recommendations represents potential best practices for the industry. Future research is required to determine the efficacy of these approaches.

Keywords: healthcare, supply chain, logistics, parcel carriers, communication, shipping

The Influence of Learning Types on Human Error Propensity

Oral

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Scholars have identified human error as a potential cause for unsatisfactory system performance. Human error can be triggered by vulnerabilities or complexities in the system or unintended deviation from protocol. Human error can further be classified into skill-based errors, rule-based mistakes and knowledge-based mistakes. With existing literature and logic both advocating that organizational learning mitigates human error, this paper aims to unveil the importance of profiting from the errors committed by the employees of an organization by rephrasing the perception of learning. The main idea is to articulate that certain errors can be rectified by certain behaviors and learning techniques, namely deutero, meta and planned learning. The novelty of this article lies in determining how the three aforementioned types of learning help to remedy the three types of human errors leading to fruitful theoretical and managerial implications along with directions for future research.

Keywords: *Human error, skill-based error, rule-based mistakes, knowledge-based mistakes, deutero learning, meta learning, planned learning*

The Internet of Things and its Effect on the Power Grid

Regular Session

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1. *Anderson University*

The Internet of Things (IoT) is an interrelated connection of objects and devices of modern day technology through online and electrical system connections. This allows the transfer, gather, exchange, and analyze data to see where society is going with new developing technology with current technology. We will cover how objects communicate with one other and how the interaction makes life easier for all societies. Our society is heavily reliant on technology and there is a limit on the total utilization, but what is the limit and how close are we? We will discuss how society will handle the limit and utilize what ways we can use this. We will analyze economic trends, renewable resources, and the effects of other sociological structures that play a part in the total IoT utilization. There are many possibilities for what IoT can turn into, many of which are positive and can improve the standard of living even more but what threats do we face? IoT is based on connections between all of our technology connecting our processes and objects in a society which correlates to the main goal of supply chain management. The possibilities are endless for IoT and we will see if our analysis and predictions play out in the way that we expect they could. We will conduct interviews with professionals representing companies whose products range from adhesives, packaging, and aeronautics.

ARTIFICIAL INTELLIGENCE IN MANUFACTURING

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The future is here. Artificial intelligence has begun to creep into every aspect of society, and many experts warn of a dystopic future where the vast majority of "low-skill" occupations are replaced by robots, resulting in the unemployment of millions of people in the first world, and eventually everywhere. One of the industries that robots are already heavily involved in is the manufacturing world. However, how likely is this "replacement"? What exactly is it that A.I.- powered robots can do that will replace the roles of humans?

One matter that must be resolved before one talks about this issue in detail is what exactly *is* artificial intelligence? Many conversations about it end up being counter-productive because the participants are each talking about different things. Merriam-Webster defines
Artificial Intelligence as "a branch of computer science dealing with the simulation of intelligent behavior in computers", and "the capability of a machine to imitate intelligent human behavior".
[4] With these definitions in mind, one can better understand A.I.'s role in the manufacturing world.

The attractiveness of A.I. to executives in manufacturing companies is easy to understand. Machines do not take breaks to eat or rest. They do not need time off. They do not need to be paid on a salary or hourly basis. Once the robot is purchased, it only needs regular maintenance, which is far cheaper than paying an employee for their labor. While the upfront cost of a manufacturing robot may be high, that investment is made back very quickly. In a world where profit is often the only motivator, minimizing costs is the priority.

However, how much progress has A.I. made into the field of manufacturing, and how far will it continue? Last year, the author of this paper had the opportunity to visit the Michelin manufacturing plant in Greenville, South Carolina. Michelin is respected as the manufacturer of some of the highest quality consumer tires on the market. Their manufacturing process explains why. From start to finish, automation drives the development of each and every tire. While some of these robots are not exactly using A.I. rather than simple algorithms, many are. Machines are inspecting the tires and moving them from station to station as the tires take shape, standardizing the process so the amount of variation in each tire is much smaller than it would be were humans more involved. Humans are participating in the process, but their role is minimal compared to what it likely was a decade ago. The amount of tasks that used to be performed by humans but are now performed by robots in this plant is staggering. While most other tire manufacturers have not yet reached Michelin's level of automation, they likely will in the next decade. Dr Jongwoon Hang, a Business Lead for AI Implementation at KIST Europe, writes that "The impact of AI on manufacturing is likely to usher in a whole new era of industrial development.

The first three industrial revolutions were triggered by the introduction of mechanical, electrical and digital technologies, respectively. Now, AI will be the driver of a fourth revolution known as 'Industrie 4.0.'" [3] Artificial Intelligence is not a niche concept anymore. It will soon usher in the fourth industrial revolution. However, A.I. has not yet replaced humans in many manufacturing positions. According to a report from Drishti on the state of A.I. in manufacturing, 72% of tasks in factories are still performed by humans. "'Machines don't
innovate anything,' said Doug Neely, director of advanced monozukuri research at Yazaki North America. 'Our people are the source of all of our competitiveness. There isn't a machine out there

that we could buy that would make us more competitive.'" [1] One can gather from this that people are clearly still important. With this in mind, why use machines at all? Many reasons have been stated previously, but one more is that humans produce variability. According to the same report, 68% of the defects on the factory floor can be attributed to human error. Humans are inconsistent, machines are not. If one wants to streamline their manufacturing process efficiently, then they need robots. Humans are still necessary, but not as much as they used to be.

What tangible ways can A.I. speed up manufacturing processes with, though? While minimizing variability is a great quality, A.I. is often far quicker than humans at performing repetitive tasks. "SAM — short for Semi-Automated Mason — created by the New York based Construction Robotics. SAM is capable of laying 3,000 bricks per day, and he is coming to the U.K. in a few months." [5] This robot, while not exactly a manufacturing robot, can offer a look into how much quicker than humans at basic tasks that robots can be. " SAM can work about 500 percent faster than humans, and discrepancy in labor cost that causes is significant. According to a report by Zero Hedge, 3,000 bricks boils down to a cost of 4.5 cents per brick. Based on a $15 per hour minimum wage rate and benefits, a human bricklayer with an average efficiency of about 500 bricks will cost construction firms about 32 cents per brick — that's more than 7x the cost of an automated bricklayer." [5] It is worth nothing that this robot does not work completely independently, (A person has to feed bricks into as well as clean up after it) but it is clear that SAM is taking the primary task that a person used to do, making it much quicker, and therefore minimizing cost. The negative effect is, of course, that the people that used to lay the bricks are out of a job.

This poses an issue that society must solve soon, or risk severe unrest and violence from those that are unemployed. In America especially, work is often a source of meaning. Many find their self-worth in their work. While this is not an ideal scenario, it is reality. While other industrial revolutions have put people out of work, the future brought on by Artificial Intelligence is poised to be the most devastating cause of unemployment yet. There are so many asks that can be automated, the possibilities are nearly endless. The potential unemployment that will result from this wave of automation is extremely dangerous, and A.I. must be closely watched. Some believe that Artificial Intelligence will create more jobs than it eliminates, but it remains to be seen what will happen to those who do the jobs that A.I. will replace.

A study by the Pew Research Center demonstrates the current divide in technology expert thought on the issue of artificial intelligence's role in society. "The vast majority of respondents to the 2014 Future of the Internet canvassing anticipate that robotics and artificial intelligence will permeate wide segments of daily life by 2025, with huge implications for a range of industries such as health care, transport and logistics, customer service, and home maintenance. But even as they are largely consistent in their predictions for the evolution of technology itself, they are deeply divided on how advances in AI and robotics will impact the economic and employment picture over the next decade." [2] This study demonstrates that the general consensus is that A.I.'s transformative power will bring sweeping changes to society. However, there is no consensus on the economic ramifications. "Half of these experts (48%) envision a future in which robots and digital agents have displaced significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order. The other half of the experts who responded to this survey (52%) expect that technology will not displace more jobs than it creates by 2025. To be sure, this group anticipates that many jobs currently performed by humans will be substantially taken over by robots or digital agents by 2025. But they have faith that human ingenuity will create new jobs, industries, and ways to make a living, just as it has been doing since the dawn of the Industrial Revolution."

[2] As one can see, there is a lot of optimism about A.I. as well as a lot of caution. Some data seems to suggest that robots will not eliminate jobs, but instead improve them. Matthew Rendall, the CEO of OTTO Motors, (a division of ClearPath Robotics) writes that "Over the last 20 years, inflation-adjusted U.S. manufacturing output has increased by almost 40 percent, and annual value added by U.S. factories has reached a record $2.4 trillion. While there are fewer jobs, more is getting done. Manufacturing employees are better educated, better paid and producing more valuable products — including the technology that enables them to be so much more productive." [6] He goes on to say that while there may be short term job losses, that the data suggests that these losses will give way to even greater gains, with the end result being a better paid workforce that works in more desirable jobs. He posits that this can be known because of how the automobile industry has already transitioned into automation, with little negative impact. So, he says, this automation revolution is nothing to be afraid of. Now, this positive impact may not play out the same way in other industries. For example, it is unlikely that self-driving cars will end up bringing better employment for truck drivers. However, at least in the manufacturing industry, some say the future is not so bleak as many make it out to be.

So, how does all of this optimism and anxiety about the future of artificial intelligence affect the manufacturing world? As it becomes more and more integrated into manufacturing processes, one can expect several different things to happen. One of the most immediate effects will be one already discussed. As machines make manufacturing processes more consistent and less prone to error, defects in products will be minimized, likely increasing profits for manufacturing companies. As these A.I. powered manufacturing robots continue to creep into these companies, they will begin to replace more and more people, putting them out of work.
The rest of the effects are unknown, but it is undeniable that its existence has huge implications for not only manufacturing, but the entire world. Another effect, at least according to Matthew Rendall, is that the job quality of many in the manufacturing industry will increase, yielding higher wages and better work environments [6]

Automation in manufacturing is inevitable. It is cheaper, faster, and quite frankly more consistent than human labor. As manufacturing companies edge closer and closer to being "taken over" by automation, the employees hang in the balance. This is, in essence, the most important consideration: How will this technological advancement affect people? Will this progress make manufacturing jobs a thing of the past? Will they merely improve wages and work environments, but largely keep jobs intact? There is evidence for both predictions. It remains to be seen just how the industry will end up once A.I. has saturated it further, but so far the results are positive. Automation speeds up processes and minimizes defects. In a world where so many products are mass-produced, humans cannot always be relied on to make sure those products are as close to identical as possible. It is only a matter of time until manufacturing processes are almost entirely automated. This fourth industrial revolution has the potential to usher in a wave of prosperity, but it must be handled carefully. How A.I. changes manufacturing can serve as an example of how it will change the rest of the world.

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BALANCED K-MEANS ALGORITHM WITH EQUITABLE DISTRIBUTION OF POWER RATINGS

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Ananthapadmanabhan Sivasankaran, Purdue University

ABSTRACT

Traditional K-means clustering algorithm helps divide the data into clusters that are similar. Similarity is based on Euclidean distances. However it does not have limits on the minimum and maximum number of observations in each cluster nor accounts for the "power ratings" of the observations. The cluster-to-cluster similarity is ignored at the cost of within-cluster similarity. We overcome this problem by developing a modified K-Means algorithm where the minimum and maximum number of observations in each cluster and the power ratings of each observation are taken as constraints.

We have implemented a heuristic algorithm(Shunzhi Zhu 2010) to transform the size-constrained and clustering problem into Linear Programming approach and develop a modified K-Means. On top of this we have added power-ratings-constraints to make the algorithm solve the problem of similarity (rather than difference) among clusters based on a specified feature.

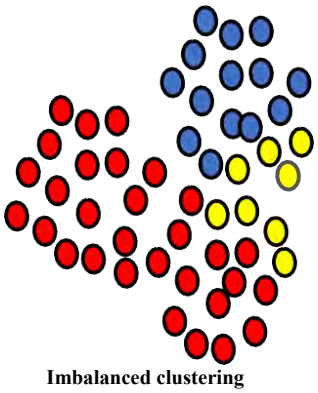
Though there have been attempts to include size constraints for K-means clustering problem our approach is unique because none of the previous papers have attempted to solve K-Means with external constraints such as power ratings. This method of Balanced K-Means with equitable distribution of power ratings is easy to interpret and has the advantage of wide acceptance.

Business case used for demonstration purpose is Division III Men's Wrestling conference realignment problem, where schools should be geographically located as close as possible to one another so that their travel time and costs are reduced. Additional constraints are that each cluster should have a similar number of schools with equitable distribution of power-ratings per cluster.

Keywords: R, Linear Programming, Balanced K-Means, Constrained Clustering, Data Mining

INTRODUCTION

K-Means is efficient in terms of clustering based on Euclidean distances. But, clusters generated are imbalanced in terms of number of observations might be infeasible to use it in practical scenarios. At times, the clusters could include just a handful of observations while there are other larger clusters with lot of observations. Such clusters without a minimum and maximum number of observations per cluster will not be useful in the cases of Market Segmentation, Supply Chain Modeling, etc.



Imbalanced clustering

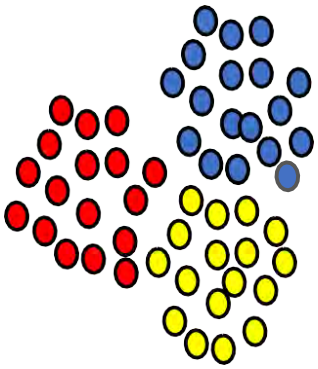


Figure 1: The difference between balanced and imbalanced clustering

As shown in above picture, the imbalanced clustering will force us to give more weightage to certain clusters and very less weightage to others – this is often not possible in real-life scenarios.

A use case we chose to demonstrate is Division III Men's wrestling. Sports Organizations such as NCAA face the problem of having a competitive regional level competition where there must be enough number of teams in each region. They would also like to reduce the travel time of the teams. Not all teams at the regional level are at the same level of competitiveness. Rankings and regional organization play a significant role in collegiate wrestling and affect the results of national tournament performance (Bigsby and Ohlmann, 2017). Hence, there should be balancing of not only the number of teams but also the "power rating" of the participating teams so that the better teams can win at regional level and the national level will be more competitive.

Division III Men's wrestling faces the above problems. Generally, in these Wrestling competitions the winning team from each of the 6 regions proceed to the national level. Other than that, 2 other wild card entries are also allowed. So, it is of paramount importance that the teams at the regional level are of approximately equal power ratings. We should also ensure that there are almost equal number of teams in each region.

As of 2016, few regions had as few as 11 teams, while others contained as many as 21. Moreover, it is unfair for the perennially successful teams that are co-located in the same regions. These features are exaggerated by an unbalanced competitive landscape among DIII wrestling teams. In the last 25 years, only two schools, Wartburg College (13 titles) and Augsburg College (12 titles) have won national titles. As a consequence of competitive imbalance, some of the best wrestlers compete in the same region and do not qualify for the national tournament.

With our Balanced K-Means approach we develop an optimal group of observations that are not geospatially wide apart while also balancing the imbalanced observations and improving the current region assignments.

Models like Genetic Algorithms are not entirely explainable to the authorities regarding the reason for clustering. Our Balanced K-Means approach overcomes this by helping with interpretability while at the same time better than the results that were attained by Genetic Algorithm approach.

There are several applications of balanced clustering with equitable power ratings:

- Supply Chain modeling where distribution centers supply products to geographically clustered stores with different demands. If the stores with higher demands are clustered together just because of geographical proximity, it will lead to greater stress on the distribution centers servicing those

stores especially during season.

- Roll out of marketing campaigns in a geography to customers of different power ratings (purchasing power). If a variety of offers are sent to only a specific group say rich customers because of their geo-spatial proximity, then the offers targeting middle and low income segments would not have enough uptake.

Due to such wide-ranging usage that is possible, this problem of Balanced K-Means with equitable distribution of power ratings is an important problem to solve. The same issues of interpretability are important in the field of Marketing Research as well and hence, our modified K-Means approach is more likely to be implemented vis-à-vis other approaches like Neural Networks or Genetic Algorithms to solve this problem.

The remainder of this paper is organized as follows: A review on the literature on various criteria and methods used for Balanced K-Means is presented in the next section. In Section 3 the proposed methodology is presented, and the criteria formulation is discussed. In Section 4 various models are formulated and tested. Section 5 outlines the performance of our models. Section 6 concludes the paper with a discussion of the implications of this study, future research directions, and concluding remarks.

LITERATURE REVIEW

The steps of K-Means are as follows:

- Create K clusters by assigning each observation to the closest centroid
- Compute K new centroids by averaging Euclidean distance between observations in each cluster
- Continue above steps until the centroids don't change

K-Means Algorithm Extensions

We found a few studies that had the same theme but different from our research. Bradley, Bennett, and Demiriz (2000) investigate adding constraints to K-Means to ensure each cluster will "have at least a minimum number of points in it." Essentially, they show that incorporating a lower bound to the number of observations within each cluster will result in reducing the likelihood that the K-Means algorithm will identify poor local solutions – those with one or few points within a group.

Wagstaff, Cardie, Rogers, & Schroedl (2001) examine constrained K-Means clustering when additional background knowledge of the problem is available. Wagstaff et al. (2001) modify K-Means by incorporating "background knowledge in the form of instance-level constraints."

Usami (2014) also recognizes the importance of efficient algorithms that result in output with good balance between clusters. In his study, he proposes a method with lower bound constraints on cluster proportions and a direct estimation of the number of unknown clusters. However, his method still requires improvement to handle clusters that do not fulfill cluster proportions and distance among clusters.

Bhattacharya, Jaiswal, and Kumar (2015) explored constrained K-Means problems by proposing an algorithm that gives a tight upper and lowers bound on the list of candidate centers. Thus, they present an alternative that intends to improve the feasibility of providing better clusters through better center candidates. K-Means (Bradley et al., 2000)

C. T. Althoff, A. Ulges, A. Dengel (2000) tried using Frequency Sensitive Competitive Learning (FSCL) algorithm to solve the K-Means algorithm. While the traditional K-Means relies on Euclidean distance, this modified version tries to balance that weight with the number of points assigned to the cluster. The paper then deviates to combine this idea with hierarchical clustering.

This modified version is further explored in Mikko I. Malinen and Pasi Fränti (2014). They tried using Hungarian algorithm to solve the assignment problem of balanced K-Means clustering algorithm. By doing so, the time complexity got reduced to O(n^3) when compared to linear programming in constrained K-means algorithm.

Shunzhi Zhu, Dingding Wang, Tao Li (2010) have proposed a heuristic algorithm to transform size constrained clustering problems into integer linear programming problems. However, this approach does not deal with Power Ratings.

Chen, Zhang and Ji (2005) have proposed an algorithm to minimize the size regularized inter-cluster similarity (this is equivalent to maximizing the size regularized intra-cluster similarity). The size regularized cut overcomes the drawback of average cut and the normalized cut that are sensitive to outliers due to the multiplicative nature of their cost functions.

Data-mining problems have demands that require balanced clusters with approximately same size or importance (Banerjee, 2006) and it is important to create K-Means variants that allow such control to increase the reliability of the clusters and its relevance to the problem.

The steps of our balanced K-Means algorithm are as follows:

- Solve K-Means as per the usual approach
- Use these as initial centroids and check for minimum and maximum number of observations in each cluster using Linear Programming approach proposed by Shunzhi Zhu, et al., 2010
- Optimize for the power ratings of the observations using this as an additional constraint in the Linear Programming

To illustrate the main contribution of our algorithm, we compare different balanced K-Means algorithms from the literature in Table 1. Based on this comparison, we want to emphasize that our method intends to be a unique solution to clustering problems, since it is meant for applications where additional external constraints are known (not only minimum and a maximum number of observations in each cluster but also the "power ratings" of each observation). By taking advantage of this additional information, our algorithm is more likely to produce a satisfactory solution.

Moreover, unlike most of the other papers (barring Shunzhi Zhu, et al.,) we have used Linear Programming approach to solve K-Means thereby making it an easily interpretable and low math complexity problem.

Table 1

Balanced k-Means methods	Easily implemented	Low math complexity	Cluster size controlling	Robustness to initialization	Scalable
Multicenter clustering (Liang, et al., 2012)	●		●	●	
MinMax K-Means (Tzortzis et al., 2014)	●		●	●	●
Min-Cut Clustering (Chang, Nie, et al., 2014)	●	●			●
Weight point sets (Borgwardt, Brieden, et al., 2016)			●	●	
Background knowledge (Wagstaff et al., 2001)	●	●	●		
Undersampled (Kumar, Rao, et al., 2014)	●	●			●
FSCL (C. T. Althoff, A. Ulges, A. Dengel, 2000)	●		●	●	

Balanced K-Means with Hungarian algorithm (Mikko I. Malinen et al., 2014)			•	•	•
Heuristic with Linear Programming (Shunzhi Zhu, et al., 2010)	•	•	•	•	
Size-regularized inter-cluster similarity (Chen, et al. 2005)			•	•	
Balanced K-Means with equitable distribution of power ratings (this approach)	•	•	•	•	

DATA

The dataset is publicly available at NCAA website. The dataset consists of the following data:

Table 1: Data used in study

Variable	Type	Description
Longitude	Numeric	Longitude of the wrestling team
Latitude	Numeric	Latitude of the wrestling team
Power Rating	Numeric	Power Rating (similar to Elo rating) of the wrestling team

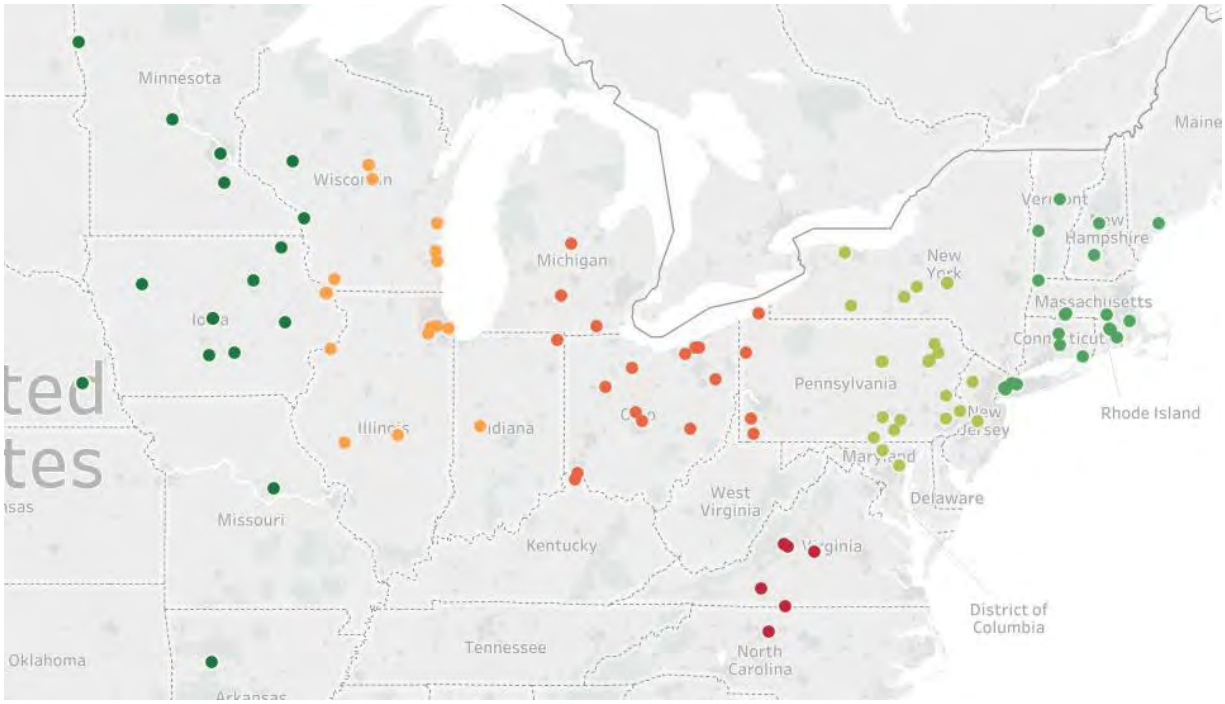


Figure 2: Clusters generated by the standard K-means algorithm

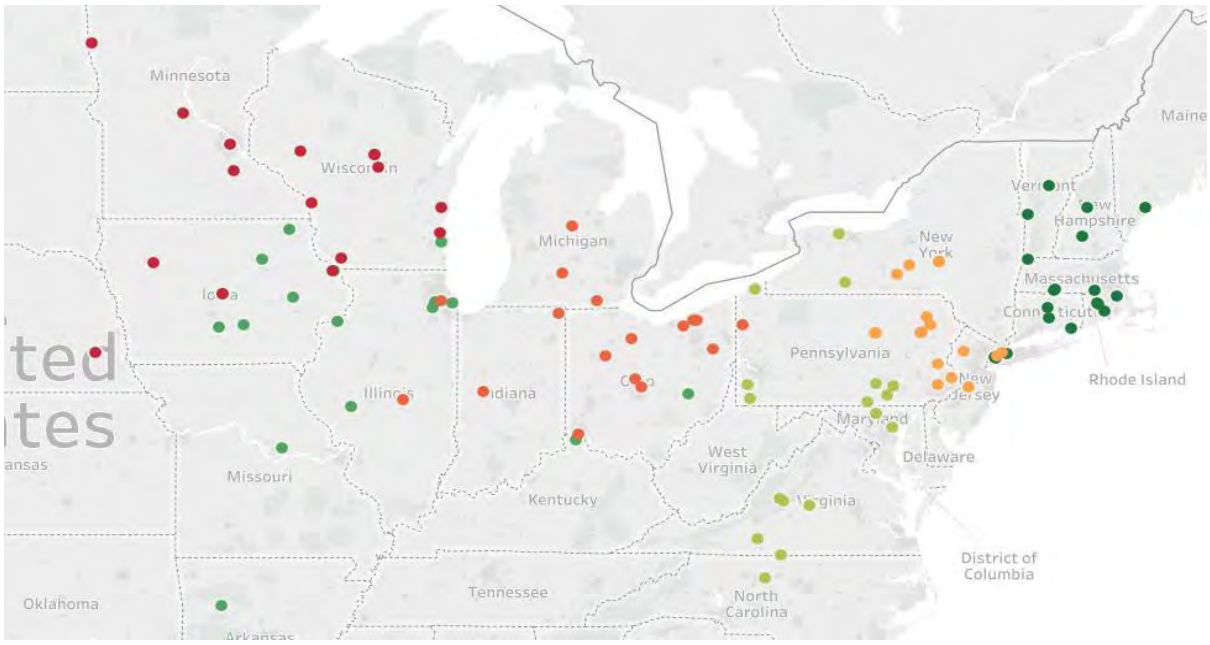
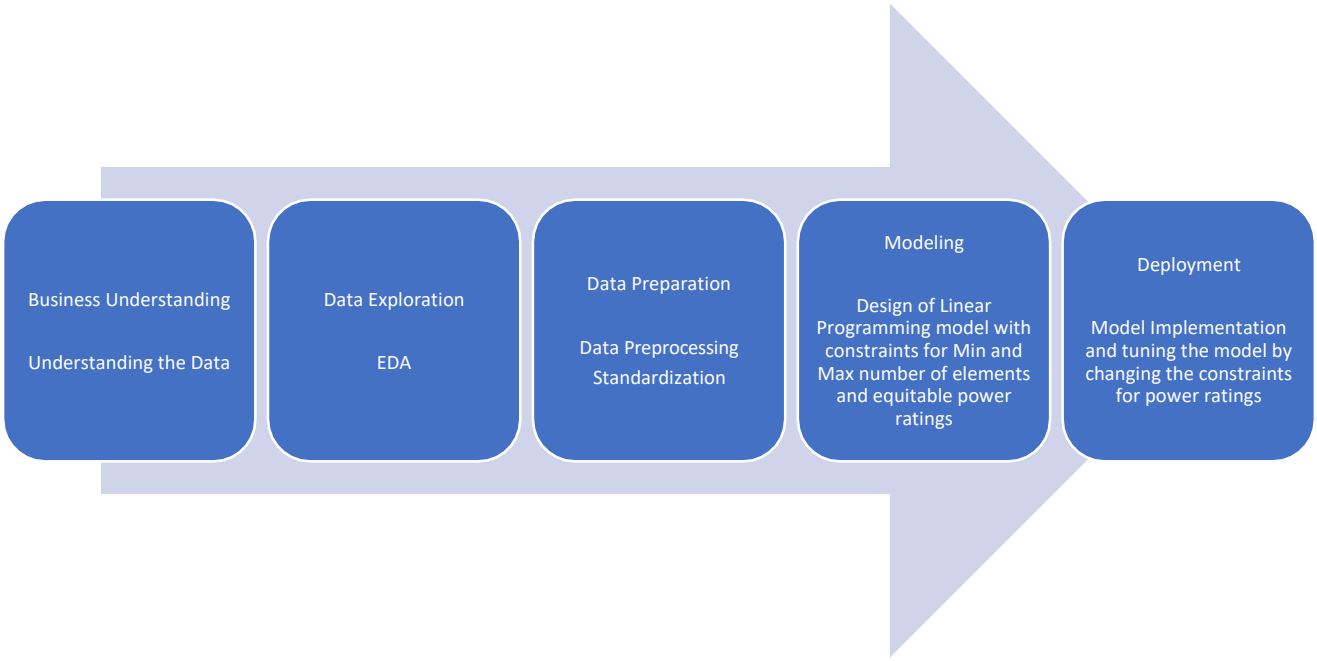


Figure 3: Clusters produced by our algorithm have observations clubbed together in terms of distance and equitably distributed power ratings eg: Wartburg College and Augsburg College are in different clusters though they are geographically close.

METHODOLOGY



We have implemented Linear Programming approach to optimize the constrains of maximum and minimum number of elements in each cluster as well as equitable distribution of power ratings in each cluster.

The user must specify the minimum number of elements in each cluster and maximum number of elements in each cluster. If minimum is set too high, the model will not be able to converge. Similarly, if the maximum is set too low, the model will fail to converge.

Optimization Parameters:

$$Minimize: \sum_{i=1}^{n} \sum_{j=1}^{k} d_{ij} * b_{ij}$$

$Subject\ to$:

$\sum b_i \geq Minimum size of the cluster$

$\sum b_i \leq Maximum size of the cluster$

$\Sigma p_i b_i \geq (\mu - delta * \sigma) * average\ size\ of\ \ cluster$

$\Sigma p_i b_i \leq (\mu + delta * \sigma) * average\ size\ of\ \ cluster$

$\sum\ b_j = 1$

$b_{ij} = \{0,1\}$

where μ and σ are the average and standard deviation values of the power rating (target variable) and d is the distance matrix between points and center of each cluster. b is the matrix of optimal cluster allocation that we want to find. p is the power rating (target variable) that we would like to maintain near the mean and delta is a user-defined value for tolerance in p. If minimum is set too high or maximum set too low, the model will not be able to converge.

Low delta makes the model to force-fit elements in such a way that power ratings are closer to mean of all the power ratings. This is a very restrictive condition. This leads to the points being widely dispersed in terms of distance.

As we relax this condition by increasing delta, the model fits the elements in a more natural way. For balanced K-Means, we see that the points are not dispersed too wide geospatially. Once the convergence is realized, we can fix the delta.

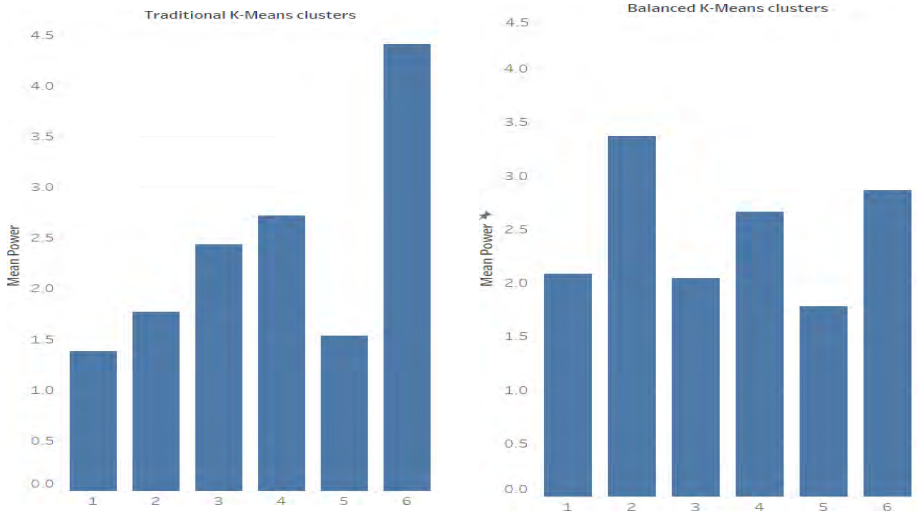


Figure 4. The comparison of mean power ratings between traditional K-Means and Balanced K-Means clearly shows the disparity

MODEL

To achieve our goal, we have used custom defined K-Means clustering. As mentioned before, this model involves using K-Means clustering to first arrive at a solution set for clusters and then optimizing this cluster allocation to arrive at the most optimal result.

Our motivation to arrive at this methodology was mainly motivated by the paper published in 'Data Clustering with Size Constraints'(Shunzhi Zhu 2010), where the heuristics were used to arrive at a similar yet balanced cluster from the preexisting allocation. We realized that instead of simple allocation, distance matrix would be a better suitable candidate for optimization. Also, since all the constraints are integral coefficients, the solution must also have integral coefficient as solution.

Regarding the constraints on the number of elements in each cluster, according to the WagStaff et al [7], imposing a minimum constraint in the number of elements is enough in most of the cases as balancing the clusters automatically gives clusters around the optimal size. But, for generalization, we have included both the boundary constraints in our models.

Like ridge and lasso extensions of OLS, we proposed a penalty constraint for deviating from the mean of target variable. This factor used as delta is user defined and would determine how important is it for the clusters to have mean target variable values. Having a low delta would force the clusters to be very haphazard at the cost of achieving close mean values of target variable. Having a large delta would defeat the purpose of having the target variable in the first place. Typically, a value of 0.5 to 2 is recommended.

For the linear optimization part, we used the predefined library 'lpsolve' from R. The distance calculation among the points were Euclidean and 'pdist' library was used to implement the same.

RESULTS

After implementing our algorithm, we obtained the following map organization in Figure 3. Clusters produced by our Balanced K-Means algorithm satisfy the problem requirements (whereas the standard K-Means algorithm does not).

The Figure 3 clearly shows that the clusters that we found are much better than the clusters that are currently assigned by NCAA. This will increase the competitiveness of the sport and increase fan following at the national level. Also, the fairness of the sport will be restored as the strong teams need not face each other at the regional level and miss out on reaching national level.

This new organization of schools is aligned with the NCAA's expectations in terms of distance between schools and average competitiveness. Both these constraints are taken care of in our clusters. Thus, we verified that our modified version of the K-Means algorithm can be implemented successfully in problems within this domain.

The decision support for Market Segmentation where there needs to be balancing of the number of customers in each segment as well as their power ratings, this algorithm can be used.

CONCLUSIONS

This simplified approach is beneficial to the business as it is easily understood and also clusters the teams appropriately leading to equitable distribution of power. This could find applications for Supply Chain Modeling and Market Segmentation where there needs to be a balance between the clusters.

Division III Men's wrestling team assignments are imbalanced leading to competitions being skewed against the stronger teams and the matches being uncompetitive at national level. This calls for a better clustering approach that not only looks at approximately equal number of teams but also the equitable distribution of power ratings of the teams within each cluster.

The conversion of K-Means to Linear Programming approach with minimum and maximum number of observations in each cluster as constraints with additional constraints for balancing the power ratings solves the problem of balancing the clusters.

We have made generalized the algorithm for any number of columns and assumed that the number of features is at least 2. Since it is a Linear Programming approach, as the number of features increases, the time taken to solve the problem increases. This is the limitation in our study.

Ways of increasing the speed of the algorithm as the number of features increases could be looked upon in the future.

Alternatively, instead of Linear Programming approach, we could explore ways to implement Hungarian Algorithm that Mikko I. Malinen, et al., proposed and include power ratings constraint in that. We could see which method gives faster and accurate results.

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BRIDGING INDIVIDUAL AND ORGANIZATIONAL RESILIENCE: A MULTILEVEL PERSPECTIVE

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ABSTRACT

In order to manage disruptions effectively, emergent research focuses on the concept of resilience – i.e., the adaptive capability to operate in the face of disruptions. Whereas extant literature largely focuses on organization- and network-level resilience, few studies advance behavioral models of risk and resilience that include the individual level. Yet, employee behavior is critical to organization- and network-level resilience. Drawing from the psychology literature to inform our view of individual-level resilience, we use the case study methodology to identify the essential attributes of employee resilience and investigate how these attributes affect organizational resilience.

STUDY OVERVIEW

In today's tightly connected global and dynamic environment, disruptions have become the norm [1]. In order to manage disruptions effectively, researchers and practitioners have started to focus on the concept of resilience, which is defined as the adaptive capability to operate in the face of disruptions [2]. Extant literature mainly focuses on organization- and network-level resilience. Christopher and Peck (2004), for example, advance five broad enablers of supply chain resilience – i.e., supply chain understanding, supply base strategy, supply chain collaboration, agility, and supply chain risk management culture; Kim et al. (2015) highlight the importance of a network-level understanding in order to cope with SC disruptions. At the organization-level, questions have been raised concerning necessary capabilities of a resilient organization [9] and actions companies must take in order to recover from disruptions and lower vulnerability [10].

Interestingly, few studies advance behavioral models of risk and resilience that include the individual level; yet, employee behavior is critical to organization- and network-level resilience. For example, Home and Orr (1997) argue that systems' responses (e.g. the responses of organizations and supply chains) to disruptions are based upon the collective actions of organizations' employees. Similarly, Van der Vegt and colleagues (2015) argue that the most important element of an organization is, at the most basic level, its employees and that a critical source of capacity for organizational resilience is embedded in the characteristics of employees. This is consistent with other recent research which asserts that

resilience is more than adapting your organization or network to its environment, but for an organization to be resilient, it requires resilient employees [6]. Thus, an organization's resilience is largely influenced by the abilities, competencies, and characteristics of its individual members, i.e., its employees [7], and their ability to respond quickly and effectively to change [8].

Despite its importance, there is limited understanding of individual factors that promote resilient behaviors in organizations. Consequently, the theoretical link that logically connects individual- and organization-level resilience, as well as the attributes that comprise employee resilience, remain unclear. Yet, establishing this theoretical connection may be important for both employees and firms. For example, disruptive events may motivate employees' self-preserving behaviors, compromise employees' abilities to perform their roles, and increase employee absenteeism at a time that organizations need their employees most. Furthermore, employee absence due to disruptions may not only affect team functioning, but also influence the network ties between employees, as well as the overall network structure, the spread of information within and between organizations, and resulting adaptive responses [11].

Individual resilience is a latent construct that has its roots in the field of psychology in the context of children with good developmental outcomes despite their high-risk situations, such as family breakdown, chronic poverty, parental psychopathology, and war [12]. The context has since broadened to encompass the ability of adults to cope with and manage abnormal situations, such as disasters, unexpected health problems, and even "routine" abnormal events such as major traffic accidents [7]. As illustrated in Figure 1, our review of the psychology literature suggests that an individual's resilience profile is comprised of several factors.

Drawing from the psychology literature to inform our view of individual-level resilience, we used the case study methodology to identify the essential attributes of employee resilience and investigate how these attributes affect organizational resilience.

Specifically, we conducted 41 interviews with managers at four manufacturing firms – a steel mill (13 interviews), a truck OEM (8 interviews), a first-tier automotive supplier (12 interviews), and a bearings manufacturer (8 interviews). These firms varied in several dimensions including number of employees, annual sales, and ownership structure. Our approach included interviews at corporate headquarters and manufacturing plants. All interviews were conducted on-site and lasted approximately 60 minutes. Interview participants varied in terms of job tenure (3-35 years), level within the organization (e.g. vice-president, managing director, and manager), and functional unit (SC, logistics, HR, quality, R&D, maintenance, production, planning, sales, controlling, customer service, and purchasing). We transcribed all interviews within 24 hours of data collection. After coding the transcripts, employee resilience factors and their individual meanings emerged from the data.

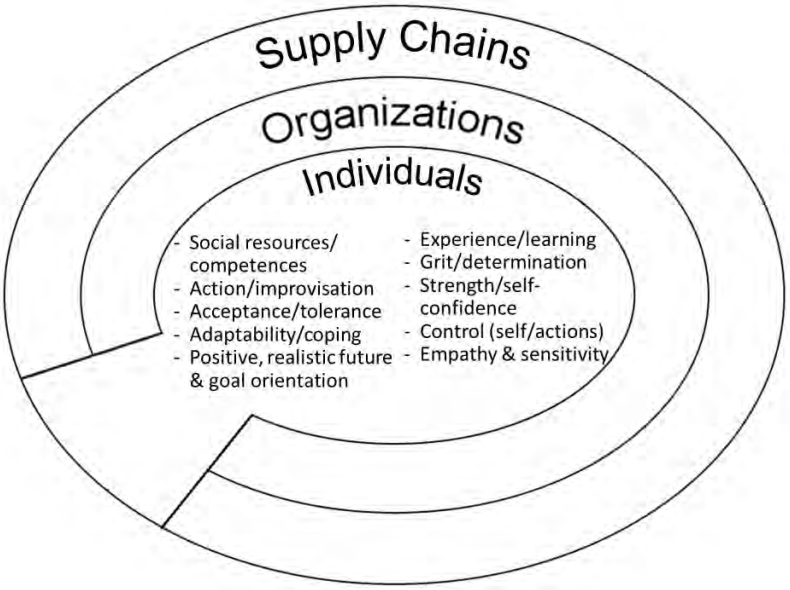

Figure 1: Conceptual Model

Our preliminary results, in select cases, align with the psychological literature; specifically, participants cited several attributes which we classified into the following seven categories: (1) social resources and competences – i.e., contacts, communication, and communication skills, (2) grit and determination – i.e., perseverance, (3) action/improvisation – i.e., the importance of acting, not waiting, and being proactive, (4) experience and learning – i.e., training and motivation, a high willingness to learn, learning and practical experience, and learning how to cope with new things, (5) empathy and sensitivity – i.e., emotional stability, open minded, honesty, and empathy, (6) adaptability – i.e., openness to new things and openness to changes, and (7) strength and self-confidence – i.e., knowing your strengths, estimating your abilities well, and trusting yourself.

The identification of employees' resilience attributes represents an initial step in developing the logic that connects individual- and organization-level resilience. Further analysis of the transcribed interviews and associated case data will further aid the development of a multi-level theory of resilience. We anticipate that our research will motivate the investigation of several related questions including: Which employee resilience attributes are critical for specific positions within an organization? To what extend must each employee possess critical individual resilience factors? Is employee resilience more important to leaders, front-line employees, or gatekeepers?

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FACTORS THAT DIMINISH THE EFFECT OF TOP MANAGEMENT ON LEAN SIX SIGMA

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ABSTRACT

Lean Six Sigma methodology is considered an excellent process improvement technique that is known for removing waste (non-value added activities) and variation in any process. The relationship between top management commitment in an organization and the success of implementing a process improvement technique has been widely explored in Operations Management research. While it is generally well known that top management commitment is needed to effectively implement Lean Six Sigma changes, the purpose of this paper is to investigate factors that could mitigate the influence of top management commitment towards the successful implementation of the Lean Six Sigma methodology in an organization. The novelty of the paper is in determining how an ambiguous scope, missing data and high implementation cost negatively moderate the relationship between top management commitment and the success of Lean Six Sigma implementation and how project duration positively moderates the relationship between top management commitment and the success of Lean Six Sigma implementation. The theoretical and managerial implications of the model have been discussed and also the implications for further research and theory development are presented in this paper.

Keywords: *Top Management, Ambiguous Scope, Missing Data, Implementation Cost, Project Duration, Lean Six Sigma*

Finding Solutions for MEGA SNACKS' Distributions

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Purpose: The examination and optimization of a small section of the current route distribution for an international snack provider - MEGA SNACKS. This was done in an effort to improve the company's delivery times, reduce its overhead, and stream-line its fleets. **Methods:** Combinatorial optimization was utilized to determine a set of routes that satisfies all customer demands while satisfying all operational constraints and minimizing the global cost. ODL Studio 1.4.1 was used to process and overlay data points onto a local map of real world roadways. **Results:** Solving the CVRP for this subpopulation reduced the fleet by one vehicle, decreased the overall route time by over four hours, eliminated 161 kilometers of travel distance per day, and reduced gas emissions and cost by over 3000 gallons of fuel used each year. **Conclusion:** Application of this method to all routes will likely produce a synergistic effect as savings will be maximized across all routes and new savings may be acknowledged by the optimization of interregional distribution points.

Introduction & Problem Definition

Delivery of goods from manufacturer to retailer, within a local market, is an important dynamic that is plagued by various problems. Delayed or early shipments of product can cause a vendor to seek stocking solutions from a different manufacturer or result in penalties on the manufacturer for contract violations[2]. Furthermore, delayed shipments can result in products expiring or perishing which is cause for concern in both an environmental and financial perspective. Route, traffic pattern, time of day, type and size of delivery, distance, and a myriad of other factors all contribute to areas of possible error on the side of distribution. It is, therefore, imperative for companies such as MEGA SNACKS that an optimal delivery route system be in place when distributing goods within a local market.

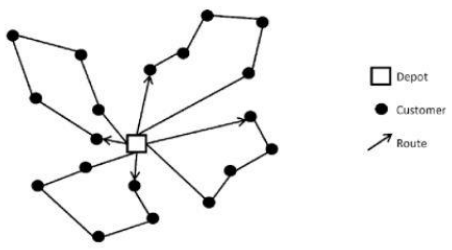
This project examines the distribution routes of one of the world's largest international salty and savory snack companies. For proprietary reasons, this company will be referred to as MEGA SNACKS. As one of the world's largest manufacturers and distributers of savory snacks, MEGA SNACKS delivers weekly supplies to retailers such as Sam's, Costco, and B.J.'s; as well as, chain grocery stores and small-town gas stations. The company delivers product to nearly 500 individual stores in the Sandhills' [NC] area alone with each store being serviced from a central warehouse located in Hope Mills, North Carolina. On average, over 20,000 dollars' worth of product is delivered to locations such as these every week. In order to stay ahead of the competition in this growing region, MEGA SNACKS must continuously improve its delivery times, reduce its overhead, and streamline its fleet. Thus, finding optimal routes for distributions is key for the operational success of the company.

Literature Review

Capacitated vehicle routing problems (CVRP) are a common issue amongst distribution companies. The problem involves a set of customers, having known locations and demands, being supplied by a fleet of capacitated vehicles out of a single distribution point with known travel costs. The problem is to design the vehicle routes such that each customer is served by a single vehicle, the vehicle capacity is not violated in any of the routes, and the total routing cost is minimized (Figure 1). They are often divided into creating taxonomy or creating a generalized framework that summarizes existing models, objectives pursued, and associated theories associated with the analysis of the problem[7]. As time progresses these problems become more diverse in their ability to capture real-time data through the usage of integrated software, global positioning systems, and other modern and emerging technologies. Set partitioning (SP) algorithms[1] and branch-and-cut-and-price (BCP) algorithms[4] have proven to be some of the most effective exact algorithms to date. Although SP was able to successfully compute lower bounds based on elementary routes and was faster than BCP, it could not solve three instances that BCP could handle[8]. The model proposed here differs in that it allows for user-defined constraint functions to have no restrictions on functional form, can handle larger instances, and is more specialized when accounting for routing problems[10].

Experimental Section

Real world, year-to-date data (December 31, 2018 through April 22, 2018) was obtained, with permission, from MEGA SNACKS Coastal Carolina Regional Manager. The data was then combed for relevancy and additional data added as need to account for location (latitude/longitude), average load times, vehicle capacity, vehicle miles per gallon, average cost of fuel, travel distances, store demand (in dollar amount), and individual download times.



[Figure 1 – Example CVRP solution]

As the MEGA SNACKS distribution issue is a non-deterministic polynomial time hardness (NP-Hard) problem[6], it is unfeasible to solve as the problem becomes exponentially larger. Thus, we used a heuristic mathematical model based on a formulation of the traveling salesman problem (TSP) [3] in which the objective function was set to

Minimize:

$$\sum_{i=0}^{n+1}\sum_{j=0}^{n+1} c_{ij}x_{ij} \quad (1)$$

Subject to:

$$\sum_{\substack{j=1\\ j\neq i}}^{n+1} x_{ij} = 1\ , \qquad i = 1,\dots,n, \quad (2)$$

$$\sum_{\substack{i=0\\ i\neq h}}^{n} x_{ih} - \sum_{\substack{j=1\\ j\neq h}}^{n+1} x_{hj} = 0\ , \qquad h = 1,\dots,n, \quad (3)$$

$$\sum_{j=1}^{n} x_{0j} \leq V \quad (4)$$

$$y_j \geq y_i + d_i x_{ij} - Q\left(1 - x_{ij}\right),\ i,j = 0,\dots,n+1, \quad (5)$$

$$d_i \leq y_i \leq Q\ , \qquad i = 0,\dots,n+1, \quad (6)$$

$$x_{ij} \in \{0,1\}\ , \qquad \mathrm{i,j} = 0,\dots,\mathrm{n}+1, \quad (7)$$

Where:

- Problem defined with complete undirected graph G(N,E)
  - N = node set = C ∪ {0, n + 1}
    - [node] 0 & n+1 denote supply point (beginning and end of route)
    - C = {1,…,n} = set of customers
      - i ε C = positive demand related to each customer
  - Set E = arcs (i,j) for node pairs i, j ε N
- cij = cost of crossing an arc (i,j) ε E
- di = node demand
- di > 0 for each i ε C
- d0 = dn + 1 = 0
- Q = Vehicle capacity
- yi = continuous decision variable represents load left after visiting customer i
- V = Number of vehicles
- xij = 1 ONLY IF route goes from customer i to j directly for i,j ε N

This model attempts to minimize the global cost by summing the total cost of the routes (1) while ensuring that deliveries to all customers are made and no customer receives a double shipment (2). The objective function is further constrained in that a vehicle that arrives at a store also departs from that store (3), the maximum number of vehicles in the fleet cannot be exceeded (4), the capacity of the vehicles cannot be exceeded (5), and subtours are avoided (6). The variable domains are further set by constraints (7).

The route generator was set up through means of a Java based toolkit known as jsprit as supplied under GraphHopper GmbH Apache License (2.0)[5]. In order to build vehicles unique to MEGA SNACKS, a vehicle type builder is used and type and capacity are specified:

```
/* * typeId "vehicleType"
   *addCapacityDimension(dimensionIndex,dimensionValue)*/
   final int WEIGHT_INDEX = 0;
   VehicleTypeImpl.Builder vehicleTypeBuilder = VehicleTypeImpl.Builder.newInstance("vehicleType").addCapacityDimension(WEIGHT_INDEX,#);
   VehicleType vehicleType = vehicleTypeBuilder.build();/*
    * Use vehicle-builder and build a vehicle located at (#, #) with type "vehicleType"*/
   VehicleImpl.BuildervehicleBuilder=VehicleImpl.Builder.newInstance("vehicle");
   vehicleBuilder.setStartLocation(Location.newInstance(#, #));
   vehicleBuilder.setType(vehicleType);
   VehicleImpl vehicle = vehicleBuilder.build();
```

Bold "#" indicate customizable fields based on capacitance of vehicle (weight index) and starting (depot) latitude/longitude coordinates; these were changed based on need for MEGA SNACKS vehicles. Next the locations of each customer that receives product from MEGA SNACKS was created. Thirty-five such locations were created, three are shown (chaining is allowed):

```
Serviceservice1 = Service.Builder.newInstance("1").addSizeDimension(WEIGHT_INDEX,#).setLocation(Location.newInstance(#, #)).build();
Serviceservice2 = Service.Builder.newInstance("2").addSizeDimension(WEIGHT_INDEX,#).setLocation(Location.newInstance(#, #)).build();
Serviceservice35=Service.Builder.newInstance("35").addSizeDimension(WEIGHT_INDEX,#).setLocation(Location.newInstance(#, #)).build();
```

Once again editable fields customized toward the specific problem at hand are denoted by bold "#". Here fields indicate locations (latitude/longitude) of customers with the weight index being the demand for each. The vehicles and routes defined previously can be built together in a builder using the following:

```
VehicleRoutingProblem.Builder vrpBuilder = VehicleRoutingProblem.Builder.newInstance();
vrpBuilder.addVehicle(vehicle);
vrpBuilder.addJob(service1).addJob(service2).addJob(service3).addJob(service35);
```

```
VehicleRoutingProblem problem = vrpBuilder.build();
```

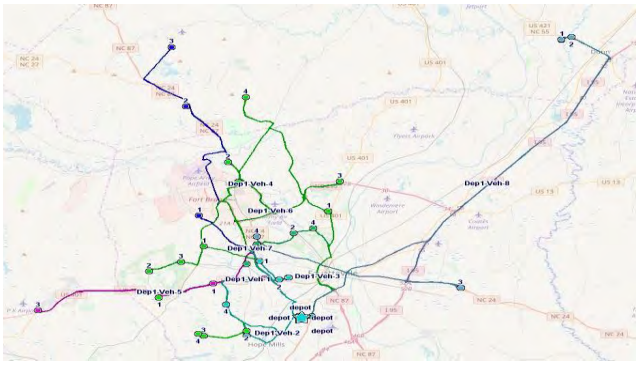
For sake of brevity, service 3 - 34 is omitted, job is customizable based on number of customers programmed. With this, an infinite number of vehicles (as defined above) are able to be used to solve the problem and transport costs are computed as Euclidean distances. The final step is to define and run the algorithm (out-of-the-box):

```
VehicleRoutingAlgorithm algorithm = Jsprit.createAlgorithm(problem);
Collection<VehicleRoutingProblemSolution> solutions = algorithm.searchSolutions();
VehicleRoutingProblemSolution bestSolution = Solutions.bestOf(solutions);
```

Here a solution is searched for that returns a collection of solutions and the statistic helper-method is utilized for the utility class Solutions in order to return the best solution in terms of lowest cost. Summaries for the solutions can be obtained through concise, detailed, or imaging means with

```
SolutionPrinter.print(problem,bestSolution, Print.CONCISE);
newPlotter(problem,bestSolution).plot("output/solution.png", "solution");
newPlotter(problem,bestSolution).plot("output/solution.png", "solution");
```

The GraphHopper code utilizes OpenStreetMap data (open source) and is integrated seamlessly into ODLStudio 1.4.1, which is an open source software application for non-real time vehicle routing and territory mapping/management. Each vehicle was attributed a specific start time based on average loading capability of a senior driver and time-windows were enforced at 14 hours per Department of Transportation regulations[9]. Both MEGA SNACKS original and optimized data were computed for comparison. Algorithms were run on an ASUS ROG utilizing Windows 10 operating system and an Intel® Core(TM) i7-4710HQ CPU @ 2.50 GHz, 2501 Mhz, 4 Core(s), 8 logical processor.



[Figure 2 – Data 1 Overall Route]

Results

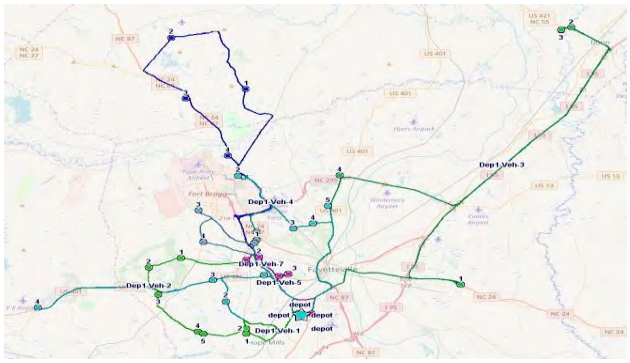
Thirty-five routes were programmed into the system with a vehicle capacitance of 13,000 dollars' worth of merchandise. In the original model (Data 1) of how MEGA SNACKS currently operates, nine routes were planned with demands varying between 350 – 1919 dollars' worth of product. This route can be viewed in Figure 2. Recalibrating the parameters for optimization, that is allowing for any number of routes to be considered and any number of vehicles within the constraints resulted in Figure 3. A full table of the data output for both models can be found in Appendix A. By assessing all of the data and doing relatively easy computations, it is seen that the Data 2 (optimized) outperforms Data set 1 (original) in total route time, total fuel cost, total distance, number of routes, and average route distance (table 1). The optimization data naturally performs more poorly in average route time and average route stops (due to changing vehicle number but set stops).

In addition to optimization data that specifically shows potential savings, this process can generate multiple forms of charts that can be useful in the planning process. These charts were not conducive to this particular project but will be included in the discussion to further emphasize the benefits of the process.

Discussion

By optimizing the distribution routes utilizing the method shown here, MEGA SNACKS can save approximately 4 hours, $24.30, 161 km, and 1 vehicle for the district 0822 (table 1). While this may not seem like significant savings, this is only one of thousands of routes per day savings. Extrapolation of this algorithm across the entire company will bring the savings into the tens of millions. Furthermore, additional savings will be realized in that it may be discovered that routes in one district actually belong in another district, making these routes even more proficient. Savings not quantified here, but no less real, include vehicle maintenance and turnover, personnel expenses, and environmental regulations.

However, there are limitations to this study. Perhaps the most glaringly obvious, is that this heuristic was only performed on a small number of stops. The data becomes infinitesimally more difficult to compute as more stops are added; adding just one more stop increases the number of possible route choices by 3.62×10^{41}.



[Figure 3 – Data 2 Overall Route]

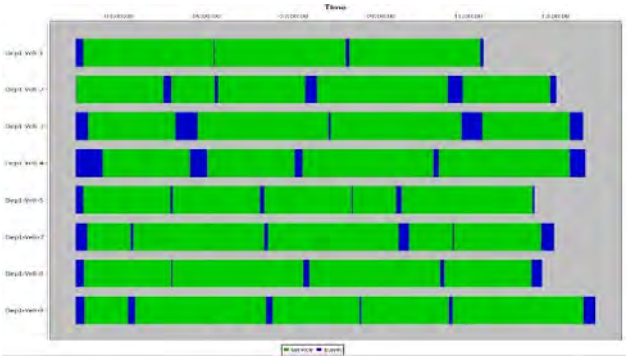
Data	Data 1	Data 2	Δ (savings)
Total Route Time (hr:min:sec)	108:03:48	103:46:12	4:13:48
Violations	0	0	0
Quantity (Under/Over)	0	0	0
Total Fuel Cost ($/day)	95.20	70.90	24.30
Total Distance (km)	630.06	469.20	160.86
Number of Routes	9	8	1
Average Route Time	9:41:33	10:15:14	- 0:33:41
Average Route Distance	70.01	58.65	11.36
Average Route Stops	3.9	4.4	- 0.5

[Table 1 – Comparison of Outputs]

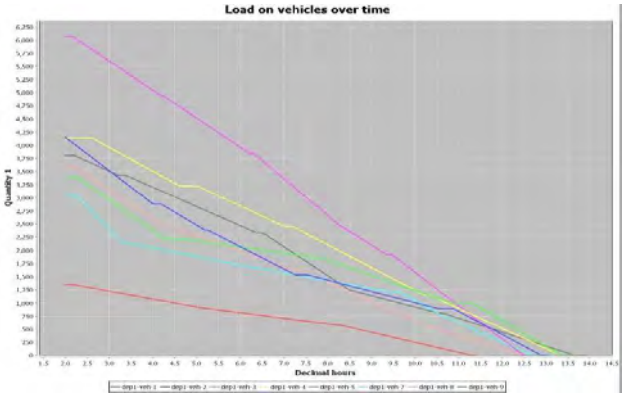
It is possible that this process will not calculate the required large scale operations in a timely manner. Furthermore, this data is generalized for set day-to-day options and does not include MEGA SNACKS' special days, nor does it account for weather variables of which there is a positive correlation between snack purchases and inclement weather.

In addition to the benefits, the nefarious side of optimization must be considered as well. Anytime cost savings occur, especially in the case of cutting routes and vehicle usage, real people risk losing their jobs. Here the data shows that although overall time and routes are down, there are some individuals who may have longer days and more stops due to decreased vehicle usage. This added work could potentially lead to more accidents and thus cost MEGA SNACKS money.

As aforementioned, there are benefits associated to this algorithm that were not used specifically for this problem, but might be utilized in different scenarios. Due to the nature of distribution and its many moving parts, it becomes difficult to ensure that task delivery is performed on time. Although this particular problem did not require time intervals, the algorithm could easily handle them. The production of a Gantt chart (figure 4) gives a visual, "at a glance" view of the distribution commitments.



[Figure 4 – Gantt Chart of Optimized Routes (service-green, travel-blue)]



[Figure 5 – Load of Vehicle over Time]

This chart could help MEGA SNACKS to assign specific people to specific routes based on demand. Load on vehicle over time charts can also be generated (figure 5) which could be very useful in forecasting future demands or estimating additional truck needs during special events.

Conclusion

The algorithm utilized here appears to be vastly superior to the one currently in use by MEGA SNACKS. This program took approximately 200 hours to complete and cost virtually nothing. If it can be utilized on a large scale and common risks associated with optimization are accounted for, MEGA SNACKS could potentially save years of work and millions of dollars it would otherwise need to roll out a different system to solve their distribution problem.

Acknowledgment

We thank MEGA SNACKS for providing up-to-date routing data to be used in this project.

Many thanks to all the contributors of the GraphHopper Initiative, which was instrumental in data computation.

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Appendix A

(Click on data table to expand)

stop-id	vehicle-nam	stop-#	stop-name	type	stop-addres	stop-latitud	stop-longitud	has-violatio	arrival-time
Start_Dep1-	Dep1-Veh-1	0	Start_Dep	depot		35.00104	-78.909994	0	2:00:00
CIS#757125	Dep1-Veh-1	1	WALMART	D	7701 S RAEF	35.0248	-79.053524	0	17:14.7
CIS#487679	Dep1-Veh-1	2	FOOD LION	D	3020 HOPE M	34.98599	-78.965044	0	30:08.9
CIS#461712	Dep1-Veh-1	3	FOOD LION	D	7215 ROCKF	34.98037	-79.008337	0	38:35.7
CIS#555559	Dep1-Veh-1	4	HARRIS TEE	D	3050 TRAEM	34.98272	-79.013812	0	40:06.8
End_Dep1-V	Dep1-Veh-1	5	End_Dep1-	depot		35.00104	-78.909994	0	59:23.9
Start_Dep1-	Dep1-Veh-2	0	Start_Dep	depot		35.00104	-78.909994	0	2:00:00
CIS#877535	Dep1-Veh-2	1	WALMART	D	3030 N MAIN	34.98018	-78.965237	0	10:24.4
CIS#876530	Dep1-Veh-2	2	WALMART	D	4220 LEGION	34.98368	-78.93285	0	16:19.7

[Complete Output for Data 1]

stop-id	vehicle-nam	stop-#	stop-name	type	stop-addres	stop-latitud
Start_Dep1-V	Dep1-Veh-1	0	Start_Dep	depo		35.001036
CIS#885599	Dep1-Veh-1	1	WALMART	D	3030 N MAIN	34.980175
CIS#235897	Dep1-Veh-1	2	FOOD LION	D	3020 HOPE M	34.985993
CIS#422221	Dep1-Veh-1	3	WALMART	D	4220 LEGION	34.983675
End_Dep1-Ve	Dep1-Veh-1	4	End_Dep1	depo		35.001036
Start_Dep1-V	Dep1-Veh-2	0	Start_Dep	depo		35.001036
CIS#155532	Dep1-Veh-2	1	FOOD LION	D	3037 LEGION	35.003524
CIS#239914	Dep1-Veh-2	2	FOOD LION	D	1738 BINGH.	35.016931
CIS#421456	Dep1-Veh-2	3	WALMART	D	970 STRICKL.	35.040153

[Complete Output for Data 2]

FIRM'S REACTION TO COMPETITION AND FIRM PERFORMANCE

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Abstract

Competition plays an important role in firms' competitive advantage generation and evolution. What competitors do and achieve affect a focal firm's strategies, operations and reactions, vice versa. The objective of this paper is to evaluate how a firm reacts to competition in order to keep competitive advantages and to achieve better performance. The main idea is that a firm's performance is a function of competitive actions between the firm and its competitors. These competitive actions and reactions from rival firms and focal firms lead them to co-evolve. We take the "Red Queen Effect" as our theoretical lens to describe a firm's reactions to both competitors' actions and business environmental changes within the industry. We use firm's rate of change of investment to represent firms' actions and reactions and argue that there are causal relationships among competitors' rate of change, focal firm's rate of change, and focal firm's performance. Our model takes the form of a spiral: while competitors' rate of change is positively related to a focal firms' rate of change, a focal firms' rate of change positively affects its performance. Subsequently, a focal firm's rate of change as well as its performance positively affect competitors' rate of change. This is an ongoing research, and currently we are in the process of analyzing data.

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KEY CHALLENGES IN QUANTITATIVE RESEARCH: RATIONALITY, CONSISTENCY, AND APPLICATION OF QUANTITATIVE MEASUREMENT

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ABSTRACT

The shifting trends in the ideological changes in public are explained in two broader ways such as relative stability and absolute stability. Here, the relative stability focuses on the relative shifts in ideology over time and on the other hand, absolute stability focuses on the absolute shifts in ideology in a specific state [1]. Berry et al. criticize these two approaches and they provided a quantitative explanation in their research article why these two are flawed. They further comment that relative stability in public ideology is very difficult to measure, evaluate, and pinpoint a specific trend. If the basic measurement and assumptions are flawed and do not accurately represent the basic shifting trends in public perceptions and ideology then the further studies, policy implementation, and government decisions will be flawed too. These days, the citizens of a society are living in interesting times where their political opinions are polarized and continuously changing due to the settings and available information. Researchers and political scientists developed different frameworks and infrastructure to analyze, measure, and evaluate the shifting trends in public perceptions about public policies, political parties, and government expenditure on certain social issues. This critical synthesis article focuses on the rationality, consistency, and application of quantitative measures, and a mixed methodology, in determining the stability of public perception in political ideology over time.

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Introduction

These days, the citizens of society are living in interesting times where their political opinions are polarized and continuously changing due to the settings and available information. Researchers and political scientists developed different frameworks and infrastructure to analyze, measure, and evaluate the shifting trends in public perceptions about public policies, political parties, and government expenditure on certain social issues. This critical synthesis article focuses on the rationality, consistency, and application of quantitative measures in determining the stability of public perception in political ideology over time.

The shifting trends in the ideological changes in public are explained in two broader ways such as relative stability and absolute stability. Here, the relative stability focuses on the relative shifts in ideology over time and on the other hand, absolute stability focuses on the absolute shifts in ideology in a specific state [1]. Berry et al. criticize these two approaches and they provided a quantitative explanation in their research article why these two are flawed. They further comment that relative stability in public ideology is very difficult to measure, evaluate, and pinpoint a specific trend. If the basic measurement and assumptions are flawed and do not accurately represent the basic shifting trends in public perceptions and ideology then the further studies, policy implementation, and government decisions will be flawed too. Berry et al. found that "Our discussion and analysis suggest that no single measure adequately captures the concept of state political ideology. Indeed, there are at least two distinct conceptualizations of political ideology: policy mood (or operational ideology) and ideological self-identification (or symbolic ideology)" [1]. Berry et. al. reinforces the idea of using one single approach in determining the shifting trends in public ideology is inaccurate and imperfect, and there are always high chances of making mistakes, making inaccurate assumptions, and probably excluding the views and opinions of certain underrepresented communities. Howell argues that "Even though one may argue that certain methodologies and methods may be more conducive for undertaking research on social phenomena and humanity, no specific approach provides a panacea in the pursuit of ultimate knowledge" [5]. Indeed, at times the quantitative research method is so focused

on data interpretation and complying the traditional validity and reliability, it tends to miss the objectivity of the study. Howell recommends moving past the positivist stance and considers the different settings, emotions, personal feeling for the different human studies. It would significantly help to redefine the objectivity of the study reinforced with more appropriate understanding and subjectivity.

Key Challenges in Quantitative Research

Accordingly, an example of the shortcomings of the quantitative method is demonstrated by the rural and remote communities in low-income countries like Bangladesh. These communities suffer from the inaccurate representation of the ideological self-identification studies. The basic questionnaire and surveys do not capture their true perception and ideology regarding the ongoing political scenario and public policies. For example, in the field of public health, the self-reported general health (SRGH) for the remote and rural communities in Bangladesh does not capture the true status and conditions. A study conducted in 2017, strongly advocated reexamining the questionnaire, approach and measuring tools to determine the SRGH.

The donor agencies and policymakers determine further policies and/or existing policy reformation in order to facilitate these communities to get better healthcare support. But the basic SRGH measurement study suffers from significant reliability and validity issues [3]. The basic wellbeing question “What is your current health status?” suffers from both validity and reliability factors. The more comparative analysis in developing the questionnaire is strongly recommended in order to assess the true status of public health in rural areas.

Similarly, the ideological self-identification process for the general public suffers from both validity and reliability issues. Validity explains the strength of the drawing conclusions from the obtained result from a study and reliability measures the consistency of the measurement process [5-6, 9]. Most of the time, the basic question like “How do you feel

about issue X?" does not properly capture the true reflection of the general public and it does not function as one of the elements of ideology perception study. Both Brace et al. and Berry et al. work on quantitative methods to analyze the shifting trends in political ideology and they utilize the positivist approach. Both do not even discuss integrating a qualitative approach in order to understand public ideology perception more deeply [2-3, 5].

Most of the time, it is difficult for the general people to understand and provide an accurate answer in any given surveys/questionnaires to explain their current political ideology, beliefs, and understandings. There are many researchers who have found that mixed methods research allows for the collection of a richer and more accurate type of data with the complex phenomenon where a respondent may not be able to express themselves fully or accurately with the data collection techniques commonly used in quantitative research. Tashakkori and Creswell define mixed methods as, "research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches"[10]. One could even go so far as to argue that an unwillingness to use both qualitative and quantitative research may negatively impact the advancement of knowledge [7-8].

Olslund et al. attempts to make a case for using mixed methods in health-related research for many of the same reasons previously discussed. Olslund et al. finds that many of the phenomena related to health care are simply to complex to be studied using quantitative methodology alone. Rather than using a quantitative only approach to research, Olslund instead suggests using a triangulation approach that serves as a methodological metaphor which can facilitate a proper integration of both qualitative and quantitative findings in mixed methods research. Olslund et al. goes so far as to state, "Using triangulation as a methodological metaphor may also support a better understanding of the links between theory and empirical findings, challenge theoretical assumptions and aid the development of new theory." [7].

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Triangulation is a mixed research methodology. This approach combines several, both qualitative and quantitative, to study a given phenomenon. The mixture of methodologies can lead to overlapping, and at times the results can be at odds with one another. However, there are benefits to this approach as well. Many researchers obtain a richer level of data by using triangulation. The technique also offers benefits to those in the field of political science, and other fields, which study marginalized populations. Often the interview process can obtain a better view of the lived experience of these populations than data collection related solely to quantitative methodology [4].

A methodology which utilizes a mixed methods approach is strongly recommended in order to make the ideological self-identification process more robust and effective. The more comparative questionnaire, explaining current policies, and proposed changes are only a few steps that could be implemented to improve the ideological self-identification process.

Concluding Remarks

Finally, in the field of political science and public policy administration, the predictive ability to determine the shifting trends of the ideological self-identification process is well recognized by the quantitative research approach. So, the demand for accurate measurement of political ideology in different settings to address various issues is also rising day by day.

Both quantitative approaches discussed in this article have their own merits, advantages, and practical application. But there are certain shortcomings in capturing the true reflection of the public's ideology only using a quantitative approach. It is here proposed that using a hybrid, or a mixed method, combining both qualitative and quantitative framework to capture the political ideology more effectively and efficiently. The aim for this critical synthesis is to address this gap of not using a qualitative approach in understanding the political ideology regardless it is interstate or intra-state. To measure

the political ideology in low-income and low-literacy countries like Bangladesh, more thoughtful and situational-based qualitative surveys were utilized to understand the shifting trends in political ideology in Bangladeshi people. Probably, this approach could be imitated in order to avoid making further false assumptions and to make these research studies more robust, reliable, and useful.

SE DSI 2019

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SE DSI 2019

OPTIMIZING DRONE ALLOCATION AND COVERAGE FOR DISASTER ZONES

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ABSTRACT

Victims of a flood disaster, or those that are inundated, are often in a critical situation that needs an urgent response. The most critical of these victims are those that are outside the reach of disaster response personnel. In this study, we consider the deployment of teams of UAVs (Unmanned Aerial Vehicle) to decrease the number of victims who are out of reach. To address this a mixed integer nonlinear optimization model has been proposed to optimize coverage of disaster areas, positioning of drone operators, and how their drones should be positioned with the most efficiency. To test the model, data from Hurricane Katrina is used as the target disaster area.

KEYWORDS: Disaster management, Assessment, Deployment, Drone, UAV, Humanitarian supplies, Optimization, Flooding

INTRODUCTION

Since 2003, natural hazards worldwide have killed nearly 1.15 million people, and nearly 2.2 billion others have been directly affected. It is forecasted that over the next 50 years disasters will increase five-fold including flooding [6, pp. 1-13]. This emphasizes the need for increased efficiency of humanitarian aid. Technological development of drones is also increasing at a rapid pace, and this can be leveraged as an asset. Disaster management has a four-step process to handling a disaster area, mitigation, preparedness, response, and recovery. In the mitigation step the goal is to install preventive measures to minimize risk to people and property. The second step, preparedness, is the placement of resources and personnel that respond efficiently to emergency situations. The response stage is the execution of disaster response operations to save lives and property. The focus of this model is on assessment, a part of the response stage, which

has a history of underperformance due to the over or under supply of resources. An extreme example of under supply during a disaster was the flood surge during Hurricane Katrina. Below is a detailed image that shows the flooded area in blue with accessible areas in orange. A distance scale has been added for ease of viewing:

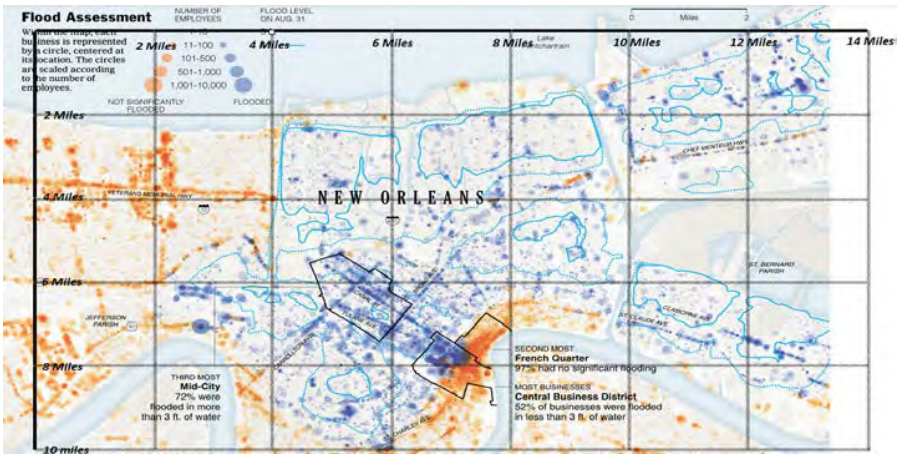

Figure 1: Flood map with blue as flooded and orange as accessible.

One of our goals is to render aid to people stranded in a flood zone. Each drone will be equipped with aid supplies in the form of a survival back pack. This back pack will allow people to sustain themselves longer in the flooded environment, giving rescue personnel additional time to organize a successful rescue mission. The survival back pack will be the Wise Company 5 Day Survival Pack Camo 01-622GSG, which weighs approximately 12 lbs. with our recommended contents. This back pack was chosen because of the essential gear it contains at a cost-effective price. Some modifications are recommended to better assist those stranded in a flood zone. The following table has a list of supplies in the Wise Company 5 Day Survival Pack Camo 01-622GSG along with recommended substitutions:

Table 1. Comparison of items in the Wise Company 5 Day Survival Pack and what we recommend be placed in the bag. Please note the M-16 Belt Floatation Device at the end of the table.

Wise Company 5 Day Survival Pack Camo 01-622GSG Contents	Recommendations	Finalized Back Pack sent to those in Need
38 servings of gourmet entrees	Substitute for MRE entrees	MRE entrees
6 packs of water 4.227 fluid ounces each	Unnecessary	Stainless steel cup
Portable stove with 24 fuel tablets	Unnecessary	Squeeze flashlight
Stainless steel cup	Keep	5-in-1 survival whistle
Squeeze flashlight	Keep	47-piece first aid and hygiene kit
5-in-1 survival whistle	Keep	Pocket tissues

47-piece first aid and hygiene kit	Keep	3 wet naps
N95 dust mask	Unnecessary	Waste bag
Pocket tissues	Keep	Mylar blanket
3 wet naps	Keep	Emergency poncho
Waste bag	Keep	
Waterproof matches	Unnecessary	
Mylar blanket	Keep	
Emergency poncho	Keep	
Playing cards	Unnecessary	
LifeStraw	Add	LifeStraw
M-16 Belt Pack Manual Inflatable Life Jacket with CO2 Charge self-inflation.	Add	M-16 Belt Pack Manual Inflatable Life Jacket with CO2 Charge self-inflation.

With these recommendations, only those supplies necessary for survival are kept and in turn this reduces the weight that the drones would have to transport. MRE entrees are substituted for the gourmet entrees because they do not require boiled water. We keep the stainless-steel cup so that water can be scooped up with it and drank with the LifeStraw that will be added to the survival pack. The squeeze flashlight and 5-in-1 survival whistle are kept in order to help rescue personnel pinpoint the location of those stranded. The 47-piece first aid and hygiene kit, pocket tissues, and wet naps are necessary to prevent infection of any minor injuries that may have occurred. The waste bag can be turned into a secondary poncho if rain continues, to keep the people who are stranded dry. This works in conjunction with the Mylar blanket to help prevent the onset of hypothermia. Most importantly, the M-16 Belt Pack with Manual and CO2 inflation, will be secured to the outside of the pack for speedy deployment to assist potential drowning victims. Below is an image of the self-inflating, with manual inflation option, floatation belt:

Figure 2: M-16 belt pack with self-inflating life vest. This is attached to the outside of the survival bag.

The Wise Company 5 Day Survival Pack Camo 01-622GSG with the recommended changes will give stranded people a significant advantage against the elements. A detailed instruction manual will be included to assist recipients in utilizing the equipment. They will be

able to survive longer and give rescue personnel additional time to come to their aid. This will result in more successful rescue missions and casualty prevention.

The UAV that our team chose was the Leptron Avenger UAS Helicopter. It is an unmanned aerial system that can withstand up to 40 mph crosswinds, has a flight time of two hours, and can carry up to 15 pounds as a payload. Below is an image and some specifications regarding the UAV:

- **Full Featured Autopilot:** Full military grade autopilot with GPS waypoints, 3D flight terrain, max/min altitudes, laser altimeter, no-fly zones, multiple vehicles, and more. Autopilot offers integration to sensors and camera packages for target tracking and encrypted data links.
- **Dual Mode:** Ground station mode and/or wireless hand-held remote
- **High Performance:** Up to 40 mph winds and up to 12,000 ft. MSL
- **Range:** 1 mile standard range, Iridium Satellite link ready
- **Endurance:** Standard 20+ minutes on battery. Specialty 2+ hours with an optional fuel engine.
- **Flexible Payload Configurations:** Camera turrets, HD video, FLIR and night vision, SAR and LIDAR packages available
- **Ultimate Mobility:** Single case for rapid deployment under 5 minutes

Figure 3: Leptron Avenger UAS Helicopter with manufacturer specifications.
http://www.leptron.com/leptron_avenger_uas_helicopter.html

LITERATURE REVIEW

The focus of this study has been on optimal placement of UAV base stations to have maximal coverage with the consideration of energy efficiency. Since assessment is our primary focus, we reviewed articles with the optimal placement algorithm as a start point to develop our own model. The field of drone deployment research is plentiful, it assisted in helping our honing in on assessment. The following articles provided the best information. Alzenad et al. employs a horizontal and vertical dimension grid for the assignment of drones with no loss of optimality [1, pp. 1-4]. This research assisted with improving how to define drone area of operation and placement. Barrientos et al. utilizes a path planning algorithm in which UAVs are guided to take the optimal route to a designated location [2, pp. 667-689]. In collaboration with area coverage it directed us into the correct realm of angle of view of cameras equipped to UAVs. This in turn allowed us to build a feasible constraint for the viewing area of each UAV. Franco & Buttazzo proposes a mathematical model that minimizes the cost of UAV placement to cover a specific target area [4]. They incorporate energy consumption as a cost driver and focus on the altitude of an UAV as the main consumer of energy. The content of this article was used to build the

constraint of height in our model. It also gave us the idea of how to mathematically instruct our model to label coverage areas. Guerriero et al. explains that using drones for difficult to access areas can save costs and increase efficiency [5, pp. 16-31]. Transportation of aid supplies is one of the focuses of the article, which reinforce the potential for drones to carry relief supplies while simultaneously surveying a disaster area. Porat et al. leveraged optimizing the efficiency of UAV pilot control as the main focus area [7, p. 568]. They went with the gradual shift in research of "how many systems can a single operator control" to "how to distribute missions among operators and systems in an efficient way". We pulled this data to set the number of operators per drone in our model and to give us an overall number of needed operators for a coverage area. Kopczak & Thomas detailed the use of creating base stations that provide wireless coverage services [6, pp. 1-13]. Instead of wireless coverage we considered a practical operating range of drone operator teams in relation to their camera field of view on the ground.

MODEL

We propose a nonlinear mixed integer model that minimizes the total distance travelled. The model has been written with GAMS (Generalized Algebraic Modeling System) and solved with the CONOPT solver via the NEOS remote server. One of the challenges we faced was how to define what an area is, and how the model would understand that we were giving it a 10x10 area to attempt to cover. Below is a portion of the binary matrix we constructed to indicate relationships between squares:

```
* TITLE Drone Coverage;
Set i / 1*100 / ;
Set j / 1*100 / ;
Table R(i,j)

    1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

1   1 1 0 0 0 0 0 0 0 0  1  0  0  0  0  0  0  0  0  0  0  0  0  0
2   1 1 1 0 0 0 0 0 0 0  0  1  0  0  0  0  0  0  0  0  0  0  0  0
3   0 1 1 1 0 0 0 0 0 0  0  0  1  0  0  0  0  0  0  0  0  0  0  0
4   0 0 1 1 1 0 0 0 0 0  0  0  0  1  0  0  0  0  0  0  0  0  0  0
5   0 0 0 1 1 1 0 0 0 0  0  0  0  0  1  0  0  0  0  0  0  0  0  0
6   0 0 0 0 1 1 1 0 0 0  0  0  0  0  0  1  0  0  0  0  0  0  0  0
7   0 0 0 0 0 1 1 1 0 0  0  0  0  0  0  0  1  0  0  0  0  0  0  0
8   0 0 0 0 0 0 1 1 1 0  0  0  0  0  0  0  0  1  0  0  0  0  0  0
9   0 0 0 0 0 0 0 1 1 1  0  0  0  0  0  0  0  0  1  0  0  0  0  0
10  0 0 0 0 0 0 0 0 1 1  0  0  0  0  0  0  0  0  0  1  0  0  0  0
11  1 0 0 0 0 0 0 0 0 0  1  1  0  0  0  0  0  0  0  0  1  0  0  0
12  0 1 0 0 0 0 0 0 0 0  1  1  1  0  0  0  0  0  0  0  0  1  0  0
13  0 0 1 0 0 0 0 0 0 0  0  1  1  1  0  0  0  0  0  0  0  0  1  0
14  0 0 0 1 0 0 0 0 0 0  0  0  1  1  1  0  0  0  0  0  0  0  0  1
```

Figure 4: Matrix R, which designates the relationship between nodes.

A binary value of 1 in a node indicates that a node is either in this location, or horizontally/vertically a single square away. The full contents of the GAMS code is located in the Appendix. Since this matrix is 100x100 a smaller example is used to impart the concept. Let us consider a 10x10 grid:

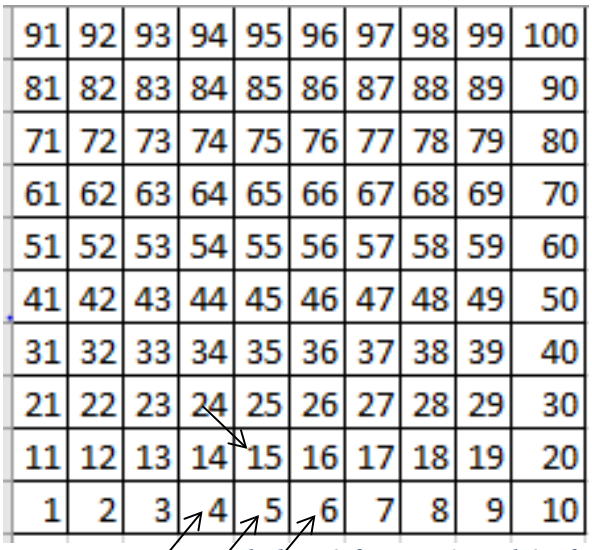

Figure 5: Matrix R is coded as 1 for 4,5,6, and 15 for j=5.

By referring to the binary matrix above, we see that the values for node 5, are 1 (or turned on) for 4, 5, 6, and 15. This instructs the solver that if a drone is located at position 5 it is also considered to provide coverage for 4, 6, and 15. By creating a matrix that is 100x100 the solver now understands the relationship of the 10x10 grid, and can attempt to optimize placement.

To translate these nodes into real distances, we included a Euclidean distance factor that is later multiplied by the real-world distance the model is tested against. The following table illustrates the Euclidean distance relationship (or $U_{(I,j)}$) with the 10x10 grid:

10.05	10.20	10.44	10.77	11.18	11.66	12.21	12.81	13.45	14.14
9.06	9.22	9.49	9.85	10.30	10.82	11.40	12.04	12.73	13.45
8.06	8.25	8.54	8.94	9.43	10.00	10.63	11.31	12.04	12.81
7.07	7.28	7.62	8.06	8.60	9.22	9.90	10.63	11.40	12.21
6.08	6.32	6.71	7.21	7.81	8.49	9.22	10.00	10.82	11.66
5.10	5.39	5.83	6.40	7.07	7.81	8.60	9.43	10.30	11.18
4.12	4.47	5.00	5.66	6.40	7.21	8.06	8.94	9.85	10.77
3.16	3.61	4.24	5.00	5.83	6.71	7.62	8.54	9.49	10.44
2.24	2.83	3.61	4.47	5.39	6.32	7.28	8.25	9.22	10.20
1.41	2.24	3.16	4.12	5.10	6.08	7.07	8.06	9.06	10.05

Figure 6: Euclidean distance between (i,j), (0,0) and potential placement node.

ASSUMPTIONS

The model assumes that the same type of drone is being used for every drone that is deployed. It is also assumed that all drones will be deployed simultaneously. Additionally, it is assumed that a single drone operator is best suited for controlling at most four drones simultaneously. This number was chosen because of a study done to test a drone operator's ability to multitask with multiple drones. According to Porat et al. in 2016, "one operator could control 4–5 vehicles... and apply supervisory control for up to 12 vehicles..."[7]. While it is possible for an operator to control more than four vehicles simultaneously, we decided on four vehicles because of the critical attention to detail required for assessment, identification, and delivery.

NOTATION

P: Perimeter in miles of a single drone team coverage area
Tac: Total area that will receive drone coverage in square miles
V: Total number of drones needed for disaster area
O: Number of drone operators required
U: Euclidean distance to node
AoV: Drone's angle of view for camera in degrees
S: Drone's safe operating speed in miles per hour
AP: Approximate accessible perimeter of disaster zone in miles
DA: Approximate area of disaster zone
L: Number of miles in length that a team can cover
I: Number of rows in matrix R

J: Number of columns in matrix R.
T: Number of drone operator teams required
F: Field of view for a single drone
H: Height for a single drone
A: Area of coverage in square miles
Z: Total distance travelled by all drones in miles
TR: Time required for deliveries to all covered points in minutes
X: Number of drones required per team
$R_{i,j:}$ Matrix containing binary values that describe how each node in a matrix connects to each other. The description indicates that each node is next to another that can be exactly one node above, below, or to the side.

PARAMETERS

$$\sum_j Y_j R_{i,j} \geq 1 \quad (1)$$

Number of drone operator teams required based on the accessible perimeter divided by the length of a perimeter a drone team will occupy.

$$p = (\sqrt{I}*2) + (\sqrt{J}*2)*\mathrm{f} \quad (2)$$

The perimeter of a drone team's operating area is found using the square root of the maximum value of I and J, which is 10 due to the nature of the matrix. Multiplying this by the value of f (or the field of view for drone cameras in mi^2) yield the perimeter of a drone team's operational area.

$$v = \sum_j * t * y_j \quad (3)$$

The sum of all the drones required for a single team's area multiplied by the number of teams yields the total number of drones required for the entire disaster response situation.

$$o = \sum \frac{y_j}{4} \quad (4)$$

Operators can effectively control four drones simultaneously. This equation gives the number of operators required for a single drone team.

$$u = \sum_j \sqrt{i^2 + j^2} \quad (5)$$

The Euclidean distance between (i,j) = (0,0) and the node in question. This number is later multiplied by the value of f (or field of view) to determine the distance, in miles, required for a drone to arrive at location (i,j).

$$AoV = 45° \tag{6}$$

The angle of view of the camera on the selected drone.

$$s = 35\ mph \tag{7}$$

The speed capability of the drones in mph.

$$AP = 36\ miles \tag{8}$$

The perimeter that is accessible for drone operator teams to stage an area of operations.

$$DA = 82.8\ mi^2 \tag{9}$$

The square mile area of the disaster area that is being responded to.

$$l = 3.91\ mi \tag{10}$$

The length of the area that a single drone operator team can cover.

$$i = 1, \dots, 100 \tag{11}$$

The values of i, or the rows of matrix R, running from 1 to 100.

$$j = 1, \dots, 100 \tag{12}$$

The values of j, or the columns of matrix R, running from 1 to 100.

$$t = \left| \frac{AP}{l} \right| \tag{13}$$

Number of teams required for the entire disaster area, based on accessible perimeter divided by the length of one side of a drone team's operating area.

DECISION VARIABLES

$$Y_j = \begin{cases} 1 \\ 0 \end{cases} If\ location\ j\ has\ a\ drone\ present\} \tag{14}$$

A binary variable that indicates whether or not a drone is present on a node in matrix R.

$$f = \frac{(\pi\ tan(AoV)h\ )^2}{27{,}878{,}400\ ft^2} \tag{15}$$

An equation that determines the field of view on the ground for drone cameras. Using the tangent of the angle of view multiplied by the height of the drone, the radius is returned which is then used as part of the equation for the area of a circle or $\boldsymbol{\pi r^2}$. The result is then divided by the number of square feet in a square mile to give the viewing area in square miles.

$$h \geq 1150\ ft \tag{16}$$

Constraint that the height of a drone cannot be less than 1,150 ft.

$$a = I * J * f^2 \tag{17}$$

Area that a single drone team can cover.

$$Tac = t * a \tag{18}$$

Total area covered throughout the entire disaster zone is found by multiplying the area that one operator team can cover by the value of the area that one team can cover.

$$z = \sum_j y_j * u_j * t * f \tag{21}$$

The objective function, which is designed to total the product of the drones by the Euclidean distances by the number of teams required by the distance in one node. This gives the total distance that needs to be covered by all drones collectively. Our model, and solver, is constructed to minimize this value in order to reduce cost by association.

$$Tr = \frac{\sqrt{i+j}*f}{s} * 60 \tag{22}$$

The amount of time required for all drones to reach their assigned destination. The value is multiplied by 60 to give the number of minutes that complete deployment will require.

$$x = \sum_j Y_j \tag{23}$$

The number of drones needed in a single area of operation.

METHODS

Our model was written in the GAMS program and solved using the NEOS Solver with CONOPT solver. NEOS solvers offer remote computation for models with many equation iterations. The CONOPT solver gave the best optimal non-linear solution and optimized drone placement.

RESULTS

After running our model, it gave us an optimal solution, with placement of drones and coverage areas. On a ten by ten grid system a drone team would be stationed at nodes 2, 4, 8, 16, 20, 21, 23, 28, 35, 40, 42, 47, 54, 59, 61, 66, 73, 78, 80, 81, 85, 93, 97, and 99. The image below illustrates grey squares in which drones are assigned, and blue squares for those that have a drone next to it horizontally or vertically one square away. This allows for the entire disaster area to be covered with the smallest number of drones possible. The overall goal of our model was to minimize total distance travelled and our optimal value came to 705.5. This means that the total distance traveled by all of the drones is 705.5 miles. Variable p comes to the optimal solution that a single drone team can cover an area with a perimeter of 15.64 miles. The field of view for a drone camera is .391 square miles. The area of coverage for a single drone team is 15.289 square miles. Other information is provided with regards to drones and operators. 9 drone operator teams are required, with 6 operators per team and 24 drones assigned to each team. This brings up a total of 216 drones needed for this optimal solution. These 216 drones can provide assessment coverage to an area of 137.6 square miles in under 9.5 minutes.

91	92	93	94	95	96	97	98	99	100
81	82	83	84	85	86	87	88	89	90
71	72	73	74	75	76	77	78	79	80
61	62	63	64	65	66	67	68	69	70
51	52	53	54	55	56	57	58	59	60
41	42	43	44	45	46	47	48	49	50
31	32	33	34	35	36	37	38	39	40
21	22	23	24	25	26	27	28	29	30
11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	10

Figure 7: Optimized placement of drones as grey squares with blue squares indicating a placed drone is only one node away.

```
----    281 VARIABLE z.L                =      705.506  Total distance trave
                                                        lled by all drones i
                                                        n miles

----    281 VARIABLE Y.L  Location that drone should be placed

2  1.000,    4  1.000,    8  1.000,    16 1.000,    20 1.000,    21 1.000
23 1.000,    28 1.000,    35 1.000,    40 1.000,    42 1.000,    47 1.000
54 1.000,    59 1.000,    61 1.000,    66 1.000,    73 1.000,    78 1.000
80 1.000,    81 1.000,    85 1.000,    93 1.000,    97 1.000,    99 1.000


----    281 VARIABLE p.L                =       15.640  Perimeter in Miles o
                                                        f a single drone tea
                                                        m coverage area
            VARIABLE f.L                =        0.391  Field of view for dr
                                                        one cameras in SqMi
            VARIABLE a.L                =       15.289  Area of coverage in
                                                        SqMi
            VARIABLE o.L                =        6.000  Number of drone oper
                                                        ators required or Op
                                                        erators
            VARIABLE x.L                =       24.000  Number of drones req
                                                        uired per team
            VARIABLE t.L                =        9.000  Number of drone oper
                                                        ator teams required
            VARIABLE v.L                =      216.000  Total number of dron
                                                        es required for disa
                                                        ster area
            VARIABLE tr.L               =        9.479  Time required for de
                                                        liveries to all dron
                                                        es covered points in
                                                        mins
            VARIABLE tac.L              =      137.600  Total area that will
                                                        receive drone covera
                                                        ge in Sq Mi
```

Figure 8: CONOPT solver results indicating where drones should be placed and the capabilities of the fleet.

DISCUSSION AND CONCLUSIONS

The results demonstrate that the format of this model can respond to one of the worst floods in U.S. history. The square miles of coverage area from all teams that the model can produce, based on information related to Hurricane Katrina, exceeds the square miles that were flooded by a moderate margin. Considering that 216 drones can be in place, with thermal vision, and equipped with a back pack of survival supplies that can prevent drowning, in under 10 minutes is a promising result. The number of drowning casualties caused by the flood surge was 389, [3]. This theoretical approach would be capable of distributing enough self-inflating floatation devices to aid 434 people in under 30 minutes. The most important feature of this model is that it provides a tightly woven assessment network in minutes. This is critical for disaster response management, who must make decisions on how to allocate resources and personnel. The flexibility of this model allows users of the code to input their real-world data, such as a different drone's specifications and different quantities for disaster area and accessible perimeter, to construct a rapid and efficient assessment plan. This same concept and model can be applied to disasters of another nature, such as earthquakes or viral outbreaks. The contents of the supply drop may change, yet the format for mass deployment remains the same. For example, a viral

outbreak supply drop may contain a vaccine and specific nutrition, hygiene, and/or first aid items that better complement the situation. Further research into the area of optimizing coverage redundancy, route optimization to include a third dimension in the operations areas, and the development of equations that more efficiently allocate less drones to an irregular shape is recommended.

APPENDIX

This appendix contains the full contents of the model. Aside from the matrix of R, due to its size, the following is the content of this model's GAMS code:

```
parameter U(j) Euclidean distance to node
/
1       1.41
2       2.24
3       3.16
4       4.12
5       5.10
6       6.08
7       7.07
8       8.06
9       9.06
10      10.05
11      2.24
12      2.83
13      3.61
14      4.47
15      5.39
16      6.32
17      7.28
18      8.25
19      9.22
20      10.20
21      3.16
22      3.61
23      4.24
24      5.00
25      5.83
26      6.71
27      7.62
28      8.54
```

29	9.49
30	10.44
31	4.12
32	4.47
33	5.00
34	5.66
35	6.40
36	7.21
37	8.06
38	8.94
39	9.85
40	10.77
41	5.10
42	5.39
43	5.83
44	6.40
45	7.07
46	7.81
47	8.60
48	9.43
49	10.30
50	11.18
51	6.08
52	6.32
53	6.71
54	7.21
55	7.81
56	8.49
57	9.22
58	10.00
59	10.82
60	11.66
61	7.07
62	7.28
63	7.62
64	8.06
65	8.60
66	9.22
67	9.90
68	10.63
69	11.40
70	12.21
71	8.06

```
72      8.25
73      8.54
74      8.94
75      9.43
76      10.00
77      10.63
78      11.31
79      12.04
80      12.81
81      9.06
82      9.22
83      9.49
84      9.85
85      10.30
86      10.82
87      11.40
88      12.04
89      12.73
90      13.45
91      10.05
92      10.20
93      10.44
94      10.77
95      11.18
96      11.66
97      12.21
98      12.81
99      13.45
100     14.14

/;


Scalar AoV/45/;
*Enter Drone Angle of view for camera in degrees
Scalar s/35/;
*Enter drones' safe operating speed in mph
Scalar AP/36/;
*Enter approximate accessible perimeter of disaster area in miles
Scalar DA/82.8/;
*Enter approximate area of disaster zone
Scalar L/3.91/;
*Enter number of miles for the length of the area a team can cover
```

```
Binary Variable
Y(j) "Location that drone should be placed";
Variables
p "Perimeter in miles of a single drone team coverage area"
f "Field of view for drone cameras in SqMi"
a "Area of coverage in SqMi"
z "Total distance travelled by all drones in miles"
x "Number of drones required per team"
tac "Total area that will receive drone coverage in Sq Mi"
v "Total number of drones required for disaster area"
tr "Time required for deliveries to all drones covered points in mins"

Positive Variable
t "Number of drone operator teams required"
h "Height that drones operate"

Integer Variable
o "Number of drone operators required or Operators"

Equation
Drone_Height,
Coverage(i),
Perimeter,
FOV,
Area,
Operators,
Teams,
Drones_Per_Team,
Total_Area_Covered,
Total_Drones_Required,
Time_Required_For_Deliveries,
Obj;

Coverage(i)..sum(j, Y(j)*R(i,j)) =g= 1 ;
Perimeter.. p =e= (sqrt(card(i))*2+sqrt(card(j))*2)*f;
FOV.. f =e= (pi*(tan(AoV)*h)**2)/27878400;
Area.. a =e= sqrt(card(i)) * f * sqrt(card(j)) * f;
Operators.. o =e= sum(j, Y(j))/4;
Teams.. t =e= round((AP)/(L));
Drones_Per_Team.. x =e= sum(j, Y(j));
Total_Area_Covered.. tac =e= t*a;
Total_Drones_Required.. v =e= (sum(j, Y(j))) * t;
```

```
Time_Required_For_Deliveries.. tr =e= (((sqrt(card(i)+card(j)))*f)/s)*60;
Drone_Height.. h =g= 1150;

Obj..z =e= sum(j, Y(j)*U(j))*t*f;

Model DroneCoverage / all / ;
Solve DroneCoverage using minlp minimizing z;
Display z.l, y.l, p.l, f.l, a.l, o.l, x.l, t.l, v.l, tr.l, tac.l;
```

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Optimizing Mail Courier Delivery Routes to Maximize Efficiency

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ABSTRACT

Public Education is a vital foundation to the success of the world, starting in the early stages affording all children an equal opportunity of learning producing future accountants, presidents, doctors, entrepreneurs and so much more. This project is the result of trying to create optimal routes for the interlocal mail courier deliveries within the Cumberland County School System. This study presents a new solution for the department to deliver shipment to each school daily, reduce excessive mileage driven, save on gas usage, and increase overall efficiency. To accomplish this task, we used Open Door Logistics Studio 1.41(ODL) to provide vehicle routing & scheduling capabilities.

KEYWORDS: Vehicle routing, Optimization, Mail delivery, Cumberland County School system, Depot, Road Network, and GeoCoder

INTRODUCTION

Cumberland County Schools (CCS) is made up of various departments also known as Central Service Personnel. CCS has many foundational departments, but in this research project a sub-department of the Auxiliary Services Department will be highlighted. The Auxiliary Services Department is considered as the silent partners that uplift and support the ultimate performance goal of the school system accomplishing the vision, mission, and goals set in place. The Federal government has a nationwide system to deliver mail and packages (US Postal Service) likewise, Cumberland County Schools has its own in-house mail delivery service that operates 5 days a week, Monday - Friday. There is a Central Distribution Center (Depot) where the drivers sort the mail for their routes, load their van, deliver mail and/or small packages to the schools, and pick-up mail from the schools to go back to the depot to be sorted to the proper route for distribution on the next schedule delivery. There are 87 Public Schools housed in 86 buildings.

MOTIVATION

Public and private sector businesses are operating in a real-world environment where they are faced with limited resources, and budgetary constraints, especially in public service organizations. This reality has placed additional challenges on our global and national public education system and made it a must to come up with new efficient ways to deliver educational value to current and future generations. Our stakeholders expect public education to spend money properly and efficiently to get the most value. The United Nations has taken-up the global education mantle, to ensure our children get needed quality education. There may be different routes to take improve

efficiency, and our goal for this project, is to start by improving the school's mail delivery functions by developing an optimizing courier model that ensures daily, and efficient, expedited mail delivery services to Cumberland County, North Carolina schools, and perhaps, school districts all over the nation. "Quality education, is listed 4th of the 17 United Nation's (UN) 'Sustainable Development Goals.' UN initiatives (17 Goals to Transform the World) support the goal of obtaining global quality education by creating sustainable development. The education ranking (4 of 17) of the UN sustainable development goals, speaks of how important it is for countries all over our vast world to have access to quality education and how it can have either a positive or negative impact on current and future generations [6, pp. 1]." Education should be affordable and accessible, and implementation and development of new models that can assist our school system to cut cost and/or improve efficiency, contribute in meeting these valuable goals. This sentiment hits home for our group; North Carolina has some of the best higher learning universities and state colleges in the nation. However, our Public-School system remains finding it challenging to keep pace with academic ratings in other states. It is the fifth largest school district in North Carolina and 78th in the nation [2, pp. 1].

CUMBERLAND COUNTY'S SCHOOLS PROFILE

- Annual Budget $417,980,340.73 (State funding = 69%, Local = 19.19%, Federal 7.52%, Competitive grants = 3.34%)
- Per Pupil Expenditure $8,495
- Total Number of Schools 87 (Elementary schools = 52 Middle = 18 High Schools = 17)
- Student Demographics (Ethnicity) – Black = 45.09%, White = 29.07%, Hispanic = 13.47%, Native American 1.64%, Hawaiian/Pacific = .50%, Two or More = 8.37%
- Employees (2nd largest employer in Cumberland County behind the Military)

[3, pp. 1]

PROBLEM DEFINITION

A satisfaction survey was taken during this project. The office staff from the 87 schools and administrative buildings were surveyed regarding the quality service of the mail couriers. One of our survey questions stated: "List the cons of having school mail delivered on an A & B schedule (every other day)". Based on the quantitative data results, about 45% responded and of the 45%, approximately 90% say the non-daily service is inefficient *(see survey results below)*. Many stated that it causes deadlines to be missed, it's an inconvenience causing trips to be made directly by car to the county office.

Figure 1. Screenshot of Survey Feedback

Time-sensitive material can be of the upmost importance. For example, a bookkeeper submitting payroll documents delivered through the courier does not reach the payroll department by the deadline due to every other day delivery. This causes frustration for key employees and adds stress because they did not get paid on-time which could leave to dissatisfaction, leading to looking for employment elsewhere. Currently, schools are not receiving mail every day; they only get mail every other day. There are 6 different routes divided up between 3 drivers covering the 87 schools. Each driver has relatively the same amount of schools regardless of distance to travel. Routes are delivered on 'A Days' and the other 3 routes are delivered on 'B Days' to complete all 87 schools. This is a significant problem for faculty and staff and the efficiency provided.

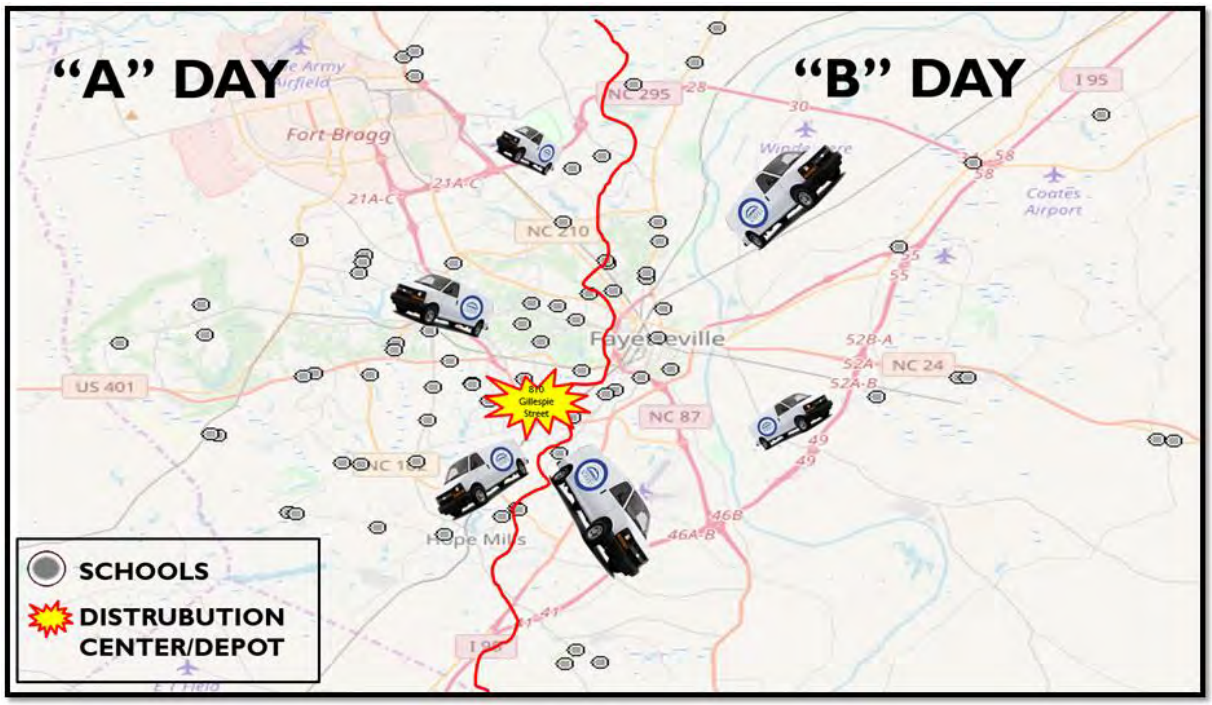

Figure 2. Map Display of 87 Schools Split into 2 Days

Increase in liabilities due to forced deliveries by office staff in their personal vehicles to make deadlines. Environmentally, increase in the number of cars on the road unnecessarily, causing an increase in vehicle emissions. The school bell times which happens at the opening of school and at the dismissal of school. The bell times may vary depending on the school. Daily each driver leaves the depot taken their current route and are advised to avoid schools on their route if it is near the school's bell time to avoid congested traffic on-site during those times. There are limited delivery hours depending on the deliver's work schedule which is 7:30 a.m. - 4:30 p.m.

All these help us structure CCS' problem as a well-known Vehicle Routing Problem (VRP) with homogeneous vehicles and time windows. Typical formulation of VRP that produces the exact optimal solution is presented below, where c_{ij} is the cost to travel from i to j, and x_{ij} is the binary variable equal to 1 if trip from i to j has been selected.

$$\text{minimize} \quad \sum_{i \neq j} c_{ij}\, x_{ij} \tag{1}$$

$$\text{subject to} \quad \sum_{j=1}^{n} x_{ij} = 1\,; \quad i = 1, \dots, n \tag{2}$$

$$\sum_{i=1}^{n} x_{ij} = 1\,; \quad j = 1, \dots, n \tag{3}$$

$$\sum_{i,j \in S}^{n} x_{ij} \leq |S| - v(S);\ S \subset V'\ \{1\};\ |S| \geq 2 \tag{4}$$

$$x_{ij} \in \{0,1\};\ i,j = 1, \dots, n\,;\ i \neq j \tag{5}$$

LITERATURE REVIEW

The focus of this study has been to develop the best available model to optimize travel routes for the mail courier deliveries within Cumberland County Schools Systems. Since optimization of vehicle routing/Mail Delivery is the focus of this study, we reviewed various Journal Articles that discusses routing problems and efficient mail delivery services related to Public Schools' Systems. One such journal article, 'Separating Logistics Flows in the Chicago Public School System' highlighted the problem of the central Chicago Public School warehouse that was responsible for the distribution of supplies to 600 schools. The article explained how at the start of the study in 1992, distribution of daily mail and other related services by the central warehouse began to deteriorate to a level that produced significant number of complaints from School Principals that mail deliveries were unreliable and lead times were long. The study conducted evaluated, collected and analyzed systems data, and made recommendations to fix the problem. Their approach used in the study, was the use of tailored logistics systems models to increase on-time delivery and increase lead times [5, pp. 265-272]. Another example of the use of logistic models use to improve

route and school transportation/delivery related matters can be seen by reviewing information on the Boston Public Schools' use of SAS® Analytics to consolidate stops, improve student experience and save money. "With public school districts across the US often underfunded, any money that can be redirected into core educational efforts is a boon for schools – and students. Cost savings can lead to more teachers, better facilities or new books, supplies and technology [6, pp. 1]." School districts, both local and abroad, continue to seek ways to reduce costs and improve educational outcomes. Recommendations resulting from our research will assist CCS to accomplish this goal.

VEHICLE ROUTING PROBLEM

The objective of this study is to create optimal routes so that the mail is delivered to each school (87 schools in total) daily, reduce the mileage driven, save on gas usage, and increase efficiency. Ensuring daily and expedited mail delivery services to CCS, and perhaps school districts all over the nation.

MODEL & METHODOLOGY

Based on the problem definition and CCS requirements, our model assumptions are listed below:

1. Each school should be visited once every day.
2. Single depot with four vehicles and four drivers.
3. Due to traffic delays avoid delivering mail to schools within 30-minute window of start time and dismissal time.
4. Depart depot by 8:00 a.m.
5. Return to depot before 4:00 p.m. to unload and load next day delivery.

Instead of adopting the exact solution approach, we considered heuristic methods (weep heuristic, neighborhood heuristic, google routing, etc.) that will provide more realistic choice of routes with the bell time restrictions. We compared several heuristics methods to gain the best and the quickest system to minimize the total cost and provide efficient service at the same time. After all, we utilized Open Door Logistics (ODL Studio 1.4.1), which is an open source software application for non-real time vehicle routing and territory mapping. It uses the excellent jsprit vehicle routing library to provide vehicle routing & scheduling capabilities. Using the jsprit integration, you can plan a set of routes for your delivery fleet to efficiently serve a set of delivery points. You can then edit these routes using our drag-and-drop vehicle route editor, analyses them in various ways, inspect the routes in a map or export detailed reports to give to your drivers. Using the jsprit integration, we were able to plan a set of routes for the delivery fleet to efficiently serve a set of delivery points also known as schools. The software also allows for edits of the routes using drag-and-drop vehicle route editor, analyses in various ways, inspect and view route details. The GraphHopper code utilizes OpenStreetMap data (open source) and is integrated seamlessly into ODLStudio.

DATA COLLECTION & NUMERICAL SOLUTION

We collected the physical addresses of each school along with the bell times. We obtained the current average of miles/gallon for each vehicle from the fleet department. The U.S. Census Bureau website provided a geocoder which was used to key in addresses to produce the latitude and longitude coordinates which the ODL database required [1, pp. 1]. Tables were imported containing data. The GrassHopper utilizes OpenStreetMap data to configure the Road Network distances. Data and programs are synced, and optimization begins producing reports, maps, solutions, etc.

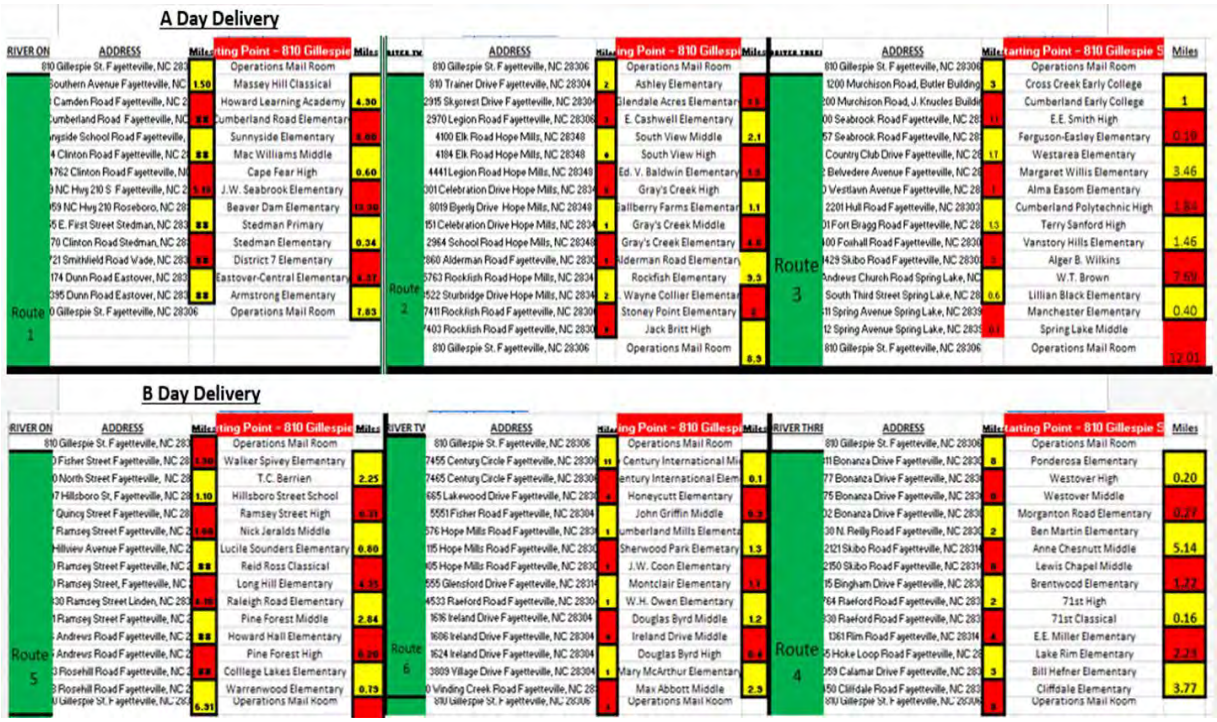

Figure 3. Current Routes with Mileage

Optimal Route Solutions

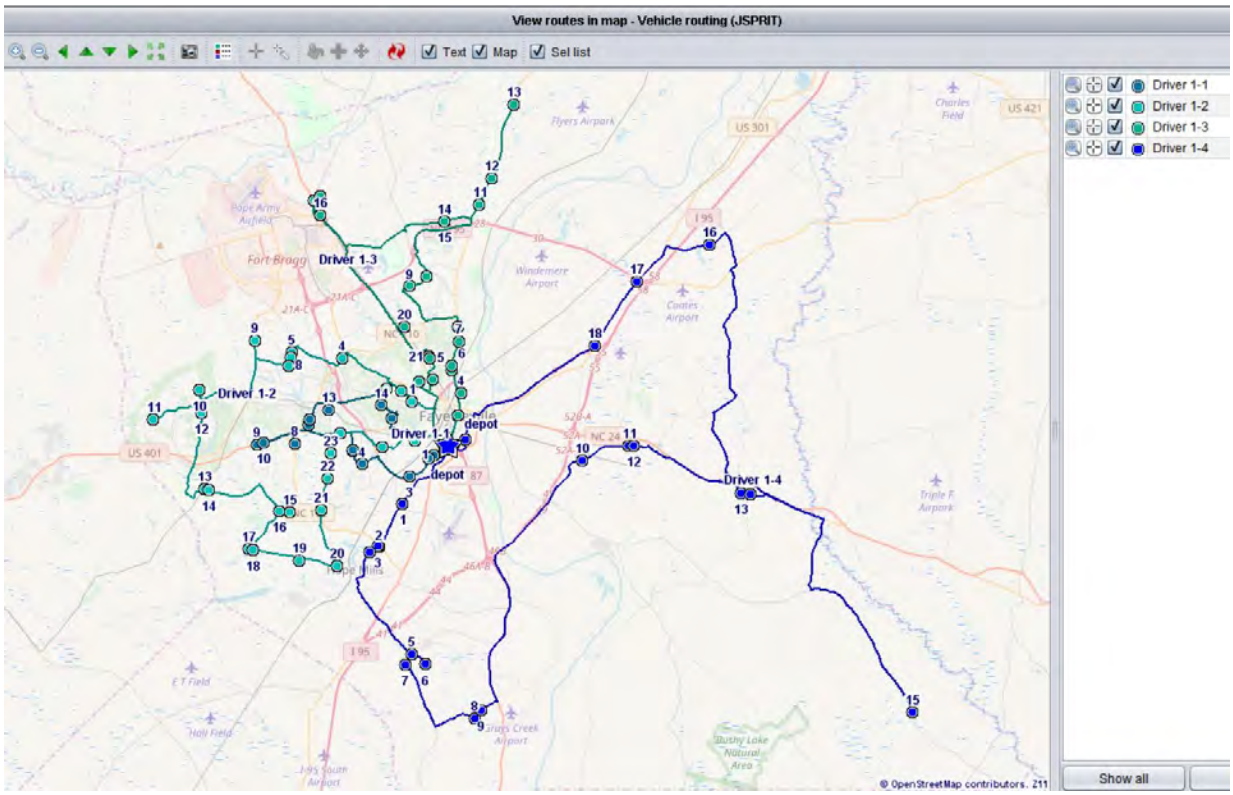

Figure 4. Overall View of Road Network Optimal Solution (ODL Studio)

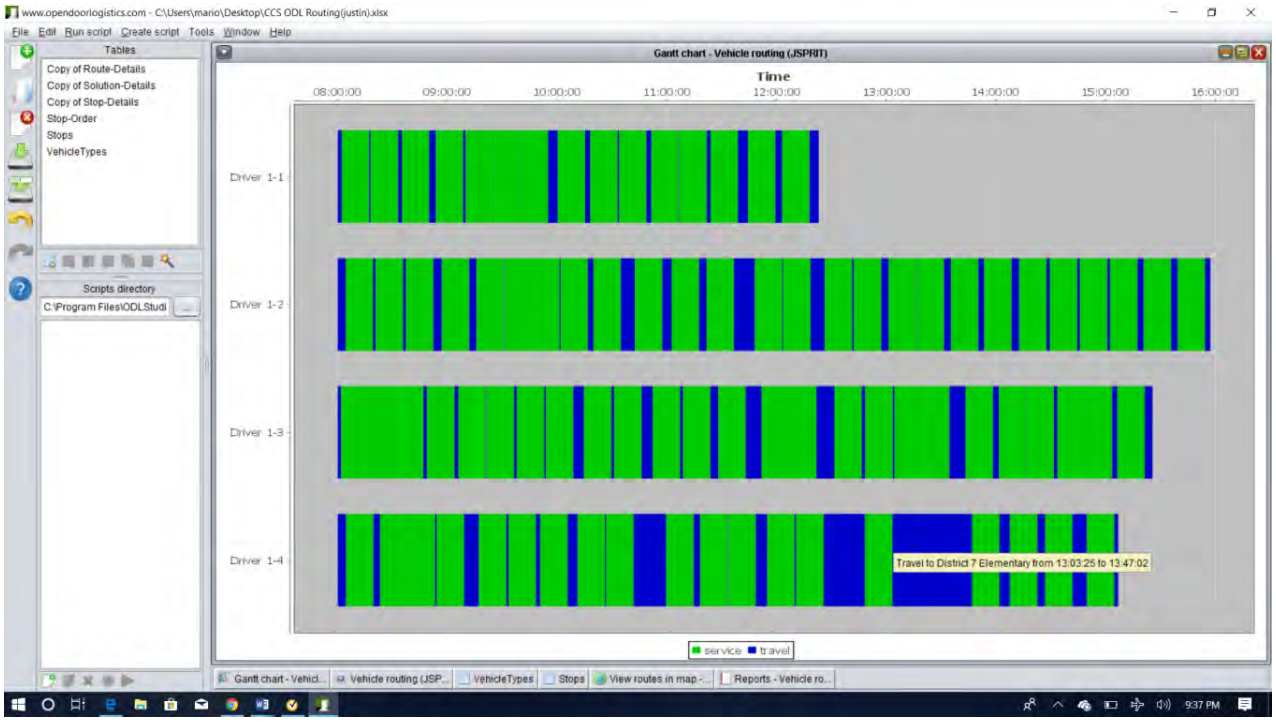

Figure 5. Gantt Chart – Distances between Next Stop (Optimal Solution)

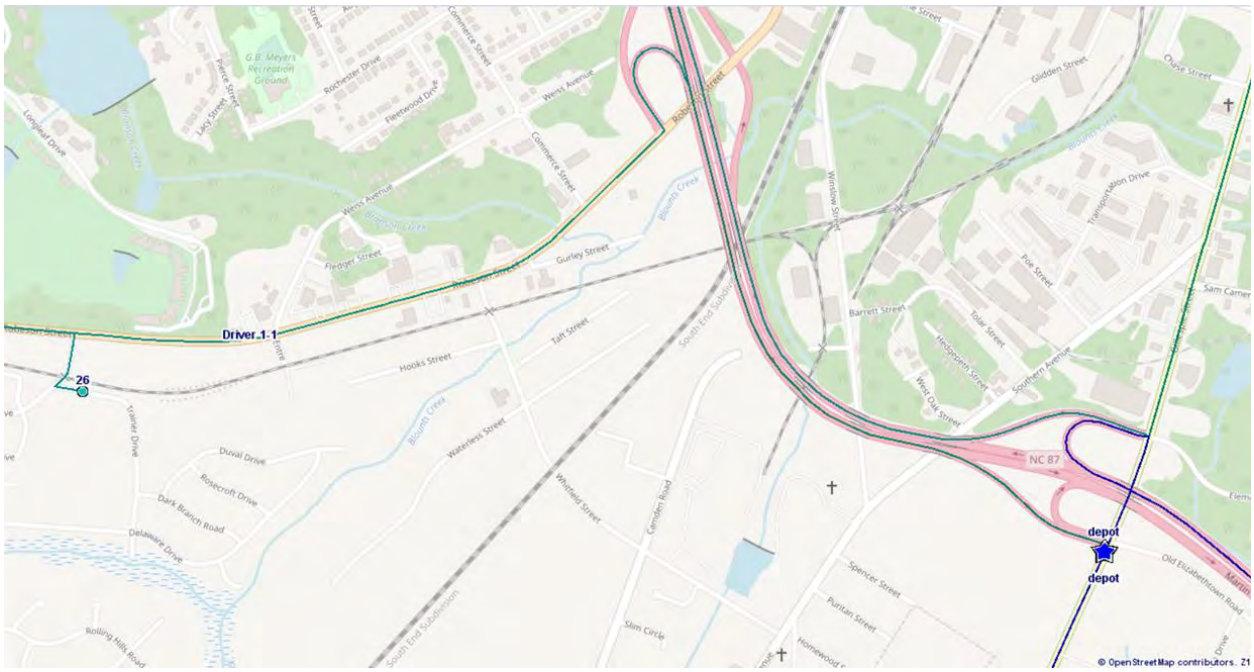

Figure 6. Zoom-In of Driver 1 - Actual Road Network

Driver 1-1 Driver 1-1 15 35.033

stop-number	stop-name	stop-address	arrival-time
1	Massey Hill Classical	1062 Southern Avenue	08:02:14.091
2	Howard Learning Academy	1608 Camden Road	08:18:04.063
3	Cumberland Road	2700 Cumberland	08:35:05.725
4	Mary McArthur Elementary	3809 Village Drive	08:53:36.183
5	Douglas Byrd High	1624 Ireland	09:10:01.954
6	Douglas Byrd Middle	1616 Ireland Drive	09:25:04.664
7	Ireland Drive Middle	1606 Ireland Drive	09:40:07.992
8	Brentwood Elementary	1115 Bingham Drive	10:00:19.641
9	71st Classical	6830 Raeford Road	10:18:09.953

Figure 7. Example of Data Report Given in ODL Studio: Driver 1 Optimal Route

CONCLUSION

The impact of the optimal solution is to add an additional van which was shown as driver 1-4, allowing all schools to receive and send mail 5 days/week instead of 2 or 3 days/week (every other day). Current Routes are evenly split 14 to 15 schools/day, but the optimized routes showed that the amount of schools allocated to each driver was dependent upon the distance between schools. Therefore, driver 1-1 only had 15 schools, driver 2-1 had 26 schools, driver 3-1 had 25 schools, and driver 4-1 will have 19 schools. This will save the county money on mileage reimbursements of .58/mile submitted to the Finance office. This will provide better quality service by increasing the customer satisfaction of our stakeholders.

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PERCEIVED PERSONALIZATION AND PRIVACY ISSUES AND THEIR IMPACT ON CHINESE ATTITUDES TOWARD ONLINE ADVERTISING

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ABSTRACT

Personalized online advertising affords marketers the power to draw in consumers' attention amid numerous competing ads; however, it may also give rise to more adverse privacy concerns. The intent of this paper is to study the impact of personalized advertising, perceived privacy concerns, irritation and trustworthiness on attitudes toward online advertising (ATOA) and behavioral intent. The survey was conducted in a large shopping mall in the Northern part of China. A total of 348 usable responses were analyzed. Factor analysis, independent t-tests, and regression methods were used in the analysis. This study indicates that personalized advertising, perceived privacy concerns, and trustworthiness significantly impact ATOA, and ATOA significantly impacts behavioral intent. This study also reveals that older, more educated, and female respondents were more concerned about privacy, predominantly those that were students, teachers, public servants, store staffs, professionals, and business persons.

INTRODUCTION

Growing interest in the reasons behind consumer attitudes toward online advertising (ATOA) has inspired manifold academic literature on advertising effectiveness. Various past studies, including Ducoffe (1996), Kim & Han (2014), and Souiden, Chtourou, & Korai (2017), have supported the positive relationship between consumer attitudes toward online advertising and behavioral intent, thus providing a useful tool for marketers in their ability to create effective advertising strategies that reach target audiences [1]. The informativeness and entertainment of online advertising have consistently been documented as significantly related to ATOA and in several studies have been identified as the most prominent determinants of advertising value [2]–[6]. Two additional widely tested determinants of ATOA, trustworthiness and irritation, will be used in this study along with perceived personalization and privacy concerns. We have chosen to omit informativeness and entertainment and instead focus on the critical importance of personalized advertisements and the consequences of perceived privacy concerns among online consumers.

Although the development of information and communication technology is signaling a shift from traditional mass advertising to highly targeted, customized marketing messages, little research has been done on the relationship between perceived personalization and

ATOA [7] [8]. The increasing use of personalized advertising may have negative consequences regarding the perceived privacy concerns of consumers. These concerns may dissuade consumers from having positive perceptions and continuing to interact with online advertising [9] [10]. The effects of perceived privacy concerns may also impact consumer trustworthiness and irritation [11]. This study serves to provide insight into the connection between perceived personalization and privacy concerns on ATOA and behavioral intent in Northern China.

Rather than using student samples, this study was conducted in a large Chinese shopping mall. By focusing on a diverse profile of Chinese perceptions and responses to online advertising, this study allows for more understanding of the online marketing environment in China and how Chinese consumers view advertising value. Moreover, this study reveals key findings regarding different demographic responses to certain influencing factors on ATOA whereas previous studies have not shown any significance across demographics [12]. Research on ATOA has mainly centered around the U.S. and other developed countries [1]; this study expands marketing literature on ATOA to contribute further to knowledge of developing online marketing industries and different cultural perceptions in an effort to aid both Chinese marketers and global marketing endeavors.

The rest of this paper is organized as follows: the next section provides a review on past literature; section three discusses the theoretical framework and hypotheses of this study; section four outlines the research methodology, data collection and analysis; section five discusses major findings of this study and is then followed by conclusions, limitations and future research suggestions.

LITERATURE REVIEW

Many factors including informativeness, entertainment, trustworthiness, and irritation have been linked to ATOA and behavioral intent, or consumer purchasing decisions. This study concentrates on only four factors: irritation, trustworthiness, perceived personalization, and perceived privacy concerns. This section discusses relevant past studies and their implications for these influencing factors on ATOA and behavioral intent.

Irritation

Irritation has been defined as the degree of annoyance, displeasure, or impatience felt by consumers [10] [13]. Findings have shown that while in some cases irritation may not directly influence consumers' attitudes toward advertising value, irritation is negatively related to ATOA. This finding is consistent among past marketing research [14]. Irritation from online advertising may be induced by certain marketing tactics chosen by advertisers to reach a target audience [4], an overload of advertisements presented to consumers [15], privacy concerns [16], poorly executed advertisement messages that fail to enthrall consumers [13], and advertising that is perceived by consumers to be manipulative, disruptive, or unauthorized [4] [16] [17]. While many scholars have supported the significant, negative relationship between perceived irritation and consumer attitudes, and

thus its effect on consumer shopping behavior, little research has continued to explore the factor of irritation and its determinants [12] [15] [18]. Studies have shown that consumers tend to be less influenced by irritation or have a more favorable perception of advertising value if they consider an advertisement to be sufficiently informative, trustworthy, and enjoyable [10] [17]. Some studies have supported the mediating effects of personalization between perceived irritation and ATOA, while others have shown a result of increased irritation due to personalization [4] [9]. Further research is needed to explore the determinants and effects of perceived irritation. Consumer attention is no longer directed toward an advertisement when consumers perceive it to be irritating; marketers must pay careful attention to their advertising effectiveness, design, and timing when presenting online advertisements to consumers so that they do not risk adding frustration or annoyance along with their messages [9] [10] [12] [18]. Past findings indicate the importance of irritation in this study.

Trustworthiness

Trustworthiness is a significant, positive predictor of ATOA [1] [6]. That is, when consumers perceive online advertising to be credible, truthful, and believable, they tend to have a more favorable perception of the advertising message. When consumers trust the advertising messages they receive, their positive perceptions toward those advertisements subsequently impact their behavioral intent [12]. In some instances, scholars have found trust to be the strongest determinant of advertising value. These results show that many consumers value advertising that they perceive to be accurate and credible in content [4], [10]. Several other research has indicated that the positive relationship between trust and ATOA may also be a result of consumers' perception that more trustworthy advertisements are less risky in terms of privacy and intent to purchase [4]. Consumers' trust in online advertising is critical when marketers seek to establish relationships with consumers and is an important element in captivating a sustainable, competitive advantage over competing marketers or online advertisements [8] [12]. Consequently, trustworthiness has been included in this study.

Personalization

Information-processing technology for web-based marketing is fostering the decline of traditional mass marketing efforts and the growing popularity of personalized marketing activities in online advertising [7] [9]. Personalized advertising involves linking marketing messages directly to individual consumer preferences through paid media based on available personal information such as customer names, buying experience, demographics, and interests [10]. By personalizing advertising messages, marketers can generate greater customer interest [10] and strengthen consumer relationship management, or CRM, to enhance consumers' overall experiences [9]. Past research has shown a positive relationship between personalization and ATOA as well as its influence on privacy, trust, and irritation [8]. Interestingly, consumers tend to perceive personalized advertisements as undesirable; however, studies have shown that irritation decreases with personalized advertising that considers consumer needs [9] [10]. Scholars also report an increase in perceived credibility of advertisements when they are personalized. Consumers may see

that marketers have specifically taken time for them or may feel that they now have a relationship with certain marketers, thus leading to less negative perceptions [9]. A consequence of personalization is the risk of invading consumers' privacy. Marketers must make consumer privacy concerns a priority so that consumer trust in advertising does not fade [8] [10]. With these factors in mind and the growing development of information and communication technology, marketers are more able to personalize advertising messages through direct, highly targeted activities [7] [8]. As marketers' knowledge and understanding of personalization in advertising expands, the more it will become a crucial tool in developing effective communication campaigns [9]. Personalization has been included in this study for its relevance and potential significance.

Privacy

Information privacy is a growing concern across a wide range of domains, including online advertising. Consumer information received by marketers is a competitive asset for creating advertising messages, thus it should be made a priority and handled with caution [7] [11]. Privacy concerns in online advertising can be explained as perceived negative consequences that result from providing personal information to others through online mediums [11]. Several studies have shown reports of a significant negative relationship between privacy concerns and ATOA; if such negative perceptions bolster, then consumers' may avoid any online advertising message that they believe risks exploiting their personal information. However, some studies also identify privacy concerns as being less of an influencing factor than others that influence positive ATOA, such as personalization and informativeness [9] [11]. Scholars suggest that to combat privacy issues, marketers may establish safeguards to protect consumers' personal information or use transparent information management that further promote consumer acceptance of online advertising messages [8]. To further understanding of the consequences of online advertising, perceived privacy concern has been chosen for this study.

Attitudes toward online advertising (ATOA)

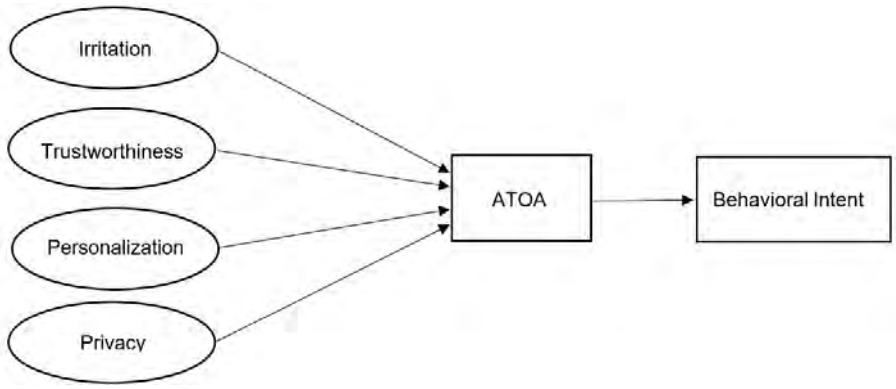
Consumer attitudes toward online advertising, influenced by characteristics of advertisements and moderating factors such as culture, can be defined as the consumers' total evaluation of perceived judgement, value and attributes of online advertisements [3] [10] [15]. ATOA positively influences consumers' intent to receive advertising and serves as a predictor for online advertising effectiveness [19] [20]. Marketers should be interested in understanding attitude toward online advertising due to its direct relationship with consumer behavior that has been supported throughout academic literature on ATOA [1] [21] [22]. With many companies focusing their marketing activities online, it is imperative that marketers recognize the volatile impact of ATOA on advertising effectiveness in today's environment [15]. ATOA is essential to the model used for this study and will hence be included in this study.

Behavioral Intent

Behavioral intent is defined as the decision to purchase or to continue seeking information after receiving an advertising message. A consumer's behavioral intent increases when they have a positive attitude toward an advertisement's message [10]. Research on this relationship has allowed insight into marketing and commerce on a global-scale [23]. Although attitudes toward advertising is a relatively new and dynamic phenomenon in connection to online advertising, findings support the significance of ATOA toward consumers' behaviors regarding advertised products or brands and their purchase decisions [15]. However, research is inconclusive due to the dynamic nature of ATOA. Consumers' perception toward online advertising remains ambiguous and little is known about the effects of attitude toward online advertising in emerging markets (e.g. China) due to the varying levels of online advertising penetration and cultural backgrounds [4] [15] [23]. Behavior intent is critical to understanding the impact of ATOA and will be used in this study.

THEORETICAL FRAMEWORK AND HYPOTHESES

This study relies on a proposed model of ATOA for the framework of the following hypotheses. The diagram below represents the underlying conceptual model used in this study. The model predicates that factors of irritation, trustworthiness, personalization, and privacy influence ATOA and further impact consumers' behavioral intent.



The model of this study is comprised of five hypotheses.

As mentioned earlier, consumers' perceived irritation toward online advertising causes an unfavorable ATOA [24] due to advertisements that create added frustration and annoyance for consumers [10]. As perceived irritation increases, the more consumers will not have a positive attitude toward online advertising:

H1**:** Perceived ad irritation will be negatively related to respondents' attitudes toward online advertising.

Previous research has supported that trustworthiness is a significant predictor of ATOA; increased credibility and believability of online advertising inspires greater trust [1]. The more trust consumers instill in advertising messages, the more favorable their attitudes will be toward online advertising:

H2**:** Perceived ad trustworthiness will be positively related to respondents' attitudes toward online advertising.

Personalization in online advertising has grown in popularity among marketing activities resulting in highly targeted, customized advertising messages [9]. Previous research has supported a positive relationship between personalization and ATOA [8]. By personalizing advertising messages, consumers are more likely to have a more positive ATOA:

H3**:** The perceived ad personalization will be positively related to respondents' attitudes toward online advertising.

Research on information privacy in online advertising has investigated the negative consequences that result from providing personal information through online mediums [11]. As consumers perceive their privacy to be increasingly at risk, the less favorable attitude they will develop toward online advertising:

H4**:** Perceived privacy concerns will be negatively related to respondents' attitudes toward online advertising.

Several scholars support the relationship between ATOA and consumers' intended behaviors [10]. Consumers' positive attitudes toward online advertisements inspire their intent to continue seeking information or decision to purchase after receiving an advertising message:

H5**:** Respondents' attitudes toward online advertising will be positively related to their behavioral intent.

METHODOLOGY

This methodology section describes the research instrument and statistical methods used, demographic information of respondents, and the detailed analysis and findings of this study.

Research Method and Statistical Measurements

The research instrument is constructed from current literature with minor modifications for internet mediums [1] [3] [9] [17] [25]. It is composed of four sections. Section one has 14 items for the four constructs of irritation, trustworthiness, personalization and privacy concerns to reflect respondents' beliefs of online advertising. Section two includes two items for the construct of ATOA. Section three has two items for the construct of behavior intention in response to online advertisement. Each of the six constructs is operationalized

with two to four items and is validated in the published studies [3] [9] [17] [23] [25]. Section four includes demographic items such as gender, age, educational level, race, nationality, and professions; respondents' experiences for internet usage are also included (e.g. the average daily number of times respondents access the internet, average daily amount of time on the internet, number of years of internet experience, and the device used to access the internet).

The five-point Likert scale is used for the instrument with 1 for strongly disagree, 2 for disagree, 3 for neither disagree nor agree, 4 for agree, and 5 for strongly agree. The items of the instrument were initially developed in English. The translations of English to Chinese and Chinese back to English are conducted by other researchers and third-party translators. This process ensures that the meaning of survey questions in the original English version is retained in the Chinese version. A pilot run of the initial version of the survey instrument collected 27 responses. The final version of the instrument is refined for the data collection with 21 items. The university institutional research board approved the instrument for data collection. A non-probability convenient sampling with the paper and pencil version of the instrument is used for data collection. The copies of the instrument were handed out to shoppers and store keepers in a large Chinese shopping mall in the summer of 2018. A total of 348 usable responses are retained for this project. SPSS (Statistical Package for the Social Sciences) was used to analyze the data. Among the statistical methods used for the analysis are descriptive statistics for the demographic information of respondents, factor reliability assessments, Pearson correlation and test, regression, and ANOVA are done with SPSS 25.

Demographics

Among the 348 respondents, 51% were males and 49% were females. Half of the respondents were 23 to 32 years old (50%) and the remaining groups of respondents were younger than 23 years old (15%), 33 to 37 years old (15%), and 38 years or older (20%). Most respondents were Chinese (more than 99%), 86% being Mandarin Chinese and the remaining respondents being Chinese minorities: Hui (6.3%), Yi or Nuosuo (2%), Tibetan (1.1%), Qiang (1.1%), and Man (1.4%). Regarding respondents' levels of education, 17% had high school or less, 11% were college students, and 64% had either associate or bachelor's degrees. The rest of respondents had post-graduate degrees (close to 7%). The respondents' professions include students (10%), teachers (5.5%), public servants (6%), store staffs (35%), professionals, business person, and workers (18.7%), farmers (1.4%), and others (23%).

The 348 respondents' average daily internet uses included the number of times respondents accessed the internet, number of hours on the internet, and number of years of experience with internet access. Among the 348 respondents, less than 15% accessed the internet less than 5 times, 47% accessed the internet between 6-10 times, 33% accessed the internet 11-15 times, and the rest accessed 6 times or more. Of the respondents, 11% spent less than 2 hours on the internet, 34% spent 2-4 hours, 48% spent 4-6 hours, and 7% spent more than 6 hours on the internet. Regarding experience, 25% have less than 6 years of experience with the internet, 39% have 6-9 years of experience,

and more than 36% have more than 9 years of internet experience. Most respondents used a mobile device to access the internet (71%) while 26% indicated they use desktop computers and less than 2.5% access the internet through computers in internet cafes, schools, or work places. A significant number of respondents used both desktop computers and mobile device to access internet. The 18-to-37-year-old respondents accessed the internet 6-15 times daily and spent between an average of 2-6 hours on the internet daily.

Factor Analysis for ATOA and Behavior Intent

Factor analysis was conducted for irritation, trustworthiness, perceived personalization, privacy concerns, ATOA, and behavioral intent. According to the analysis, the value of the Kaiser-Meyer-Olkin (KMO) was 0.782 which is acceptable for the factor analysis. The KMO statistic is a measure of common variance among the variables in the model. A value 0.6 or lower of KMO indicates the sampling is not adequate whereas a value of 0.8 and above is adequate. A hypothesis test of no correlation among the variables in the model yields a significant value of 0.000 of Bartlett's Test of Sphericity. The 14 items were classified into four factors with the cumulated percentage of variance explained in the model being 61.09%, which is considered acceptable. Therefore, factor analysis was considered appropriated for this study.

Table 1 summarizes the mean and factor loading for each survey item, and the reliability of each factor as measured by Cronbach α. The values of Cronbach α ranging from 0.625 for perceived personalization to 0.835 for irritation are within an acceptable range. Among the four items for irritation, the item of "internet advertising is annoying" has a mean 2.89 and a factor loading .846. Among the three items for trustworthiness, the item of "internet advertising is credible" has a mean 2.98 and a factor loading 0.809. Among the four items for perceived privacy concerns, the item of "I am concerned about misuse of personal information" has a mean 3.61 and a factor loading 0.788. Among the three items for the factor perceived ad personalization, the item of "I think personalized internet advertising enables me to order products that are tailor-made for me" has a mean 3.13 and a factor loading 0.790. Among the two items for ATOA, the item "Overall, I like Internet advertising" has a mean 3.10 and a factor loading 0.816. Among the two items for behavior intent, the item "I click on it to find more information" has a mean 2.71 and a factor loading 0.799.

TABLE 1: SUMMARY OF FACTOR ANALYSIS, MEAN, AND FACTOR LOADING

Factors	Items	Mean	Factor loading
Irritation Cronbach's α =.835 [19]	Internet advertising insults people's intelligence	2.70	0.872
	Internet advertising is annoying	2.89	0.846

	Internet advertising is irritating	3.01	0.730
	Internet advertising is deceptive	3.05	0.732
Trustworthiness Cronbach's α =.681 [5][26]	Internet advertising is trustworthy	2.89	0.724
	Internet advertising Is credible	2.98	0.809
	Internet advertising Is convincing	2.95	0.687
Perceived Privacy Concerns Cronbach's α =.788 [7]	I feel uncomfortable when information is shared without permission	3.38	0.780
	I am concerned about misuse of personal information	3.61	0.788
	I feel fear that information may not be safe while stored	3.66	0.715
	I think companies share information without permission	3.63	0.790
Perceived Ad Personalization Cronbach's α =.625 [9],	I feel internet advertising makes personalized purchase recommendations that match my needs	3.02	0.696
	I think personalized internet advertising enables me to order products that are tailor-made for me	3.13	0.790
	Overall, I find personalized advertising on internet is tailored to my situation	3.15	0.708
Attitudes Cronbach's α =.686 [19]	Overall, I consider Internet advertising a good thing	3.06	0.785
	Overall, I like Internet advertising	3.10	0.816

Behavior intent Cronbach's α = .649 [19]	I click on it to find more information	2.71	0.799
	I pay more attention to it	2.95	0.794

Pearson correlation matrix among the six factors are listed in Table 2. As expected, irritation is significantly positively correlated to perceived privacy concerns, and significantly negatively correlated to trustworthiness. Trustworthiness is significantly negatively correlated to perceived privacy concerns and significantly positively correlated to perceived personalization, ATOA, and behavior intent. Perceived privacy concerns are significantly positively correlated to ATOA. Perceived personalization is significantly positively correlated to ATOA. ATOA is significantly positively correlated to behavior intent.

TABLE 2: PEARSON CORRELATION MATRIX FOR FACTORS

	1	2	3	4	5	6
Irritation 1	1.000					
Trustworthiness 2	-.385**	1.000				
Privacy 3	.228**	-.202**	1.000			
Personalization 4	.014	.240**	.073	1.000		
Attitudes 5	.064	.154**	.255**	.340**	1.000	
Behavior 6	.022	.243**	-.013	.316**	.381**	1.000

Notes: ** indicates the correlation is significant at the 0.01 level (2 – tailed)

To prepare the data for multiple regression analysis, the factor average was obtained through averaging the items for the factor, i.e., for irritation, the four items were averaged to form the value for irritation to be used in regression. A normality test for the data through skewness and kurtosis reveals no significant departure from normality. Two separated regression analyses were conducted. For the first regression analysis, ATOA was the dependent variable; irritation, trustworthiness, perceived personalization, and privacy

concerns were independent variables. The hypotheses H1 through H4 were carried out through the analysis of the first regression output. For the second regression analysis, ATOA was the independent variable and behavior intent was the dependent variable. The fifth hypothesis test was conducted through an analysis of the second regression analysis. Table 3 summarizes the results of the two regression analyses. The R^2 value of 0.186 indicates that 18.6% of the variance in ATOA can be explained by irritation, trustworthiness, perceived personalization and privacy concerns. The F-test was significant for the model with 3 of the 4 factors included with irritation excluded from the model. The R^2 value of 0.145 shows that 14.5% of the variance in behavior intent can be explained by ATOA. The F-test was significant for the model of ATOA as the independent variable and behavior intent as the dependent variable.

According to the results on Table 3, 3 out of the 4 factors of irritation, trustworthiness, perceived personalization and privacy were significant at the 0.01 level to be used to model the relationship between these factors and ATOA. Irritation was not significant to model its relationship with ATOA. The standardized regression coefficient beta value of 0.138 for trustworthiness was significant at the 0.01 level and revealed that for one standard deviation change of trustworthiness, the standard deviation of ATOA would change by 0.138. The perceived personalization had a beta value of 288 ($p<0.01$), and perceived privacy had a beta value of 0.262 ($p<0.05$). Therefore, hypothesis H2 to H4 were supported. The hypothesis H1 regarding irritation was not supported. For the hypothesis H5, Table 3 showed that the effect of ATOA on behavior intent had a beta value of .381 and was significant at 0.01 level. It indicated that there was a significant relationship between ATOA and behavior intent, thus the hypothesis H5 was supported.

TABLE 3: SUMMARY OF MULTUPLE REGRESSION ANALYSIS

Hypothesis	Independent variable	Dependent variable	Beta	T - score	P - value	R^2
H1	Irritation	ATOA	-	-	-	.186
H2	Trustworthiness	ATOA	.138	2.679	.008	
H3	Perceived personalization	ATOA	.288	5.700	.000	
H4	Perceived privacy concern	ATOA	.262	5.225	.000	
H5	Attitudes toward online advertising	Behavior intent	.381	7.671	.000	.145

DISCUSSION

The purpose of this study was to test the impact of influencing factors on Chinese attitudes toward online advertising and the relationship between Chinese attitudes and consumer behavioral intent. Four factors were tested for their influence on ATOA: Irritation, trustworthiness, perceived personalization, and privacy. The results of this study show information that may aid marketers in developing effective advertising messages. The findings support that trustworthiness, perceived personalization, and privacy concerns are significantly related to attitudes toward online advertising. Conversely, the hypothesis that perceived ad irritation will be negatively related to respondents' attitudes toward online advertising was not supported by this study. The results of this study clearly showed the significant, positive relationship between attitudes toward online advertising and behavioral intent.

Unexpectedly, irritation and its relationship to ATOA was not significant in this study. Consumers' perceived irritation toward online advertising did not influence their attitudes toward online advertising. This differs from findings consistent among previous research that found irritation to be negatively related to ATOA [24]. The findings from this study show that among the lower educated group of respondents, ad irritation was more prevalent than among the higher educated group. However, ad irritation may not be a significant enough consideration for marketers when creating online advertising campaigns.

Regarding the perceived trustworthiness of online advertising, this research further supports past research findings that trustworthiness is positively related to ATOA [1] [6]. Consumers' tend to have more positive perceptions toward online advertising when they perceive advertisement messages to be truthful and credible. Previous studies have suggested that consumers perceive trustworthy ads to be less risky to pursue than advertisements they do not trust [4]. Some demographic factors moderate ad trustworthiness on ATOA and others do not. There was no significant difference between age and gender; however, the more educated group of respondents believed trustworthiness was an important determinant for advertisement value whereas the less educated group was less concerned with the trustworthiness of advertising. When comparing respondents' professions, Group A (students, teachers, public servants, store staffs, professionals, and business persons) believed trustworthiness was more important than respondents who were in Group B (workers, farmers, or other professions) at a 5% significance level. These findings are useful for expanding marketers' understandings for effective online advertising campaigns.

Personalization is another factor influencing the effectiveness of online advertising by directly connecting marketing messages to individual consumer preferences. By personalizing advertising messages, marketers can generate greater customer interest and enhance consumers' overall experiences [9] [10]. This study supports previous findings that there is a significant, positive relationship between ad personalization and ATOA [8]. When advertising messages are personalized for each consumer's needs and context, consumers are more inclined to have favorable attitudes toward online advertisements.

This study shows that ad personalization was marginally more important for respondents in Group A professions than respondents in Group B professions (10% significance level). No other tested demographic characteristic had an impact on personalization and ATOA. As personalized online advertisements further saturate the industry, marketers will need to pay more attention to its influencing effect on other factors such as privacy concerns and ad trustworthiness.

This study identified a negative influence of privacy concerns and ATOA. Consumers tend to have negative perceptions of online advertising when they believe online advertisements invade their privacy. This is supported by past findings that identify a negative relationship between perceived privacy concerns and attitudes toward online advertising [9] [11]. Several demographic factors had a significant impact on privacy and ATOA. Female respondents were more concerned with privacy than male respondents. Respondents in the lower educated group and in Group B professions were also more skeptical regarding privacy concerns (5% significance level for Group B professions). Additionally, older respondents (age 27 and up) were more concerned with privacy. Past scholars did not find any significant impact of the demographics tested for the factors in this study [12]. These findings further aid marketers' understanding of the reasons behind different consumer attitudes toward online advertisements and thus will help marketers to develop effective advertising campaigns that do not interfere with consumers' perceived risk of privacy.

Attitudes toward online advertising and consumer behavioral intent was the strongest, significant relationship found in this study. As supported by several past studies, ATOA is positively related to behavioral intent [1] [10] [15]. Surprisingly, there were moderating effects of minority vs. majority and attitudes toward online advertising. The minority respondents (Hui, Nouosuo, Tibetan, Qiang, Man, etc.) had more positive attitudes toward online advertising than the majority, Mandarin Chinese respondents. It is important for marketers to create perceptions of trust toward online advertisements and use elements of personalization in messages without intruding on consumer privacy. Perceived irritation may not be significant. These influencing factors on consumer attitudes toward online advertising further impact consumer behavioral intent thus satisfying the goal of effective online advertising. It is necessary to understand the implications behind this relationship in order to create effective online advertising campaigns.

CONCLUSION

Online advertising has become pervasive in today's marketing environment, and although much literature is available, the volatile nature of consumers' perceptions toward online advertising requires more research investigating the influencing factors of ATOA. Furthermore, online advertising in China has been on an upward trend in recent years thus shifting Chinese marketing activities online and creating a recent need for research on Chinese consumer attitudes toward online advertising. This study aimed to determine the impact of irritation, trustworthiness, personalization, and privacy on Chinese attitudes toward online advertising and the impact of Chinese attitudes on consumer behavioral intent.

The major findings from this study support that perceived ad trustworthiness and personalization are positively related to attitudes toward online advertising whereas perceived privacy concerns are negatively related to attitudes toward online advertising. Perceived ad irritation was not significantly related to ATOA.

LIMITATIONS AND FURTHER RESEARCH

There are a few limitations of this current study. Most of the published studies used students as respondents. It would be interesting to compare the differences in ATOA between the students and those non-student samples. Most of the current literatures on ATOA are in western culture. It would be interesting to conduct a cross-cultural study about ATOA to show how respondents differ in Western and Eastern cultures. The current study only includes factors such as irritation, trustworthiness, perceived personalization and perceived privacy concerns. More factors could be included such as informativeness and entertainment.

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SWOT/TOWS Analysis of Williams-Sonoma, Inc.

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ABSTRACT

As an Honors student furthering my education at a public institute of higher education, I was tasked with applying an advanced level of critical thinking to a capstone class assignment. I worked to update an old version of the capstone assignment and further expanded my knowledge on the assignment by conducting a case study that would act as a question, the solution being the updated assignment. This case study reviews a scenario with CEO of Williams-Sonoma, Inc., Laura J. Alber and employee of Williams-Sonoma, Inc. Alex. Alex is assigned to complete a SWOT/TOWS analysis report using the data that is presented throughout the case study. The report overviews both the internal and external analysis of the company and identifies the top strengths, weaknesses, opportunities, and threats. It then provides a pairing analysis of all possible scenarios the company could experience while disregarding those that may seem unfeasible. Those scenarios that remain are then ranked and combined to create a final list of critical issues the company should assess for future reference.

TABLE OF CONTENTS

APPENDIX S1: SWOT/TOWS ANALYSIS | THE PROBLEM

Characters
Alex: Employee of Williams-Sonoma, Inc. Laura J. Alber: CEO of Williams-Sonoma, Inc.

Setting
Williams-Sonoma, Inc. Worldwide Headquarters 3250 Van Ness Avenue San Francisco, CA 94109

Scene 1: *Overview of the Problem*
Laura J. Alber, CEO of Williams-Sonoma, Inc., needs a report that complies all a SWOT/TOWS analysis of the company. This should include an external analysis with the opportunities and threats and an internal analysis with the strengths and weaknesses of the company. The opportunities have been identified in order of importance as; e-commerce to go to connect with customers directly, strong buyer demand for products in the industry, offer a mixed quality product-line within one of the products it already produces in the industry, growth of the Home Furnishing Industry, and increased telecommunications usage. The threats have been identified in order of importance as; security of customer data in the industry, abandonment of trade agreements, ease of entrance into industry due to e-commerce, launch of competitor e-commerce makes it very competitive across many aspects of the industry, and firms in different industries offer substitute products at lower costs. The strengths of the company have
been identified in order of importance as; skills and capabilities, I.T. system, cost advantage with their distribution and supply network, growth, and established clear vehicles for expansion of the company to foreign markets. Lastly, the weaknesses of the company were identified in order of
importance as; competing against themselves, e-commerce is taking away from their retail outlets, total asset turnover, variation of vendors, and employee satisfaction. Laura J. Alber needs employee
of Williams-Sonoma, Inc., Alex, to pair all possibilities of the SWOT analysis then determine which options are the most feasible. After the most feasible options have been determined Laura needs Alex to create various ways that the actions would play out. At the end of this report, Laura should be able to answer the question, what scenarios are associated with the critical issues facing the firm over the next few years?

Scene 2: *Conversation between Alex and Laura J. Alber*
Laura: Good afternoon Alex. Next week I am boarding a plane to meet with a potential new subsidiary for Williams-Sonoma, Inc. and they need us to compile a report of our top five strengths, weaknesses, threats, and opportunities. After this is done, I need you to do a pairing assessment between the internal and external scenarios of the company. While some of these pairings will seem impossible, please disregard those and include only the most feasible scenarios. Lastly, I will need you to include the top actions for each issue and different ways the scenario could play out.
Alex: O.K. I will get to work on this right away. What different types of play should I include in the last portion of the report?
Laura: I would like you to include; power play, defense postures, core inadequacies, and maximum exposure. If any of these do not apply to the scenario, make note of it in the report using N/A. After all of that is complete include a summary of the entire report.

Alex: Great, I will get started now. Thanks.

Scene 3: *Alex's reflections of the conversation with Laura J. Alber*
I have begun working on identifying major issues in the company internally and externally. After paring all the scenarios and eliminating the options that were not feasible, I came to conclusion of a final list externally and internally. Externally the identified issues are; how to secure data, what to do about political changes, and what to do about saturation of the market from e-commerce. Internally the identified issues are; what to do about competing against themselves, whether e-commerce is taking away from their retail stores, and how to keep improving I.T. systems. After determining both sets of issues, I combined them into a list that contains all these critical issues. I then ranked these issues and chose the top three being; e-commerce is taking away from their retail stores, saturation of market from e-commerce, and lastly political changes. After determining the top three actions by issue I needed to assess the different ways that each scenario could play out. When evaluating the first critical issue, what to do about e-commerce taking away from retail stores, I used the power play scenario which used combined scenarios that could potentially solve the critical issue. The TOWS scenarios used for critical issue one includes; **S1|O4:** skill and capabilities: growth of the Home Furnishing Industry, **S1|O5:** skill and capabilities: increased telecommunications usage, **S5|O4:** established clear vehicles for expansion of the company to foreign markets: growth of Home Furnishing Industry, and **S5|O5:** established clear vehicles for expansion of the company to foreign markets: increased telecommunications usage. The other type of play for the first critical issue uses core inadequacies. The TOWS scenario applied
is **W1|O1:** which states, competing against themselves: e-commerce to go to connect with customers directly. These TOWS scenarios were created when preforming the pairing analysis and you can see that we have disregarded ones that do not apply to this scenario such as; **S1|O2:** capitalize on skills and capabilities to take advantage of strong buyer demand for products in the industry.
The next critical issue, what to do about saturation of market due to e-commerce, used the defensive postures and the maximum exposure as the various types of play applicable to this critical issue. When looking at the defensive postures, I found the following TOWS scenarios that applied to this
issue; **S1|T3**: Skills and capabilities; Ease of entrance due to e-commerce, **S3|T3**: Cost Advantage with distribution and supply network; Ease of entrance due to e-commerce, **S4|T3**: Growth; Ease of entrance due to e-commerce, and **S5|T3**: Established clear vehicles for expansion of the company to foreign markets; Ease of entrance due to e-commerce. For the maximum exposure play, I applied one TOWS scenario; **W2|T3**: E-commerce is taking away from their retail outlets; Ease of entrance due to e- commerce.
The last critical issue, what to do about political changes, used the defensive postures and the maximum exposure as the various types of play applicable to this critical issue. The defensive postures used the following TOWS scenarios; **S1|T2**: Skills and capabilities; Abandonment of trade agreements, **S3|T2**: Cost Advantage with distribution and supply network; Abandonment of trade agreements, **S4|T2**: Growth; Abandonment of trade agreements, and **S5|T2**: Established clear vehicles for expansion of the company to foreign markets; Abandonment of trade agreements. The maximum exposure used the following TOWS scenario; **W3|T2**: Total asset turnover; Abandonment of trade agreements and **W4|T2**: Variation of Vendors; Abandonment of trade agreements.

Since the TOWS scenarios for all critical issues have been identified they can now be formed into precise actions for the scenario. An example of creating a precise action using the first TOWS
scenario **S1|O4** would be as follows; Capitalize on skills and capabilities to take advantage of growth of the Home Furnishing Industry. This must be done for each TOWS scenario, so CEO, Laura J. Alber can have a detailed action statement for these scenarios
Finally, I will summarize all my findings and include potential challenges that I have concluded based off my findings in the SWOT/TOWS Analysis report. Continue to Appendix S2, to review the findings of Williams-Sonoma, Inc. SWOT/TOWS Analysis report.

APPENDIX S2: SWOT/TOWS ANALYSIS | THE SOLUTION

External Analysis Summary
The following table was created based using the example from the Strategic Management Handbook (Keels, 2014). The information was filled in using Appendix L.

Table 50

Williams-Sonoma, Inc. External Analysis Summary		
O/T	**List in order of importance/criticality based on external analyses**	**Source**
Opportunities	E-Commerce as a way to go to connect with customers directly Strong buyer demand for products in the industry Offer a mixed quality product-line within one of the products it already produces in the industry Growth of Home Furnishing Industry Increased telecommunications usage	Appendix F Appendix J Appendix I Appendix H Appendix F
Threats	Security of customer data in the industry Abandonment of trade agreements Ease of entrance into industry due to e-commerce Launch of competitor e- commerce makes it very competitive across many aspects of the industry	Appendix G Appendix K Appendix F Appendix I Appendix J
	5. Firms in different industries offer substitute products at lower costs	

Table 50 lists the top 5 opportunities and threats discovered during the external analysis, ranked by their importance and criticality. The top opportunity being e-commerce connecting with consumers directly and the top weakness being the security of customer data.

Internal Analysis Summary

The following table was created based using the example from the Strategic Management Handbook (Keels, 2014). The information was filled in using Appendix R.

Table 51

Williams-Sonoma, Inc. Internal Analysis Summary		
S/W	**List in order of importance/criticality based on external analyses**	**Source**
Strengths	Skills and Capabilities I.T. System Cost advantage with their distribution and supply network Growth Established clear vehicles for expansion of the company to foreign markets	Appendix M Appendix O Appendix M Appendix P Appendix M
Weaknesses	Competing against themselves E-commerce is taking away from their retail outlets Total asset turnover Variation of Vendors Employee satisfaction	Appendix M Appendix M Appendix N Appendix N Appendix P

Table 51 shows the top 5 strengths and weaknesses discovered through the internal analysis, based on order of importance and criticality. The top strength for Williams-Sonoma, Inc. being skill and capabilities and their top weakness being competing against themselves.

SWOT Analysis

The following table was created based using the example from the Strategic Management Handbook (Keels, 2014).

Table 52

Williams-Sonoma, Inc. SWOT Analysis	
STRENGTHS S1. Skills and capabilities S2. I.T. system S3. Cost Advantage with distribution and supply network S4. Growth S5. Established clear vehicles for expansion to foreign markets	**WEAKNESSES** W1. Competing against themselves W2. E-commerce takes away from retail outlets W3. Total asset turnover W4. Variation of Vendors W5. Employee Satisfaction
OPPORTUNITIES O1. E-Commerce as a way to connect with customers directly O2. Strong buyer demand for products in industry O3. Offer a mixed quality product-line within one of the products it already produces in the industry O4. Growth of Home Furnishing Industry O5. Increased telecommunications usage	**THREATS** T1. Security of customer data in the industry T2. Abandonment of trade agreements T3. Ease of entrance into industry due to e- commerce T4. Launch of competitor e-commerce markets T5. Firms in different industries offer substitute products at lower costs

Table 52 shows a SWOT analysis done for Williams-Sonoma, Inc. based on the strengths and weaknesses it currently has and opportunities and threats available to them. The five strengths discovered were skills and capabilities, I.T. systems, cost advantages with distribution and supply network, growth, and established clear vehicles for expansion to foreign markets. The top five opportunities discovered were e-Commerce as a way to connect with customers directly, strong buyer demand for products in industry, offering a mixed-product line within one of its products it already produces, growth of home furnishing industry and increased telecommunications usage. The top five weaknesses discovered were competing against themselves, e-commerce takes away from retail outlets, total asset turnover, variation of vendors and employee satisfaction. The top five threats discovered were security of customer data in the industry, abandonment of trade agreements, ease of entrance into industry due to e- commerce, launch of competitor e-commerce markets and firms in different industries offer substitute products at lower costs.

Scenarios

The following table was created using the example from the Strategic Management Handbook (Keels, 2014).

Table 53

Williams Sonoma, Inc. Scenarios	
S1|O1	Skills and capabilities ; E-Commerce as a way to go to connect with customers directly
S1|O2	Skills and capabilities ; Strong buyer demand for products in the industry
S1|O3	Skills and capabilities ; Offer a mixed quality product-line within one of the products it already produces in the industry
S1|O4	Skills and capabilities ; Growth of Home Furnishing Industry
S1|O5	Skills and capabilities ; Increased telecommunications usage
S1|T1	Skills and capabilities ; Security of customer data
S1|T2	Skills and capabilities ; Abandonment of trade agreements
S1|T3	Skills and capabilities ; Ease of entrance due to e-commerce
S1|T4	Skills and capabilities ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
S1|T5	Skills and capabilities ; Firms in different industries offer substitute products at lower costs
S2|O1	I.T. system ; E-Commerce as a way to go to connect with customers directly
S2|O2	I.T. system ; Strong buyer demand for products in the industry
S2|O3	I.T. system ; Offer a mixed quality product-line within one of the products it already produces in the industry
S2|O4	I.T. system ; Growth of Home Furnishing Industry
S2|O5	I.T. system ; Increased telecommunications usage
S2|T1	I.T. system ; Security of customer data
S2|T2	I.T. system ; Abandonment of trade agreements
S2|T3	I.T. system ; Ease of entrance due to e-commerce
S2|T4	I.T. system ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
S2|T5	I.T. system ; Firms in different industries offer substitute products at lower costs
S3|O1	Cost Advantage with distribution and supply network ; E-Commerce as a way to go to connect with customers directly
S3|O2	Cost Advantage with distribution and supply network ; Strong buyer demand for products in the industry
S3|O3	Cost Advantage with distribution and supply network ; Offer a mixed quality product-line within one of the products it already produces in the industry
S3|O4	Cost Advantage with distribution and supply network ; Growth of Home Furnishing Industry
S3|O5	Cost Advantage with distribution and supply network ; Increased telecommunications usage
S3|T1	Cost Advantage with distribution and supply network ; Security of customer data
S3|T2	Cost Advantage with distribution and supply network ; Abandonment of trade agreements
S3|T3	Cost Advantage with distribution and supply network ; Ease of entrance due to e- commerce
S3|T4	Cost Advantage with distribution and supply network ; Launch of competitor e- commerce makes it very competitive across many aspects of the industry
S3|T5	Cost Advantage with distribution and supply network ; Firms in different industries offer substitute products at lower costs
S4|O1	Growth ; E-Commerce as a way to go to connect with customers directly
S4|O2	Growth ; Strong buyer demand for products in the industry
S4|O3	Growth ; Offer a mixed quality product-line within one of the products it already produces in the industry

S4|O4	Growth ; Growth of Home Furnishing Industry
S4|O5	Growth ; Increased telecommunications usage
S4|T1	Growth ; Security of customer data
S4|T2	Growth ; Abandonment of trade agreements
S4|T3	Growth ; Ease of entrance due to e-commerce
S4|T4	Growth ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
S4|T5	Growth ; Firms in different industries offer substitute products at lower costs
S5|O1	Established clear vehicles for expansion of the company to foreign markets ; E- Commerce as a way to go to connect with customers directly
S5|O2	Established clear vehicles for expansion of the company to foreign markets ; Strong buyer demand for products in the industry
S5|O3	Established clear vehicles for expansion of the company to foreign markets ; Offer a mixed quality product-line within one of the products it already produces in the industry
S5|O4	Established clear vehicles for expansion of the company to foreign markets ; Growth of Home Furnishing Industry
S5|O5	Established clear vehicles for expansion of the company to foreign markets ; Increased telecommunications usage
S5|T1	Established clear vehicles for expansion of the company to foreign markets ; Security of customer data
S5|T2	Established clear vehicles for expansion of the company to foreign markets ; Abandonment of trade agreements
S5|T3	Established clear vehicles for expansion of the company to foreign markets ; Ease of entrance due to e-commerce
S5|T4	Established clear vehicles for expansion of the company to foreign markets ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
S5|T5	Established clear vehicles for expansion of the company to foreign markets ; Firms in different industries offer substitute products at lower costs
W1|O1	Competing against themselves ; E-Commerce as a way to go to connect with customers directly
W1|O2	Competing against themselves ; Strong buyer demand for products in the industry
W1|O3	Competing against themselves ; Offer a mixed quality product-line within one of the products it already produces in the industry
W1|O4	Competing against themselves ; Growth of Home Furnishing Industry
W1|O5	Competing against themselves ; Increased telecommunications usage
W1|T1	Competing against themselves ; Security of customer data
W1|T2	Competing against themselves ; Abandonment of trade agreements
W1|T3	Competing against themselves ; Ease of entrance due to e-commerce
W1|T4	Competing against themselves ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
W1|T5	Competing against themselves ; Firms in different industries offer substitute products at lower costs
W2|O1	E-commerce is taking away from their retail outlets ; E-Commerce as a way to go to connect with customers directly
W2|O2	E-commerce is taking away from their retail outlets ; Strong buyer demand for products in the industry
W2|O3	E-commerce is taking away from their retail outlets ; Offer a mixed quality product-line within one of the products it already produces in the industry

W2|O4	E-commerce is taking away from their retail outlets ; Growth of Home Furnishing Industry
W2|O5	E-commerce is taking away from their retail outlets ; Increased telecommunications usage
W2|T1	E-commerce is taking away from their retail outlets ; Security of customer data
W2|T2	E-commerce is taking away from their retail outlets ; Abandonment of trade agreements
W2|T3	E-commerce is taking away from their retail outlets ; Ease of entrance due to e- commerce
W2|T4	E-commerce is taking away from their retail outlets ; Launch of competitor e- commerce makes it very competitive across many aspects of the industry
W2|T5	E-commerce is taking away from their retail outlets ; Firms in different industries offer substitute products at lower costs
W3|O1	Total asset turnover ; E-Commerce as a way to go to connect with customers directly
W3|O2	Total asset turnover ; Strong buyer demand for products in the industry
W3|O3	Total asset turnover ; Offer a mixed quality product-line within one of the products it already produces in the industry
W3|O4	Total asset turnover ; Growth of Home Furnishing Industry
W3|O5	Total asset turnover ; Increased telecommunications usage
W3|T1	Total asset turnover ; Security of customer data
W3|T2	Total asset turnover ; Abandonment of trade agreements
W3|T3	Total asset turnover ; Ease of entrance due to e-commerce
W3|T4	Total asset turnover ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
W3|T5	Total asset turnover ; Firms in different industries offer substitute products at lower costs
W4|O1	Variation of Vendors ; E-Commerce as a way to go to connect with customers directly
W4|O2	Variation of Vendors ; Strong buyer demand for products in the industry
W4|O3	Variation of Vendors ; Offer a mixed quality product-line within one of the products it already produces in the industry
W4|O4	Variation of Vendors ; Growth of Home Furnishing Industry
W4|O5	Variation of Vendors ; Increased telecommunications usage
W4|T1	Variation of Vendors ; Security of customer data
W4|T2	Variation of Vendors ; Abandonment of trade agreements
W4|T3	Variation of Vendors ; Ease of entrance due to e-commerce
W4|T4	Variation of Vendors ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
W4|T5	Variation of Vendors ; Firms in different industries offer substitute products at lower costs
W5|O1	Employee satisfaction ; E-Commerce as a way to go to connect with customers directly
W5|O2	Employee satisfaction ; Strong buyer demand for products in the industry
W5|O3	Employee satisfaction ; Offer a mixed quality product-line within one of the products it already produces in the industry
W5|O4	Employee satisfaction ; Growth of Home Furnishing Industry
W5|O5	Employee satisfaction ; Increased telecommunications usage
W5|T1	Employee satisfaction ; Security of customer data
W5|T2	Employee satisfaction ; Abandonment of trade agreements
W5|T3	Employee satisfaction ; Ease of entrance due to e-commerce

W5|T4	Employee satisfaction ; Launch of competitor e-commerce makes it very competitive across many aspects of the industry
W5|T5	Employee satisfaction ; Firms in different industries offer substitute products at lower costs

Table 53 shows the various combinations of strengths, weaknesses, opportunities and threats that result in various scenarios for Williams-Sonoma, Inc. An example of a strength and opportunity would be skills and capabilities and commerce as a direct tool to connect with customers. An example of a strength and threat would be skills and capabilities and a saturated market. An example of a weakness and opportunity is variation of vendor issues and growth in the home furnishing industry. Lastly an example of a weakness and threat is competing against themselves and saturation of market.

TOWS Analysis

The following table was created using the example from the Strategic Management Handbook (Keels, 2014).

Table 54

Williams Sonoma, Inc. TOWS Analysis	
S1|O1	Capitalize on skills and capabilities to take advantage of connecting with customers directly via e-commerce
S1|O2	Capitalize on skills and capabilities to take advantage of strong buyer demand for products in the industry
S1|O3	Capitalize on skills and capabilities to take advantage of offering a mixed-product line within one of the products it already produces in the industry
S1|O4	Capitalize on skills and capabilities to take advantage of growth of Home Furnishing Industry
S1|O5	Capitalize on skills and capabilities to take advantage of increased telecommunications usage
S1|T1	Using skills and capabilities to protect against secure customer data
S1|T2	Using skills and capabilities to protect against possibilities of abandonment of trade agreements
S1|T3	Using skills and capabilities to protect against a possible saturated market due to ease of entrance due to e-commerce
S1|T4	Using skills and capabilities to protect against launch of competitor e-commerce
S1|T5	Using skills and capabilities to protect against firms in different industries offering substitute products at lower costs
S2|O1	Capitalize I.T. systems to take advantage of e-Commerce as a way to go to connect with customers directly
S2|O2	Capitalize I.T. systems to take advantage of strong buyer demand for products in the industry
S2|O3	Capitalize I.T. systems to take advantage of offering a mixed-product line within one of the products it already produces in the industry
S2|O4	Capitalize I.T. systems to take advantage of growth of Home Furnishing Industry
S2|O5	Capitalize I.T. systems to take advantage of increased telecommunications usage
S2|T1	Using I.T. system to protect against secure customer data issues
S2|T2	Using I.T. system to protect against abandonment of trade agreements

S2|T3	Using I.T. system to protect against saturation of market due to ease of entrance due to e-commerce
S2|T4	Using I.T. system to protect against launch of competitor e-commerce makes it very competitive across many aspects of the industry
S2|T5	Using I.T. system to protect against firms in different industries offer substitute products at lower costs
S3|O1	Capitalizing on cost advantage of distribution and supply network to take advantage e-Commerce
S3|O2	Capitalizing on cost advantage of distribution and supply network to take advantage strong buyer demand for products in the industry
S3|O3	Capitalizing on cost advantage of distribution and supply network to take advantage of offering a mixed-product line within one of the products it already produces in the industry
S3|O4	Capitalizing on cost advantage of distribution and supply network to take advantage of growth of Home Furnishing Industry
S3|O5	Capitalizing on cost advantage of distribution and supply network to take advantage of increased telecommunications usage
S3|T1	Using cost advantage with distribution and supply network to protect against security of customer data issues
S3|T2	Using cost advantage with distribution and supply network to protect against abandonment of trade agreements
S3|T3	Using cost advantage with distribution and supply network to protect against a saturated market due to ease of entrance due to e-commerce
S3|T4	Using cost advantage with distribution and supply network to protect against launch of competitor e-commerce makes it very competitive across many aspects of the industry
S3|T5	Using cost advantage with distribution and supply network to protect against firms in different industries offer substitute products at lower costs
S4|O1	Capitalization of growth to take advantage of E-Commerce
S4|O2	Capitalization of growth to take advantage of strong buyer demand for products in the industry
S4|O3	Capitalization of growth to take advantage of offering a mixed-product line within one of the products it already produces in the industry
S4|O4	Capitalization of growth to take advantage of growth of Home Furnishing Industry
S4|O5	Capitalization of growth to take advantage of increased telecommunications usage
S4|T1	Using growth to protect against security of customer data issues
S4|T2	Using growth to protect against abandonment of trade agreements
S4|T3	Using growth to protect against ease of entrance due to e-commerce
S4|T4	Using growth to protect against launce of competitor e-commerce makes it very competitive across many aspects of the industry
S4|T5	Using growth to protect against firms in different industries offer substitute products at lower costs
S5|O1	Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of e-Commerce as a way to go to connect with customers directly
S5|O2	Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of strong buyer demand for products in the industry

S5|O3	Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of offering a mixed-product line within one of the products it already produces in the industry
S5|O4	Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of growth of Home Furnishing Industry
S5|O5	Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of increased telecommunications usage
S5|T1	Using established clear vehicles for expansion of the company to foreign markets to protect against security of customer data issues
S5|T2	Using established clear vehicles for expansion of the company to foreign markets to protect against abandonment of trade agreements
S5|T3	Using established clear vehicles for expansion of the company to foreign markets to protect against saturation of market due to ease of entrance due to e-commerce
S5|T4	Using established clear vehicles for expansion of the company to foreign markets to protect against launch of competitor e-commerce makes it very competitive across many aspects of the industry
S5|T5	Using established clear vehicles for expansion of the company to foreign markets to protect against firms in different industries offer substitute products at lower costs
W1|O1	Fix competing against themselves in order to take advantage of e-Commerce as a way to go to connect with customers directly
W1|O2	Competing against themselves and Strong buyer demand for products in the industry
W1|O3	Fix competing against themselves in order to take advantage of offering a mixed- product line within one of the products it already produces in the industry
W1|O4	Fix competing against themselves in order to take advantage of growth of Home Furnishing Industry
W1|O5	Fix competing against themselves in order to take advantage of increased telecommunications usage
W1|T1	Correct competing against themselves to reduce vulnerability of customer data issues
W1|T2	Correct competing against themselves to reduce vulnerability of abandonment of trade agreements
W1|T3	Correct competing against themselves to reduce vulnerability of saturation of market due to ease of entrance due to e-commerce makes business difficult
W1|T4	Correct competing against themselves to reduce vulnerability of launch of competitor e-commerce makes it very competitive across many aspects of the industry
W1|T5	Correct competing against themselves to reduce vulnerability of firms in different industries offer substitute products at lower costs
W2|O1	Fix e-commerce taking away from their retail outlets in order to take advantage of e-Commerce as a way to go to connect with customers directly
W2|O2	Fix e-commerce taking away from their retail outlets in order to take advantage of strong buyer demand for products in the industry
W2|O3	Fix e-commerce taking away from their retail outlets in order to take advantage of offering a mixed-product line within one of the products it already produces in the industry
W2|O4	Fix e-commerce taking away from their retail outlets in order to take advantage of growth of Home Furnishing Industry

W2|O5	Fix e-commerce taking away from their retail outlets in order to take advantage of increased telecommunications usage
W2|T1	Correct e-commerce taking away from their retail outlets to reduce vulnerability of security of customer data issues
W2|T2	Correct e-commerce taking away from their retail outlets to reduce vulnerability of abandonment of trade agreements
W2|T3	Correct e-commerce taking away from their retail outlets to reduce vulnerability of market due to ease of entrance due to e-commerce
W2|T4	Correct e-commerce taking away from their retail outlets to reduce vulnerability of launch of competitor e-commerce makes it very competitive across many aspects of the industry
W2|T5	Correct e-commerce taking away from their retail outlets to reduce vulnerability of firms in different industries offer substitute products at lower costs
W3|O1	Fix total asset turnover in order to take advantage of e-Commerce can help to connect with customers directly
W3|O2	Fix total asset turnover in order to take advantage of strong buyer demand for products in the industry
W3|O3	Fix total asset turnover in order to take advantage of offering a mixed-product line within one of the products it already produces in the industry
W3|O4	Fix total asset turnover in order to take advantage of growth of Home Furnishing Industry
W3|O5	Fix total asset turnover in order to take advantage of increased telecommunications usage
W3|T1	Correct total asset turnover in order to reduce vulnerability of security of customer data issues
W3|T2	Correct total asset turnover in order to reduce vulnerability of abandonment of trade agreements
W3|T3	Correct total asset turnover in order to reduce vulnerability of ease of entrance due to e-commerce
W3|T4	Correct total asset turnover in order to reduce vulnerability of launch of competitor e-commerce makes it very competitive across many aspects of the industry
W3|T5	Correct total asset turnover in order to reduce vulnerability of firms in different industries offer substitute products at lower costs
W4|O1	Fix variation of vendors issues in order to take advantage of e-Commerce as a way to go to connect with customers directly
W4|O2	Fix variation of vendors issues in order to take advantage of strong buyer demand for products in the industry
W4|O3	Fix variation of vendors issues in order to take advantage of offering a mixed- product line within one of the products it already produces in the industry
W4|O4	Fix variation of vendors issues in order to take advantage of growth of Home Furnishing Industry
W4|O5	Fix variation of vendors issues in order to take advantage of increased telecommunications usage
W4|T1	Correct variation of vendors issues in order to reduce vulnerability of security of customer data issues
W4|T2	Correct variation of vendors issues in order to reduce vulnerability of abandonment of trade agreements
W4|T3	Correct variation of vendors issues in order to reduce vulnerability of ease of entrance due to e-commerce

W4|T4	Correct variation of vendors issues in order to reduce vulnerability of launch of competitor e-commerce makes it very competitive across many aspects of the industry
W4|T5	Correct variation of vendors issues in order to reduce vulnerability of firms in different industries offering substitute products at lower costs
W5|O1	Fix issues with employee satisfaction in order to take advantage of e-Commerce as a way to go to connect with customers directly
W5|O2	Fix issues with employee satisfaction in order to take advantage of strong buyer demand for products in the industry
W5|O3	Fix issues with employee satisfaction in order to take advantage of offering a mixed-product line within one of the products it already produces in the industry
W5|O4	Fix issues with employee satisfaction in order to take advantage of growth of Home Furnishing Industry
W5|O5	Fix issues with employee satisfaction in order to take advantage of increased telecommunications usage
W5|T1	Correct issues with employee satisfaction in order to reduce vulnerability of security of customer data issues
W5|T2	Correct issues with employee satisfaction in order to reduce vulnerability of abandonment of trade agreements
W5|T3	Correct issues with employee satisfaction in order to reduce vulnerability of saturation of market due to ease of entrance due to e-commerce
W5|T4	Correct issues with employee satisfaction in order to reduce vulnerability of launch of competitor e-commerce makes it very competitive across many aspects of the industry
W5|T5	Correct issues with employee satisfaction in order to reduce vulnerability of firms in different industries offering substitute products at lower costs

Table 54 shows the actions available based on the various opportunities, threats, strengths and weaknesses. An example of a strength and opportunity would be capitalizing on skills and capabilities to take advantage of e-commerce as a direct tool to connect with customers. An example of a strength and threat would be using skills and capabilities to protect against a saturated market. An example of a weakness and opportunity is fixing variation of vendor issues in order to take advantage of growth in the home furnishing industry. Lastly an example of a weakness and threat is correcting competing against themselves in order to reduce vulnerability of saturation of market.

Major Issues

The following tables were created using information from Appendix L and Appendix R. **Table**

Table 55 A

Williams-Sonoma, Inc. **Major issues identified in External Analysis**
1. How to secure data (Appendix L)
2. What to do about political changes (Appendix L)
3. What to do about saturation of market from e-commerce (Appendix L)

Table 55 B

Williams-Sonoma, Inc. **Major issues identified in Internal Analysis**
1. What to do about competing against themselves (Appendix R)
2. Whether e-commerce is taking away from their retail stores (Appendix R)
3. How to keep improving I.T. systems (Appendix R)

Tables 55 A and 55 B show the major issues discovered from the external and internal analyses.

Combined Set of Issues

The following table was created based on information found in Table 54 and 55.

Table 56

Williams-Sonoma, Inc. Combined Set of Critical Issues
1. How to keep improving I.T. systems (Appendix R)
2. How to secure data (Appendix L)
3. What to do about competing against themselves (Appendix R)
4. What to do about e-commerce taking away from retail stores (Appendix R)
5. What to do about political changes (Appendix L)
6. What to do about saturation of market from e-commerce (Appendix L)

Table 56 shows the combined critical issues that resulted from the top external and internal critical issues.

Top Critical Issues

The following table was created using the example from the Strategic Management Handbook (Keels, 2014).

Table 57

Williams-Sonoma, Inc. Critical Issues Prioritization						
	External Analysis Top Three Issues			**Internal Analysis Top Three Issues**		
	EXT CI1: Security of data	**EXT CI2: Political Changes**	**EXT CI3: Saturation of market from e-commerce**	**INT CI1: Competing against themselves**	**INT CI2: E-commerce is taking away from their retail stores**	**INT CI3: Need to ke improving I.T. system**
Related Strength Scenarios	S1|T1 S2|T1 S4|T1	S1|T2 S3|T2 S4|T2 S5|T2	S1|T3 S3|T3 S4|T3 S5|T3	S1|O2 S1|O4 S3|O2 S3|O4	S1|O4 S1|O5 S5|O4 S5|O5	S2|O1 S2| S2|T1
Related Weaknesses Scenarios	W5|T1	W3|T2 W4|T2	W2|T3	W1|O4	W1|O1	W4|T1 W5|
Average Ranking Score	16/8 =2	32/12 =2.7	30/10 =3	25/10 =2.5	32/10 =3.2	23/10 =2.3

Table 57 shows the average ranking scores of the critical issues.

- Customer data security (2.0)
- Need to keep improving I.T. system (2.3)
- Competing against themselves (2.5)
- Trade agreements abandonment (2.70
- Threats from e-commerce (3.0)

- E-Commerce is taking away from their retail stores (3.2)

The critical issues were rated based on their related strength and weakness scenarios and then listed in order or lowest to highest ranking. Customer data security had the lowest ranking with a 2.0 whereas e-commerce taking away from retail stores had the highest ranking at 3.2.

Top Actions by Issues
The following tables were created using the example from the Strategic Management Handbook (Keels, 2014). The top three critical issues were chosen based on their priority ratings calculated in table 57.

Table 58

Williams-Sonoma, Inc. Top Action by Issue		
Critical Issue 1: What to do about e-Commerce taking away from retail stores		
Play	**Tows Scenarios**	**Precise Action for Scenario**
Power Play	**S1|O4:** Skills and capabilities; Growth of Home Furnishing Industry **S1|O5**: Skills and capabilities; Increased telecommunications usage	Capitalize on skills and capabilities to take advantage of growth of Home Furnishing Industry
	S5|O4: Established clear vehicles for expansion of the company to foreign markets; Growth of Home Furnishing Industry **S5|O5**: Established clear vehicles for expansion of the company to foreign markets; Increased telecommunications usage	Capitalize on skills and capabilities to take advantage of increased telecommunications usage Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of growth of Home Furnishing Industry Capitalizing on established clear vehicles for expansion of the company to foreign markets to take advantage of increased telecommunications usage
Defensive	N/A	N/A
Core	**W1|O1**: Competing against	Fix competing against

	themselves; E-Commerce as a way to go to connect with customers directly	themselves in order to take advantage of e-Commerce as a way to go to connect with customers directly
Maximum	N/A	N/A

Table 58 shows the various plays applicable to critical issue #1 e-commerce taking away from retail stores. For this critical issue the plays present are power plays and core inadequacies. The power play has four different scenarios, whereas the core inadequacy has just one.

Table 59

Williams-Sonoma, Inc. Top Action by Issue		
Critical Issue 2: What to do about saturation of market due to e-commerce		
Play	**Tows Scenarios**	**Precise Action for Scenario**
Power Play	N/A	N/A
Williams-Sonoma, Inc. Top Action by Issue		
Critical Issue 2: What to do about saturation of market due to e-commerce		
Play	**Tows Scenarios**	**Precise Action for Scenario**
Defensive Postures	**S1|T3**: Skills and capabilities; Ease of entrance due to e-commerce **S3|T3**: Cost Advantage with distribution and supply network; Ease of entrance due to e-commerce **S4|T3**: Growth; Ease of entrance due to e-commerce **S5|T3**: Established clear	Using skills and capabilities to protect against a possible saturated market due to ease of entrance due to e- commerce Using cost advantage with distribution and supply network to protect against a saturated market due to ease of entrance due to e- commerce Using growth to protect against ease of entrance due to e- commerce Using established clear vehicles for expansion of the company to foreign markets to protect against saturation of market due to ease of entrance due to e-commerce

	vehicles for expansion of the company to foreign markets; Ease of entrance due to e-commerce	
Core Inadequacies	N/A	N/A
Maximum Exposure	**W2**|**T3**: E-commerce is taking away from their retail outlets; Ease of entrance due to e-commerce	Correct e-commerce taking away from their retail outlets to reduce vulnerability of market due to ease of entrance due to e-commerce

Table 59 shows the various plays applicable to Critical Issue #2 saturation of market due to e-commerce. For this critical issue the plays present are defensive posture and maximum exposure. The defensive posture has four scenarios whereas the maximum exposure has one scenario present.

Table 60

Williams-Sonoma, Inc. Top Action by Issue		
Critical Issue 3: What to do about political changes		
Play	**Tows Scenarios**	**Precise Action for Scenario**
Power Play	N/A	N/A
Defensive Postures	**S1**|**T2**: Skills and capabilities; Abandonment of trade agreements **S3**|**T2**: Cost Advantage with distribution and supply network; Abandonment of trade agreements **S4**|**T2**: Growth; Abandonment of trade agreements **S5**|**T2**: Established clear vehicles for expansion of the company to foreign markets; Abandonment of trade agreements	Using skills and capabilities to protect against possibilities of abandonment of trade agreements Using cost advantage with distribution and supply network to protect against abandonment of trade agreements Using growth to protect against abandonment of trade agreements Using established clear vehicles for expansion of the company to foreign markets to protect against abandonment of trade agreements
Core Inadequacies	N/A	N/A
Maximum Exposure	**W3**|**T2**: Total asset turnover; Abandonment of trade agreements **W4**|**T2**: Variation of Vendors; Abandonment of trade agreements	Correct total asset turnover in order to reduce vulnerability of abandonment of trade agreements Correct variation of vendors issues in order to reduce vulnerability of abandonment of trade agreements

Table 60 shows the various plays applicable to Critical Issue #3 political changes. For this

critical issue the plays present are defensive posture and maximum exposure. The defensive posture has four scenarios whereas the maximum exposure has two scenarios present.

SUMMARY: APPENDIX S

Williams-Sonoma, Inc. has a variety of strengths, weaknesses, opportunities, and threats. The top five opportunities and threats were extracted from the Appendix L during the external analysis. The top five weaknesses and threats were extracted from Appendix R during the internal analysis.

The opportunities, threats, strengths and weaknesses were then placed into a SWOT analysis chart to create a visual representation. The SWOT analysis was then analyzed based on all possible combinations of strengths, weaknesses, opportunities and threats. Following the SWOT analysis a TOWS analysis was done to analyze all possible actions and scenarios that occur based on the SWOT scenarios.

The top three major issues from both the external and internal analyses were combined and then ranked based on priority. The 6 issues were Customer data security, a need to keep improving I.T. system, competing against themselves, trade agreements abandonment, ease of entrance due to e-commerce, and e-Commerce is taking away from their retail stores.

All relevant strengths and weaknesses were associated with each critical issue, and then an average ranking score was calculated. Customer data security received lowest score of (2.0), need to keep improving I.T. system received a score of (2.3) competing against themselves receive a score of (2.5), trade agreements abandonment receive a score of (2.7) ease of entrance due to e-commerce receive a score of (3.0) e-Commerce is taking away from their retail stores receive a score of (3.2). Customer data security issues received lowest score of (2.0) whereas E-commerce taking away from retail stores received the highest score at (3.2).

After identifying the 6 critical issues and ranking them based on priority the top three were analyzed to identify which used power plays, defensive postures, core inadequacies, and maximum exposures. Critical Issue #1 is e-commerce is taking away from retail stores. Critical Issue #1 had four power play scenarios and one core inadequacy. Critical Issue #2 is the possibility of saturation of market due to ease of entrance due to e-commerce. Critical Issue #2 had four defensive posture scenarios and one maximum exposure scenario. Critical Issue #3 is political changes. Critical Issue #3 had four defensive posture scenarios and two maximum exposure scenarios.

The importance of writing this analysis is to evaluate all possible scenarios that the company could experience then rank them to determine the top critical issues that the company has. Pulling all this information into one report organizes it and shows a strategic way that a company can form a decision based off previous references. This case study was designed for teachers to use as an assignment where students can apply firm dynamics to craft a report that is like the one included in Appendix S2. The report should answer the following question; what scenarios are associated with the critical issues facing the firm over the next few years? This case study is replicating a good introduction to creating a real-time case where the information included must be gathered using extensive research.

THE IMPACT OF INFORMATION TECHNOLOGY CAPABILITY ON PRODUCTION PROCESS VARIABILITY UNDER ENVIRONMENTAL UNCERTAINTY

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ABSTRACT

Operations managers are continually searching for ways in which they can improve the production process performance. Theory of swift even flow (TSEF), as a fundamental theory in operations management, suggests that the speed and consistency of the flow of material and information into, through, and out of any production process determines its productivity. Hence, an increase in the variability of flow of goods and information in a production process will cause lower productivity and vice versa. Today, as firms are moving towards globalization, they are operating in an uncertain environment, so the variability in production process will be enhanced which reduces production performance. Therefore, it is important to diagnose, manage, and reduce such variability in operations processes. We look at this issue through the organizational information processing theory (OIPT) lens. By recent improvements in information technology (IT), companies are able to better process the information and deal with uncertainties by improving their process management. This study develops a conceptual model that explains the linkage between IT capability, production process variability, environmental uncertainty, and operations performance. We empirically examined our model using secondary information collected from Compustat database and InformationWeek 500 ranking over a 9 years period. Structural equation modeling is used to evaluate the model. The results of this study indicate a positive relationship between IT capability and operating performance. In addition, a moderating role of IT capability on relationship between environmental uncertainty, process variability, and operating performance is supported. Accordingly, this study contributes to the literature by explaining the underlying mechanism in which IT capability improves the production process performance, and its impact on process variability in an uncertain environment. In addition, it made a bridge between two big theories of TSEF and OIPT by looking at the impact of IT capability on process variability. Moreover, managers can consider IT capability as a tool to control process variability and its detrimental effects on operations performance.

Keywords: Process variability, IT capability, Swift even Flow, Information Processing Theory, Environmental uncertainty

THE IMPACT OF PARCEL CARRIERS ON THE H EALTHCARE SUPPLY C HAIN

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ABSTRACT

Logistics is a major theme in current research regarding healthcare supply chain management, and communication is a key component of supply chain efficiency. This case study summarizes interviews with four healthcare organizations regarding shipping issues with parcel carriers. This area of logistics represents an area of opportunity in the healthcare supply chain. In addition, a representative from a group purchasing organization (GPO) and a representative from a third-party logistics provider (3PL) were interviewed for further insight. Interviewees provided recommendations based on their industry experience. It was determined that planning, internal communication, relationship management, and the implementation of priority shipping options have the potential to decrease issues with parcel carrier shipments. The compilation of these recommendations represents potential best practices for the industry. Future research is required to determine the efficacy of these approaches.

Keywords: healthcare, supply chain, logistics, parcel carriers, communication, shipping

THE IMPA CT O F PARCEL CARRIERS ON T HE HE ALTHCAR E SUPP LY CHAIN

The healthcare industry is the second largest industry in the United States, behind insurance carriers and related activities. In 2017, healthcare contributed 6.6% of U.S. Gross Domestic Product (GDP). Hospitals are responsible for 46.8% of industry revenue [5]. Despite its significant size and impact on society, the healthcare industry is trailing other industries with lower operational efficiency rates due to a struggle to manage its supply chain. These inefficiencies are affecting profit margins, the bottom line, and the success of organizations. One study estimates logistics costs for healthcare organizations (HCOs) make up 38% of their total expenses, in comparison to the 5% cost in the retail industry [3]. Logistics costs represent the second largest cost segment for hospitals, after personnel costs. Several researchers have identified logistics as the key to reducing healthcare costs. It is estimated up to half of logistics-related costs can be eliminated by mirroring best practices exemplified by other industries [6]. There is extensive research on the implementation of various supply chain tools in the healthcare industry and how these tools can provide cost-saving opportunities.

An important element of the healthcare supply chain is the shipping and receiving of product, which requires efficient communication between the HCO and carriers. This case study focuses on shipping issues that HCOs experience with parcel carriers. Four HCOs were interviewed to learn more about the common shipping issues they face. From these interviews, examples were derived and then a list of recommendations to resolve the issues was compiled. This research seeks

to understand and summarize the shipping challenges that HCOs experience and propose direction for future research.

LITERATURE REVIEW

The abundance of literature regarding the need for a greater focus on supply chain management in the healthcare industry extends back into the 1990s. Despite the amount of academic research available, the industry has been slow to adopt the supply chain tools available. Kwon et al. estimate that billions of dollars in savings could be achieved if HCOs pursued supply chain integration in the same way as other industries [3]. They focus on how supply chain management can be leveraged to improve efficiency of operations as well as quality of care for patients. It is not a tradeoff; the two can be achieved simultaneously. They explain that the implementation of many supply chain tools is blocked by a lack of cooperation between partners due to a lack of trust. Another issue they identify is a misunderstanding of supply chain management as a synonym for purchasing. This limited scope prevents HCOs from considering the tools such as VMI (Vendor Managed Inventory), CPFR (Collaborative Planning Forecasting and Replenishment), lean principles, and the use of business analytics to optimize operations.

Landry and Philippe emphasize the importance of logistics in creating strategic value [4]. They propose new management ideas based on the impact that logistics has on the healthcare industry. Through international case studies, they found that supply chain integration can result in lower costs, increased efficiency, and improved patient care. Their proposal involves using activity-based costing and reengineering of various logistics processes, while emphasizing the criticality of communication between partners to promote integration. Throughout their research, they analyze internal distribution networks in hospitals, POS distribution techniques, automated transportation systems, and hospital flow design to help streamline people, material, and information.

Al-Qatawneh and Hafeez examine specific challenges associated with inventory management in hospitals [2]. They build off the traditional ABC classification system which categorizes inventory items solely based on percentage of spend. They incorporate criticality and usage for a more holistic approach to appropriately adjust service levels for different categories.
This system can reduce costs and improve quality of care by maintaining the availability of critical items. Through utilizing inventory management techniques, hospitals can improve their operations.

Ageron, Benzidie, and Bourlakis summarize several papers concerning current logistical areas of interest to the healthcare industry [1]. They discuss topics such as strategic logistics decisions. Outsourcing activities, such as supply management and purchasing, are becoming more widespread in the healthcare industry. Lean concepts and continuous improvement have entered the field alongside a newfound emphasis on the physical, patient, and information flows, as well as distribution network design. One paper determined that hospitals tend to perform poorly in inventory and information technology management, which are critical to operational success. Another paper discusses how purchasing influences a significant portion of healthcare costs. Success in purchasing groups is driven by communication, cooperation, and commitment from top management.

Volland, Fügener, Schoenfelder, and Brunner offer an overview of literature focused on hospital material management with an emphasis on quantitative methods [6]. They examine supply and procurement, inventory management, distribution and scheduling, and holistic supply chain management to explain how optimization techniques are being implemented in these areas. They conclude that reducing logistics costs would not create a reduction in the quality of patient care. In contrast, they discovered it improved patient care because clinical staff spent less time on logistical activities such as restocking supplies. If clinical staff can spend less time on logistical activities, it will allow them to devote more time to the quality of bedside patient care.

DATA COLLECTION AND A NALYSIS

Research was conducted through interviews in a confined geographical location to gain insight into the shipping and receiving issues HCOs commonly face. After hearing of the challenges that HCO 1 faces, other HCOs were interviewed to understand the challenges and how other HCOs approach their relationship with small parcel carriers. Interviewees were asked a variety of questions listed in Appendix A to learn more about the size of their HCO, their experience in the healthcare industry, specific issues they faced with shipping and receiving, and what they recommended to resolve the issue. Four HCOs from a 60-mile radius were interviewed. Each hospital varied in trauma level, number of facilities, total beds, and patient revenue. Table 1 summarizes the characteristics of the various HCOs interviewed. Interviews were conducted over the phone or in person. Table 2 provides information regarding each HCO representative that was interviewed in this study. In addition, a representative from a Group Purchasing Organization (GPO) and a representative from a Third-Party Logistics provider (3PL) were interviewed to gain a different perspective on these supply chain related challenges. Information from each interview was compiled to determine common issues and potential resolutions related to healthcare logistics. Table 3 summarizes the issues discovered and the probable cause of each issue.

TABLE 1

HCO Characteristics

Identifying Label	Total Beds*	Number of Facilities*	Patient Revenue*	Public or Private	Trauma Level**
HCO 1	600	63	$2,289,000,000	Private	III
HCO 2	1,500	315	$5,862,000,000	Private	I
HCO 3	385	37	$1,042,000,000	Private	III
HCO 4	25	1	$80,000,000	Private	N/A

*Counts and values are estimates based on interview responses and publicly accessible data
**For HCOs with multiple hospitals, the highest trauma level is listed

TABLE 2

Interviewee Stat istics

Organization	Title	Year s of Experience in Healthcare Indu stry
HCO 1	Director, Supply Chain	21
HCO 1	Materials Management Contracts Specialist	37
HCO 2	Director, Materials Management Operations	38
HCO 3	Director, Supply Chain Management & Chief Procurement Officer	43
HCO 4	Materials Management Manager	33
GPO 1	Implementation Manager	18
3PL 1	National Account Manager	6

RESULTS FROM INTERVIEWS

Case Example

HCO 1

HCO 1 provides illustrations of the challenges that HCOs could potentially face when working with parcel carriers. HCO 1 consists of 3 hospitals, 60 physician practices and a total of over 600 beds. Interviews were conducted with the Director of Supply Chain as well as a Materials Management Contract Specialist.

In example one, a surgeon called the distribution center on Friday requesting two products for a surgery on Monday. This HCO could not overnight the products on Saturday to Sunday because the distribution center was closed over the weekend. The contract specialist had these two products ordered on Sunday to be overnighted and arrive at 9:00 am on Monday. The truck driver arrived

at 9:00 am at the distribution center and delivered one of the products. The second product was overlooked and remained on the truck. The driver finished their route before realizing that the second product was still on the truck. They returned to the distribution center with the second product at 10:30 am. However, the HCO 1 truck had already left with product 1 to deliver to the surgeon. To remedy the situation, the Contract Specialist was required to personally deliver the second product to ensure that surgery was able to take place as planned.

In example two, an order for tissue allograft was placed on Friday. It was scheduled to be delivered on Monday and used in a surgery on Tuesday. The tissue left the vendor and arrived at the parcel carrier's distribution hub. When the truck arrived on Monday at 10:30 am, the tissue was not on the truck. The biologics distributor tracked the tissue and determined it was still at the carrier's distribution center. It was discovered that the tissue had been left on the dock over the weekend. Due to oversight, it was not placed on the truck to be delivered to the HCO. This neglect resulted in ruining the temperature-sensitive product; it could no longer be used in surgery, thus delaying the operation. The cause of this oversight is due to miscommunication within the carrier's organization.

Example three involves an order for face masks during flu season. The order was submitted directly with the vendor and the face masks were shipped via a parcel carrier. The truck was misrouted and headed in the wrong direction, delaying the delivery of the product. The product was scheduled to arrive at the HCO on Monday but was not delivered until 5:00 pm on Friday. HCO 1 called the parcel carrier's distribution hub to resolve the issue. The truck had to be rerouted to the HCO to make the delivery. HCO 1 ran the risk of completely stocking out of face masks due to the parcel carrier's oversight. If the masks had not been delivered, the HCO would have incurred additional costs to expedite another shipment.

In all these situations, the HCO incurs additional costs that could have been avoided. Delaying a surgery requires that the surgeon, anesthesiologist, nurses, and other medical personnel be rescheduled. Other additional costs could be caused by underutilized operating room (OR) capacity, and patients spending additional time in the hospital until the surgery can be rescheduled. The hospital is held responsible for those costs. Delays ultimately have a negative impact on the health of the patient by postponing treatment. These delivery failures result in wasted time, strained relationships with parcel carriers, and an unnecessarily high risk for surgery cancellation.

Supporting Interviews

HCO 2

HCO 2 has approximately 1,500 beds from 9 hospitals and over 300 other facilities. HCO 2 receives a daily truck from two major parcel carriers with approximately 150 packages on each. Since HCO 2 receives a large volume of products each day, their packages are delivered on time and consistently. However, the high volume of packages introduces a new problem. When packages arrive at the warehouse, warehouse employees are required to sign for the shipment. When signing for the shipment, employees only check to ensure they received the proper number of packages; they are not checking if the shipment includes all the specific packages listed on the packing slip. Periodically, the content of the shipment does not match the packing slip thus

incorrect packages are accepted at the warehouse. When HCO 2 realizes that an expected package was not delivered, the vendor and HCO must collaborate to create a solution. The carrier cannot be held liable because they have a signature indicating that the shipment was received. HCO 2 incurs additional costs when resolving issues of this nature. In one specific story from HCO 2, two expensive pieces of equipment should have been among the typical 150 package shipment. When it was discovered that the pieces were not delivered, a long process of searching for the product ensued. The HCO ultimately had to replace the items at their own expense. This additional cost was incurred due to a lack of documentation and communication between supply chain partners.

HCO 3

HCO 3 has 1 hospital with 385 beds, an outpatient surgery center, and 35 physician practices. The primary issue for this HCO is labeling. Shipments are received at the warehouse without specific labels indicating their final destination within the hospital system, which means that information was omitted when the order was placed. It can take several days to determine where to deliver the shipments. This consumes time and delays the use of the product. While labeling is not the carrier's responsibility, the Director of Supply Chain Management at HCO 3 indicated that the carrier should screen packages to confirm that they have appropriate identifying information. This issue is a result of the lack of communication within the HCO and between the HCO and carrier.

HCO 4

HCO 4 is a critical access hospital with only 25 beds. This HCO is a part of a managing organization. This membership includes a national contract with a major carrier. When HCO 4 experiences any shipping issues with their major carrier, they contact their managing organization and the carrier. The issue is then resolved by the other parties. Being a member of the managing organization negates many of the problems that other HCOs face. The small size of HCO 4 helps with logistics because there are fewer orders to manage. The Materials Management Manager can devote attention to every critical order to ensure that mistakes are not made in the process. The manager also communicates daily with the OR Director allowing them to be informed on upcoming procedures. Overall, this HCO does not experience any notable issues with parcel carriers.

TABLE 3

Summary of Interview Findings

Organization	Issue	Cause
HCO 1	Late delivery	Driver oversight
HCO 1	Ruined product; not delivered	Carrier oversight
HCO 1	Late delivery	Misrouted truck
HCO 2	Products not delivered	Miscommunication in supply chain
HCO 3	Delayed final internal delivery	Mislabeled packages

GPO 1

A representative from a nationwide GPO shared their insight into how HCOs can prevent the types of issues that HCO 1 experienced through their planning processes. A GPO is an organization that works with HCOs to aggregate their purchasing volume to establish leverage in negotiating prices. As a member of a GPO, HCOs benefit from pre-negotiated prices. Suppliers benefit from guaranteed sales. This representative emphasized the importance of inventory management, a strong relationship with suppliers, and an awareness of the external environment. Knowing what possible disruptions may occur allows an HCO to have contingency plans in place. Planning can prevent stockout issues which contribute to delays. Maintaining strong relationships with key contacts in the vendor organizations can minimize shipping complications. This established avenue of communication allows for efficient resolutions. Smaller HCOs with fewer staff members are typically not equipped to maintain this level of planning. Less staff committed to activities such as scanning the external environment, scoping out new suppliers, and planning for potential backorders, could explain some of the challenges that smaller HCOs face.

3PL 1

A representative from a nationwide 3PL discussed how HCOs can invest in long-term solutions to these shipping issues. Partnering with a 3PL allows HCOs to outsource supply chain activities such as logistics, inventory management, and the management of carrier relationships. HCOs with fewer internal resources can benefit from the assistance of a 3PL to optimize shipping solutions. If an HCO encounters a shipping complication, their recommended first step is contacting their 3PL. It is the responsibility of the 3PL to resolve issues with carriers. An additional recommendation is to maintain contact directly with the truck drivers. Open communication with drivers is more likely to result in an immediate resolution than calling the national customer service line. Currently, none of the HCOs interviewed work with a 3PL.

DISCUSSION

While each HCO faces different logistical issues, they are characterized by the same theme: a need for greater communication and collaboration within and between supply chain partners.

HCO 1's challenges involve communication issues. Example one displayed miscommunication within the carrier's organization. This resulted in late delivery of the product and a disruption in the distribution center's daily operations. Example two involved an oversight by the carrier that resulted in a ruined product. Example three demonstrated another carrier error resulting in a shortage of critical product during a pandemic scenario. While these issues appear to be caused by carrier oversight, miscommunication from the vendor or HCO could also contribute to these problems.

HCO 2 experiences challenges due to their high volume of daily packages. In the specific example listed, two pieces of equipment were lost. The error was made within either the vendor or the carrier's organization. The lack of documentation and tracking resulted in the HCO having to absorb the cost of replacing the equipment. This problem is most likely caused by miscommunication in the vendor or carrier organization. However, due to the lack of

documentation in the vendor organization, the true cause cannot be determined. The absence of documentation is evidence of inadequate internal communication.

HCO 3 is primarily concerned with the labeling of packages. There is a lack of information on the package identifying the final destination of the product. Once it arrives at the distribution center, determining the final location of a package takes several days, prolonging the final delivery within the healthcare system. There is a need for greater communication between the HCO and carrier to determine delivery specifications.

Based on examples that HCOs provided, logistical issues are often indicative of communication problems that exist within and between supply chain members. Research into this area of opportunity reveals possible methods of improvement. Interviewees provided suggestions for improving healthcare logistics by cultivating clear and consistent methods of internal and external communication.

RECOMMENDA TION S

Throughout the interview process, each interviewee offered recommendations based on their experience in healthcare. These recommendations could improve logistics in the healthcare supply chain. Efficient planning, internal communication, and relationship management, as well as the implementation of priority shipping alerts, could resolve some of the issues that HCOs face.

Planning is critical to the success of every HCO. Being aware of the external environment is necessary to anticipate potential supply chain disruptions such as natural disasters, pandemic scenarios, and other events that would impact reliability of supply. To prepare for unforeseen circumstances, HCOs should have emergency suppliers who can provide the product if vendors are backordered. Additionally, effective inventory management is vital to prevent stockouts. Continuous planning processes are necessary to support the operations of the HCO.

Internal communication is an integral part of each HCO. One issue that impacts purchasing is communication with the OR. Often the buyers do not receive requests for products until the last minute. This is often unavoidable because the OR may not know what is needed until the patient arrives. However, the impact could be minimized through the development of a more efficient communication line between the OR and the purchasing department. Another area of opportunity could be developing a procedure to ensure proper identifying information is included when placing an order. This would ensure packages are delivered to the correct final destination and would minimize delays caused by mislabeled packages. Lastly, HCOs who receive a high volume of packages could develop a system to ensure that the correct packages are being delivered. This system would cross-reference packages against the drivers' delivery list and the HCO's expected arrivals. This could improve the efficiency of HCOs by ensuring they received the packages signed for. Improving these internal processes could decrease the risk associated with logistical challenges.

A strong relationship with vendors could benefit HCOs by providing a way to resolve issues when they arise. Having a key contact with each vendor provides a direct communication path to address

issues and seek resolutions. Similarly, it is necessary to communicate with carriers. A 3PL can be utilized to manage these carrier relationships for an HCO. The 3PL becomes the first point of contact when encountering shipping related issues. When an HCO encounters a shipping issue, their first step should be to inform their 3PL representative. If the issue persists, they should continue to escalate the concern. HCOs should also establish relationships with their truck drivers. In addition to contacting their 3PL, the HCO can reach out to their driver to resolve issues. 3PL's aid in creating long-term solutions to prevent recurring issues, while contacting the drivers, can result in a one-time solution to meet immediate needs. The supply chain is built on relationships, and members of the supply chain must clearly communicate to optimize the flow of materials and information.

Another opportunity to improve shipping is to utilize different shipping options. Currently, there is no differentiation between healthcare packages and other packages on the carrier's truck. One option would be to utilize a priority alert system which places an additional label on the package to indicate its priority status. This colored label would minimize the risk of oversight by grabbing the attention of the driver, ensuring the package is handled appropriately. Priority alert options also provide better tracking and information on the package. The HCO would be able to know where the package is at all times and would also be alerted if the status of delivery changes due to potential delays. Using priority shipping options can prevent oversight that could result in lost packages or delays in delivery.

LIMITATIONS O F RESEARCH

Interviews for this case study were limited to only four HCOs, all located within a confined geographical area. Additionally, all HCOs were private institutions. A greater sample size with more diversity is needed to identify the frequency and distribution of different logistical issues for HCOs. Additionally, carriers and vendors were not interviewed. Their perspectives on common shipping issues could provide insight into potential solutions. Interviews did not include everyone involved in the procurement process at each HCO. For example, in some cases the Director of Supply Chain Management was interviewed, but not the purchasing agents. A more inclusive scope of interviewees would provide greater detail into each issue.

FUTURE RESEARCH OPPORTUN ITIES

Given the limitations of this research, there are opportunities for future research through interviewing more HCOs. Interviewing a variety of HCOs with representatives from all trauma centers, located throughout the U.S., would present a more accurate representation of the larger population of HCOs.

Due to the additional costs of priority alerts, financial analysis needs to be conducted to determine the feasibility of employing this priority service. Future research should quantify the additional costs incurred due to shipping complications, as compared to the cost of utilizing priority alerts and their rate of success in preventing these issues. This analysis is necessary for HCOs to determine if this option would be beneficial to their organization.

Another opportunity for future research would be to determine the impact of e-commerce on the ability of parcel carriers to maintain levels of service for all packages handled. The representatives from HCO 1 cited growth of e-commerce as a possible cause of the shipping issues they are experiencing and pointed out that the frequency of issues increases during the holiday season, possibly because more packages are being ordered during this time period. Future research could be done to assess the capacity of parcel carriers and the impact of e-commerce retail growth on other types of shipments.

Lastly, research could be conducted to determine the effectiveness of the recommendations described above. This research could compile a list of best practices to improve the healthcare supply chain for all HCOs across the United States.

CONCLUSION

This paper has investigated logistical challenges that HCOs experience associated with parcel carrier shipments. Results from the four HCOs interviewed reveal communication as a possible area of opportunity. Several recommendations were also made by interviewees. Planning, internal communication, and relationship management could be optimized to improve shipping experiences. Additionally, priority shipping options may help eliminate issues with parcel carriers. The results of this case study are a starting place for future research to be conducted to determine what other issues exist in this area and to test the effectiveness of the solutions presented.

APPENDIX

Interview Questions

1. Tell us about your career - your experience in the healthcare industry, what your current job looks like, etc.
2. What are some of the most significant issues you have experienced with shipping and receiving at your hospital?
3. Can you share some specific stories of different problems you have encountered with shipping and receiving?
4. Do these issues involve shipments by parcel carriers? Or were they shipped by the manufacturer or distributor?
5. Does your hospital work with a 3PL? What part do they play in the issues you've experienced?
6. Do you work closely with any sales reps? What part do they play in the stories you've shared?
7. Are these problems that have developed over time, or has your hospital always struggled with these issues? If they are relatively new problems, do you have any ideas about what factors may have caused the change?
8. Do you believe the expansion of e-commerce has affected your deliveries?
9. Do you have any ideas about working toward a solution to these problems? What are some areas to explore in the future? Is there anything you are already working on to solve these issues?

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THE INFLUENCE OF LEARNING TYPES ON HUMAN ERROR PROPENSITY

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ABSTRACT

Scholars have identified human error as a potential cause for unsatisfactory system performance. Human error can be triggered by vulnerabilities or complexities in the system or unintended deviation from protocol. Human error can further be classified into skill-based errors, rule-based mistakes and knowledge-based mistakes. With existing literature and logic both advocating that organizational learning mitigates human error, this paper aims to unveil the importance of profiting from the errors committed by the employees of an organization by rephrasing the perception of learning. The main idea is to articulate that certain errors can be rectified by certain behaviors and learning techniques, namely deutero, meta and planned learning. The novelty of this article lies in determining how the three aforementioned types of learning help to remedy the three types of human errors leading to fruitful theoretical and managerial implications along with directions for future research.

Keywords: *Human error, skill-based error, rule-based mistakes, knowledge-based mistakes, deutero learning, meta learning, planned learning*

THE INTERNET OF THINGS AND ITS EFFECT ON THE POWER GRID

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ABSTRACT

The Internet of Things (IoT) is an interrelated connection of objects and devices of modern-day technology through online and electrical system connections. This allows the transfer, gather, exchange, and analyze data to see where society is going with new developing technology with current technology. We will cover how objects communicate with one other and how the interaction makes life easier for all societies. Our society is heavily reliant on technology and there is a limit on the total utilization, but what is the limit and how close are we? We will discuss how society will handle the limit and utilize what ways we can use this. We will analyze economic trends, renewable resources, and the effects of other sociological structures that play a part in the total IoT utilization. There are many possibilities for what IoT can turn into, many of which are positive and can improve the standard of living even more but what threats do we face? IoT is based on connections between all of our technology connecting our processes and objects in a society which correlates to the main goal of supply chain management. The possibilities are endless for IoT and we will see if our analysis and predictions play out in the way that we expect they could. We will conduct interviews with professionals representing companies whose products range from adhesives, packaging, and aeronautics.

THE INTERNET OF THINGS AND ITS EFFECT ON THE POWER GRID

INTRODUCTION OF THE TOPIC

The world has reached a point where everyone is immersed with technology that can control itself and make decisions. The Internet of Things (IoT), which was first coined in the late 20th century at the beginning of the Internet Revolution, refers to the virtual connection of everyday physical objects have with one another at any time of day (Mometti, 2014). Also described by Mometti (2014) as "a world where physical objects and beings, as well as virtual data and environments, all interact with each other in the same space and time", IoT technology allows for "smart" devices to communicate through both the virtual and physical world (p. 25). It gives companies and homeowners a competitive advantage for beneficiary results. From keeping the living room at a nice temperature to refrigerators sensing a food shortage, the Internet of Things communicates data with people, and themselves, in a way never thought of before (Qureshi & Saldeen, 2018).

Another vital source of technology that connects all the sources of electrical energy with one another is the power grid. Power grid technology is how smart devices relate to one another and opened the minds of engineers to perceive how objects interact with energy. It can be described as the network that electrical energy flows through to connect and distribute data with other

systems and communicate with one another. Existing since 1922, this technology was originally created to distribute massive amounts of electricity from generators to consumers. Today, power grids are a complex network and are designed to be more reliable. Its demand has risen within the past decade with new wireless technological advancements (Mometti, 2014). The demand for usage in the power grid has increased within the past decade due to the technological advances to transmit data more swiftly and efficiently.

Our research focused on answering the following questions:
Research Question 1: How do purchasing professionals utilize the Internet of Things?
Research Question 2: What is the implication of IoT on power consumption in companies?
In order to address these research questions, we conducted a literature review and interviewed four purchasing executives who could give us a deeper insight on how IoT impacts the power grid in local and multinational manufacturing industries. One day the power grid could reach its capacity with its increasing use; therefore, industries need to understand their demand while communicating its supply chain around to buyers and sellers (Kumar & Kumar, 2017). The Internet of Things continues to evolve in a variety of ways, and it relies on the power grid's electrical outlet to bridge together connections.

LITERATURE REVIEW

"IoT applications provide advantages in various domains from smart cities, factories of the future, connected cars, home automation, e-health to precision agriculture. This fast-growing ecosystem is leading IoT towards a promising future" (Drira, 2018, p. 1). We can expect to see IoT heavily impacting our daily lives, through the implementation of smart homes (Alexa), smart appliances (LG, SAMSUNG, etc.), and smart security systems (KUNA). Using smart home technology, we one day may be able to consolidate all of these devices into a one easy to use app, so we can control the thermostat, preheat the oven, and turn on the lights all from our phone. Although the advances in the home will be significant, we can expect an even larger change in the business, especially through the supply chain. IoT will allow for a more effective inventory system, with RFIDs we can track, identify, and locate individual pieces of inventory. Using RFIDs any change that happens to any piece of inventory can be seen instantly via any device with access to the internet. With this better tracking, we can shorten payment terms to almost net0 days. Focusing on Walmart we can see the shift to automated and self-checkout services for groceries. Walmart applies a vendor managed inventory system. This means that the inventory currently sitting on Walmart's shelves are not owned by Walmart but, by the vendor. This system, although not preferred by the vendors, does allow for an interesting application of IoT. In which, the vendor can be paid instantly the moment the product is sold. Amazon's new automated store the customer is charged the moment they pull something from the shelf. This action would then send the fund directly to Amazon, the Vendor, and possibly even their suppliers. Due to IoT accuracy would increase dramatically causing less inventory shrink. All parties involved in the selling of these goods would benefit from the time value of money and the interest of having access to the capital instantly as a product is sold (Drira, K., 2018). The future of IoT is almost at fruition.

Curpen et al. (2014) views the power grid as the "'central nervous system' of power production, distribution, and consumption." However, the power grid has had a difficult time keeping up

with the pace of technology advancements, technology advances at a pace of three to four times faster. The increasing demand for power supply affects the power grid to the point where managing its distributions and connections start to become difficult. From a supply chain perspective, this means supply and demand need to be highly coordinated to assure information gets from place to place in the right time. The U.S. faces a high number of power grid blackouts compared to other countries and it can lead to all sorts of communication through IoT coming to a delay (Kumar & Kumar, 2017). Therefore, the power grid has to offer efficient and reliable levels of distribution and energy for smart devices to communicate with one another.

INTERVIEW DISCUSSION

We selected purchasing professionals for interviews based on personal and mutual connections as well as their expert knowledge within their specialized field(s). The first purchasing professional we interviewed was, Vice President of Global Purchasing for Resins and Direct Materials(VP) at Company 1, a 4.5 billion dollar packaging company. Another purchasing executive from Company 1 that we decided to interview was the North American Purchasing Manager (PM). We also selected a Customer Program Manager (CPM) at Company 2, an aeronautical manufacturer. The final candidate we selected was a Buyer at Company 3, a 20 billion dollar adhesive manufacturer. With each professional selected, we knew that we would receive valuable perspectives on how these companies, within their diverse industries, handle and integrate IoT and power consumption.

The questions we developed (See Appendix A) were based off our initial research to gain a foundation of the topic itself. Our initial question to start off the conversations was to understand how IoT is utilized in their organizations, especially within the operations side. After discovering how recent IoT has been in existence from Mometti (2014), we were curious to know if they had noticed any changes within their power consumption based on the impact of IoT. In addition, when we discovered some forecasts for the increase in energy consumption in the next decade from Curpen, Iliescu, Sandu, and Zamfir (2013), we asked for their personal opinion on how they see IoT greatly affecting their company's energy capabilities in the next decade. That being said, we wondered what they thought would be the biggest risks with the growth of IoT. Aside from their responses regarding their IoT impacting their day-to-day responsibilities within company walls, we also asked how IoT has affected the relationships they maintain with multiple suppliers and customers outside company walls. After these interviews, our knowledge on the impact IoT plays on supply chains and overall business functions throughout the nation.

The number one thing each professional discussed when asked about how they utilize IoT in their companies was the database systems they use for ordering, monitoring, and evaluating supply, demand, inventory, and transportation. The VP and PM commented on how Programmable Logic Controllers (PLC)-based systems and SAP systems are the new norm for tracking and forecasting data for maintaining distributions, supply, and demand, whereas back in the late 20th century everything was handwritten or faxed to and from customers and suppliers. The CPM discussed the numerous intranet databases he and his colleagues use on a day-to-day basis within their operations to review and interact with historical data ranging from receipts and shipments to giving access rights to external associates. The Buyer mentioned that Company 3 does not integrate IoT with their used technology and machines as much as other manufacturing

companies do; however, he did point out that the biggest utilization of IoT in Company 3 is receiving notifications that the machines out on the floor "read" themselves and feed the information towards associates. Hence, he sees the machines as additional tools for forecasting and ordering parts when needed. Overall, each executive sees the machines and devices that are IoT-based playing a supportive role in their company's supply chain.

The VP and PM gave similar responses on how IoT has affected Company 1 throughout years from when they started back in the 1990s to present day. When asked about IoT has affected their relationships both internally and externally, the first thing that popped into their minds was the reminiscence of receiving company pagers. Before that, all purchase orders and documents containing valuable information had to be handwritten and sent to their customers and suppliers through the mail and the fax machine. Five years after using a pager they were upgraded to Blackberrys, the main phone Company 1 distributed to all its employees in the mid-2000s. Receiving these phones was the beginning to how they communicate with others, through text, phone call, or email, at anyplace and anytime. These changes throughout the years allowed them to really notice how utilizing these devices could increase their productivity and communication to quickly contact others about their company needs with a touch of a button. Though these statements were not exactly what we were asking for, the Company 1 executives portrayed their point-of-view of IoT and how the use of standard devices and technological advancements continue to explore ways of integrating smart devices into industries all around.

When speaking to our purchasing professionals, we learned what potential dangers and successes they see in IoT. We were also able to learn what they have seen in terms of power consumption since implementing some IoT measures. The VP believed that the biggest threat to IoT is the possibility of hacking. In response to this threat, many companies have already implemented a series of security measures. Such as, a company he worked with has in place a strike system in which employees that fall victim to phishing emails and clickbait are given a certain number of strikes. When the employees use all of their internet access is restricted for a certain amount of time. The VP also said that the power consumption has not increased since his time working at Company 1. The PM believed that the security issues are the largest threat to IoT. He also said that to combat these scams and hackers Company 1 has implemented training programs to educate employees on what to look out for and how to avoid them. The PM said that Company 1 makes these sessions mandatory. The PM did, however, believe that consumption of energy since implementing IoT has "if anything dropped". He said even in his home life he saw little change in consumption thanks to new technologies like fiber optics.

The CPM believed that the biggest threat to IoT is the dependence on the Network. Essentially asking the question when all the work that can be done must be done via the internet can anything be done during a network outage? The CPM said that this question stemmed from his real-life experience. While he was at work the network in the office was down. All the work he needed to do was being pushed back due to the network failure. The CPM was eventually able to find connection via his phone's hotspot. The CPM believes that steps should be taken to ensure that there are backup plans for networks failures.

The Buyer felt that the biggest threat to IoT is the loss of job opportunities and the automation of certain positions. He also said that the limit to IoT is that even if it can replace certain positions it

lacks the ability to replaces human relationships with their suppliers and customers. The Buyer also felt that power consumption since the implementation of IoT has not increased power consumption. He also said that IoT has allowed for better monitoring of their power consumption. Each professional felt that there are different risks associated with IoT but, they all felt that there has been little or no change in the consumption of power since their respective companies have initiated in IoT.

MANAGEMENT IMPLICATIONS

The capacity for IoT is constantly growing due to the ongoing advancements in technology worldwide. Businesses are finding more efficient ways to do tasks specifically in the purchasing profession. The operations are highly affected by IoT because things are more easily tracked and updated faster than before. The systems are constantly being updated and making things easier. The power grid is a great way for the company to send and receive data in shipments and various other operational activities. The advancements in the power grid and more efficient procurement are highly correlated. Communicating from products to vendors, to customers and all internal operations in the company are how the new IoT system will gather the best data possible to advance current processes. The current processes will never stop advancing and will always be making operations more efficient and the IoT along with the power grid is the best way.

The steps to increase the capacity of the power grid and IoT in organizations is solely based on what a company is trying to implement new processes or updating old ones. The first step is deciding that the company needs to update the system being used. The next step is gathering data before the decisions can be made. Comparing best options comes next followed by making predictions based on both. Once the best option is determined it is time to implement the new system. The capacity can play a big part in the power grid. Everything has a limit and can only handle so much power and information being produced and applied at a current time. The power grid will continue to grow and expand but there will always be a certain capacity that cannot be surpassed, and it is very important to know the limits and the certain point in time.

IoT is a very new thing in our society and is very unknown to this point what it is capable of and the effects it causes. As a society, we are dealing with a force that cannot be forecasted or predicted how powerful it will be. It is growing at an exponential rate that is tough to measure considering many companies use it to different degrees and it is tough to track how much it is being utilized. The technology that communicates to other technology through the internet creates snowball effects of uses throughout the use of various technologies.

When talking about the effects of IoT on outside factors, the most prominent effect is through the power grid. This type of technology communication uses a distinguishable amount of power compared to other technologies. Power has always been much easier to attribute to technologies in the past because it was much more feasible to trace what instruments were using what power on an hourly basis. This process of measuring the amount of power utilization is not a reasonable process to use as a measurement because IoT is a different type of use that requires a new undeveloped process of tracking the total use of the technology and how much power these different communications use. There is no longer a safe assumption of how much power this technology will use and how much this will affect the utilization in the total power grid

capabilities (Mittal, Poor, & Soltan, 2018).

Many appliances and technologies are now hooked to Wi-Fi and use the internet to communicate. All of these appliances can control one another through the internet and can be controlled remotely which in turn affects the total power demand and what is consumed. Manipulating the power demands can greatly affect the total power grid because the grid is based on what is expected to be used. Because it is impossible to forecast at this point, it can be dangerous to what is going on in our society and the limits that our power grid has. Tracking the source can be difficult and the transfer of the information and data through the internet can be a difficult thing (Mittal et al., 2018). On a small scale this is not a big deal but on a larger scale through an entire population of companies, people, business, and other various daily operations that could use technology, the total use of power and the cumulation greatly affects the total limit of the power grid. It is a multiplicative effect compared to the older effects of technology on total power utilization from the power grid. Another thing to take into consideration is the automation of activities and processes in organizations. Factories and many other forms of business are going to have more and more machinery and technology communicating with one another. To what extent the world takes this automation is to yet be determined. We can assume that it will be greatly implemented into almost all processes in business. This will greatly increase the communication between machines due to the technology of all kinds will be working together to achieve tasks without the help of human labor.

Technology is always becoming more prominent and is implemented in more and more processes. This makes everything easier. Gathering data and analyzing how certain things are being done is a key component. One thing every company should take into account is that other competitors are constantly updating their processes using IOT to gain a competitive advantage. The communication between all electrical products is consistently growing and most things are communicating with other factors in companies, whether internal or external. Knowing the customer, the supplier and everything about them along with what is going on inside the company is key to more success and the technology advancements are the most advantageous way (Mittal et al., 2018). The implications to business are that all technology, using updated materials, will be able to communicate what is being done in all process surrounding the business. Whether it is the customer or the supplier or producer of products.

We would tell a professional to study and begin to develop a deeper meaning for IoT and what it means to that specific business. It is important to stay up to date and with all of these advancements in technology, if not your competitors will gain a large competitive advantage. There are very important changes in business that must be acknowledged and identified. Not all companies will experience large changes depending on what field they are in. The power grid and IOT will affect every business to some capacity. Knowing and understanding how business can change, and to what degree, is vital in the business moving forward.

CONCLUSION

In all, the Internet of Things is really opening doors for companies and the operations of them. This expands all the way throughout the business affecting aspect. This makes procurement and all supply chain operations much easier due to all the accessible data and updated more efficient

processes. This field of advancements is continuously growing and is changing the entire landscape of business. It can be surmised that in the distant future, this will be the main resource for driving everyday business. At the same time, it is important to understand the threats and opportunities that could arise from the unventured waters that are the future of IoT and the effect of it on the power grid. As time goes on and we learn more about what IoT will truly be to our world, we will understand more so how to handle it and cope with it. The reality is that once we truly understand and learn how to handle this new technology and its effect on the power grid there will be new more advanced technology that might make our old methods obsolete bringing us back to square one.

APPENDIX A

INTERVIEW QUESTIONS

1) How do you utilize IoT in your company?
2) What role does IoT play in the operations of your company?
3) Since the implementation of IoT, has your company noticed changes, if any, in your power consumption?
4) Do you see IoT greatly affecting your company's energy capabilities and consumption within the next decade?
5) How has IoT affected your relationships internally as well as externally?
6) What is the biggest risk associated with IoT?

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Supply Chain Management and Logistics

A Review of Scholarly Literature on Food Hubs

Poster

Dr. Keli Feng [1]

1. *South Carolina State University*

Food hubs offer aggregation and distribution services for local small and midsize farmers and emerge as a new business model in the regional food supply chain systems. However, limited research has been conducted to review the existing scholarly literatures, identify the research gaps, and recommend the future research on food hubs. This study surveys and synthesizes the recent existing research and studies in food hubs from different perspectives in the United States. The research also discusses the research gaps in the literature and direction for future research.

Agent Based Simulation approach:Effect of Hybrid distribution method on retail stores' performance.

Regular Session

Ms. Hafsa Mohsin [1], ***Dr. Brian Huff*** [1]

1. *UTA*

Today's retail chain faces around 1.75 trillion of dollars a year in ghost economy-overstock, out of stock and return sales. These are the results of improper management of inventory. Retailers' need to check their performance to exist in the market. Customer satisfaction is the main target for any business. Uncertainty of demands make it difficult for retailers to have optimum stocks in their stores to satisfy their customers. Choosing the right distribution method of products from suppliers' end also contribute a lot on inappropriate stocks in stores. Not only the amount but also the products' category, shelf life, suppliers' minimum order value; retailers need to choose product delivery methods. Effect of inappropriate delivery methods that also leads to increase in product wastage, unsatisfied customers, inventory costs in retail business is the encouragement of this study. Direct store delivery (DSD) is one type of decentralized delivery system where bypassing warehouse or distribution center (DC), products go directly from suppliers end to retailers. In this paper, agent-based simulation has been used to identify the effects of DSD and warehouse based delivery methods on retailers' performance

An Organization of Disassembly Line Complexities

Regular Session

Dr. Roger Gagnon [1], ***Dr. Shona Morgan*** [1]

1. *North Carolina A&T State University*

Abstract

With decreasing product life cycles, concern over disposing hazardous materials, the reduced land available for waste disposal, and increasing governmental regulations, remanufacturing products for reuse have received added importance and attention. While the issues and problems surrounding forward assembly lines have been revealed and studied for a sustained period, disassembly operations have distinct challenges or "complexities". We review and analyze the complexities mentioned in the literature and provide a new, comprehensive, strategic-to-tactical organization and analysis. This is beneficial for recognizing the complete spectrum of remanufacturing complexities and their incorporation into disassembly line model formulations, solutions, and professional applications.

Analyzing Consumer Purchase and Consumption Behavior in High Risk Foods

Regular Session

Ms. Megan Watkins [1], ***Dr. Lauren Davis*** [1], ***Dr. Shona Morgan*** [1]

1. *North Carolina A&T State University*

According to the Centers for Disease Control and Prevention, one in six American become ill or die from foodborne contamination. Flaws in security, quality control, or transportation are some examples of how food may be accidentally or intentionally contaminated. In order to build a secure and resilient food supply chain network, food producers and manufacturers need to have the ability to assess contamination risk as a function of consumer behavior. Specifically, we explore the likelihood of being exposed to contaminated food product as a function of food choice, shopping frequency, and consumption patterns. Using the data from an IRB-approved survey, characterizing consumer risk by demographic information, food choice, shopping frequency, and consumption patterns. A logistic regression model is developed to determine the likelihood of purchasing certain foods that are more susceptible to contamination. The results of this research identify which factors are significant in predicting the likelihood an individual will experience foodborne illness.

Deterministic Dynamic Lot-Sizing Problems: Inventory Balance Formulations and Extensions

Regular Session

Dr. Hadi farhangi [1], ***Dr. Suman Niranjan*** [1]

1. *Savannah State University*

Dynamic lot sizing problem aims to plan the production and distribution of products. In this paper, a generic deterministic dynamic lot sizing problem and its extensions are presented considering productions, inventories, capacities, bill of materials, lead time, back-order, re-manufacturing, supply, and transportation issues. This paper does not exhaust the literature and exclude the solution methods form the paper. We conclude the paper on future directions for the research in dynamic lot sizing.

FACILITY LOCATION-ALLOCATION-ROUTING DECISION USING GOAL PROGRAMMING MODEL AND DATA ENVELOPMENT ANALYSIS

Regular Session

Dr. Jae-Dong Hong [1], ***Dr. Ki-young Jeong*** [2]

1. *South Carolina State University,* ***2.*** *University of Houston Clear Lake*

Contrary to the traditional models for the strategic facility location/allocation and routing (FLAR) decisions focusing primarily on cost-efficiency, we introduce an efficiency-driven approach to FLAR decision under the risk of disruptions using data envelopment analysis (DEA) approach. We consider multi-objectives of minimizing the total relevant costs and total routing distance and of maximizing the total amount of covered demand. Combining a goal programming (GP) model with a concept of efficiency score generated by DEA, we propose an innovative procedure for finding the most efficient FLAR decisions. We conduct a case study to evaluate the proposed procedure and demonstrate that our proposed procedure performs very well and can help the practitioners and decision-makers to evaluate FLAR decisions fairly.

LINKING STRUCTURE, DYNAMIC CAPABILITIES AND PERFORMANCE IN SUPPLY CHAIN MANAGEMENT

Regular Session

Dr. Xun Li [1]

1. *Nicholls State University*

This paper investigates a framework that portrays firm performance as an outcome of appropriate alignment between a firm's structural choice of placing the top supply chain management (SCM) executive at a higher hierarchical position, supply chain alertness and supply chain agility. The results from a sample of 121 firms provide statistically significance evidence for the contention that a firm that places the top SCM executive at a higher hierarchical position, develops better alertness to identify changes for SCM and operations, and then use these identified changes to implement and execute agility-embedded practices will experience higher levels of firm performance.

Quality Improvement Prioritization Approaches in a Simple Flow Line

Regular Session

Dr. Carl Betterton [1]

1. *The Citadel*

Much effort and money can be wasted in misguided “improvement” efforts because those involved lack effective methods to choose among improvement alternatives. This study investigates how to prioritize quality improvements in a simple flow line. Yield loss (scrap) directly and negatively affects individual workstations and overall production system performance. An important factor in dealing with yield loss is planned improvement efforts. To make effective improvement decisions, management must understand how a system will respond to an improvement approach. This implies an understanding of important system differences as well as an appreciation for the correct approach. Four approaches or decision rules to guide improvement were defined - three from the quality literature, generally exercised within the context of traditional accounting performance measures, and the fourth relying on performance measures proposed in the Theory of Constraints (TOC) literature. Results show that a TOC approach results in maximum system improvement and profit.

Revisiting the Newsvendor and Traveling Salesman in a Healthcare Disaster or Pandemic Response

Poster

Dr. Rebecca Scott [1], ***Dr. Stephen Rutner*** [2]

1. *University of North Carolina Wilmington,* ***2.*** *Texas Tech University*

Healthcare related disasters have the ability to create vast amounts of destruction and provide a significant challenge to medical professionals, government and non-government organizations during a limited critical time period. The availability of medical supplies and inventory during an event remains a significant challenge to supply chain professionals and planners. A series interviews were conducted with various healthcare practitioners (supply chain and providers), first responders, military supply chain professional with relief experience, other governmental agency and finally non-government organizations. The series of interviews included what tools where they using and what types of tools would they likely use while doing relief planning and operations. This research analyzed this specific, critical situation and developed a mathematical framework using both the multi-product newsvendor and traveling salesman models to determine optimal ordering of perishable biopharmaceutical products while maximizing overage while minimizing transportation costs. The results of the two step approach is to provide a relatively simple new mathematical basis that can be quickly and easily input into Excel or other common spreadsheet software by practitioners to dramatically improve stock levels and replenishments. The goal of this abstract is to gather feedback to improve the model before finalizing it for publication and distribution to healthcare supply chain organizations in a format that they can use.

Risk Management Integration and Supply Chain Performance in Relation to ISO 9001 Certification: A Preliminary Empirical Analysis

Regular Session

Dr. Mauro Falasca [1], ***Dr. Scott Dellana*** [1], ***Dr. John Kros*** [1], ***Dr. William Rowe*** [1]

1. *East Carolina University*

This research develops a model for characterizing the relationship of supply chain (SC) performance to SC risk management integration (RMI) in the United States and compares ISO 9001 certified firms with firms that are not certified. A structural equation model is used to model the RMI measure as a mediator between SC logistics performance (LP) and both SC cost performance (CP) and SC service performance(SP). Further, CP and SP are related to overall firm performance (FP) in the proposed model. Based on the participation of 140 SC managers, we find that LP is positively related to RMI, CP and SP and that SP and CP are positively related to FP in both certified and non-certified firms. However, we find that, for ISO 9001 firms, RMI partially mediates the relationship of LP with both CP and SP, while for firms that are not ISO 9001 certified, RMI does not mediate these relationships at all. The study findings suggest that ISO 9001 certified firms are capable of leveraging their SC risk management integration efforts to impact positively on CP and SP, whereas non-certified firms are not.

Supply Chain Manager's Assessment of Collaboration: The Moderating Role of Integration Tools

Regular Session

Dr. Suman Niranjan [1], ***Dr. Katrina Savitskie*** [2]

1. *Savannah State University,* ***2.*** *University of West Florida*

Business leaders today seek greater insight on issues that impact firm performance including collaboration and efficiency; along with those issues that help facilitate integration. Supply chain activities require managers to develop inter-organizational relationships. Tools which facilitate relationship building can have a significant performance impact through improved customer responsiveness and improved efficiency as a result of the reduction of wasted effort. Firms need a better understanding of the impact of collaborative activities and integration tools including Collaborative Planning Forecasting and Replenishment (CPFR), Vendor Managed Inventory (VMI), or Just-in-Time (JIT) practices. Therefore, the construct integration tools awareness was created given that a number of processes/technologies facilitate integrated supply chain decision-making which can have a pronounced impact on firm performance. As an exploratory study our model examined the collaborative activities firms engage in, including joint decision making and process resource collaboration to determine their impact on firm efficiency and firm performance and integration tool awareness moderates these relationships. After pilot testing the survey, it was administered via *Qualtrics*. The analysis of panel data from 105 supply chain managers was conducted using Structural Equation Modeling. This study indicates the continued importance of the manager's willingness to collaborate with key partners as a means of improving firm performance and efficiency, moreover integration tools play a key role in these relationships. Contributions to the supply chain literature include the assessment of integration tools awareness on the relationship between collaboration activities and firm performance.

Theoretical models for service supply chain collaboration and integration

Regular Session

Dr. Ping Wang [1], ***Dr. Gang Li*** [2], ***Ms. Chunli Li*** [3]

1. *James Madison University,* ***2.*** *School of Management, South-Central University for Nationalities, Wuhan,* ***3.*** *Sichuan University of Arts and Science*

This presentation is to update joint research effort with two exchange scholars from China. The study investigates the construction supply chain relationship quality and the innovative performance mediated by knowledge sharing.

WHICH IS IT, JUST-IN-TIME OR LEAN? OUR CLEAR PREFERENCE, OPERATIONS SCIENCE

Regular Session

Dr. Bob Orwig [1]***, Mr. Hugh Scott*** [1]

1. *University of North Georgia*

Academics and practitioners use operations management extensively. This paper discusses the similarities and differences between terms within the operations management realm. We recognize major areas of overlap and suggest that what the overlapping concepts teach about operations management has become more important than the original terms themselves. Also by insisting on the usage of these terms we limit our understanding of operations science and limit the ability to solve problems.

AGENT BASED SIMULATION APPROACH: EFFECT OF HYBRID DISTRIBUTION METHOD ON RETAIL STORES' PERFORMANCE

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ABSTRACT

Customer satisfaction is one of the main targets for any retail industry. But to satisfy customer demand, it is not desired to have overstock at store which may expire. The man objective of this paper is to evaluate retail stores performance with a hybrid delivery method that is Direct Store Delivery (DSD) along with Distribution Center (DC) based delivery to mitigate number of expired products and at the same time increase customer satisfaction using agent-based simulation.

KEYWORDS: Direct store delivery, Distribution center, Hybrid distribution method, Agent-based simulation.

INTRODUCTION

Customer satisfaction is the main goal of retail industries. To achieve this, they need to provide the right products at the right time at best quality and at a reasonable price. For these, one of the most important things is to ensure product delivery to the stores. Some retail industries want to have only DSD policy to get the products from suppliers when they want instead of waiting for DC for having products in their stores if it is periodic review inventory policy. Frequent delivery from DC is also not always possible as it may increase transportation cost. But for DSD, as all the products will be delivered by DSD method, the store's door will be busy most of the time to unload products. Another thing is that there is not a space to store products as safety stock to meet uncertain demand or there are products discontinuation or out of stock situations at supplier's end. DC can hold some products for these unwanted situations. Both delivery method has their advantages and disadvantages. As there is always demand uncertainty, retailers have to face overstock, understock and sales return. Worldwide retailers experience $984 billion of out of stock [3]. Food waste is also a part in retail industry. Around 89 million of tones foods are wasted every year in EU [1]. Among different issues of food wastage, expiry date issue is one of the root causes [8]. As retailers store different categories of products with different shelf life, delivery methods of those products should be different to avoid products early expiration.

Based on the characteristics of the inventory items, different inventory control policies should be taken and delivery can be direct store, cross dock or DC based [9]. Perishable category can be sub categorized where day fresh items can be delivered directly to stores to reduce wastes and also it can be tried to introduce substitution between products in the same category. Registering daily waste, taking account in weekly sales pattern will help to have a better understanding of stocks. DSD is preferable not only for perishable items but also for bakery items [4].

Stock out in retail stores have impact on both the suppliers and retailers. In their research, Rosales, Whipple and Blackhurst used an agent-based simulation approach to find out the response of customers to repeated stock out situation [6]. They found that it increases number of Dissatisfied customers. If DSD is embraced by the retailers, it will not cost any money to them. Retailers can save their labor cost. In fact, sales staff can focus more on customer handling as they are not required to lose time in products unloading. According to Grocery manufacturing association (GMA) DSD suppliers represents 25 percent of total store labor in the North American market. Whether it is DC delivery or DSD delivery, the performance of a retail store depends on the forecast to get the products to satisfy customer demands. Milan et al worked on a food retailer who get it's products only by DSD delivery. In their paper, they evaluated the performance of DSD system where store get products based on forecasting. This forecasting is for getting products by DSD delivery. They found that if forecasting technique for current system does not work well, changing it what they did to change from moving average to winter method, improved the inventory of DSD system in that store [2].

Some researchers worked on electronic commerce enabled in inter organizational system for the improvement of entire supply chain. S.Kurnia and R.B Johnston found in their case study in Australian retail that very low level of electronic commerce (EC) implementation is required for DSD as representative from supplier end will be in the store most of the time [5]. But implementing EC will reduce the pressure of manual checkup of stocks in retail store. Both way trust is required to have a successful DSD.

In this paper, we have used an example model and deployed a hybrid delivery system across multi store system. To understand the performance of hybrid system, we compared the performance measures of retail store with distribution center- based distribution system. In next part of this paper, methodology has been discussed which has later been followed by results and discussion. In the last part, research summery, findings and future research works has been included in conclusion.

AGENT BASED SIMULATION

In agent-based simulation, there is sovereign agents who interact with each other in a certain environment. It mimics the relationship and objects of real world. So, it is easy to understand the complexity of practical field. A good applicant for agent-based model simulation is a problem where components or agents of the model needs to move over a landscape, agents can learn and predict the reactions of other agents. Agent based simulation has overcame the limitations of discrete event simulation [7].

PRODUCT'S VALUE FUNCTION

It is very important to consider the relation between product's value with time passed in store. Most of the time market retail price of a product remain same in the stores after passing a certain amount of days if its not a overstock product or its close to the end of its shelf life. We used a simple linear function to address this fact.

$$L_p = \begin{cases} \textbf{1 if has full life} \\ \textbf{or} \\ (\mathbf{lt - f}) * \mathbf{c} \Big/ \tan\frac{(\mathbf{f})}{\mathbf{c}} \end{cases} \quad \textbf{(1)}$$

L_p=Fraction of full price based on remaining life of product
f =Shelf life of product
l_t =Age of product at time t
c=purchasing price of product from supplier

METHODOLOGY

For developing our model using agent-based simulation approach, we used Anylogic 8.3.2 Personal Learning Edition. We considered a distribution center (DC), stores, stores order placed to DC, DC vehicles, Supplier, supplier trucks and DSD order as agents for our example model. One product with 15 days shelf life and selling price of $2 has been considered. (Q, R) inventory policy was used for DC delivery where every R period, Q amount will be delivered to retailers based on the forecasted demand for the retailer. We are assuming that every week, DC will deliver 7 days demand to retailers based on their respective forecast. Retailers will have the option to prefer DSD if its stock level is less than three days stock based on customers' arrival (actual sales). As the delivery cost to stores are on supplier for DSD, we are assuming that supplier will agree to deliver if the order value meets minimum order value (MOV) which is $100 for our model or the store is within 100000 meters of supplier's factory. Most of the case suppliers will consider MOV. We ran our model considering MOV and distance-based requirement and also only MOV and presented the results in later part of this paper.

For this study, we considered a case where there are four different stores located at Austin, Waco, Arlington and Grapevine and the DC is located at Dallas. At starting of the simulation, we assumed that every store has zero stock.

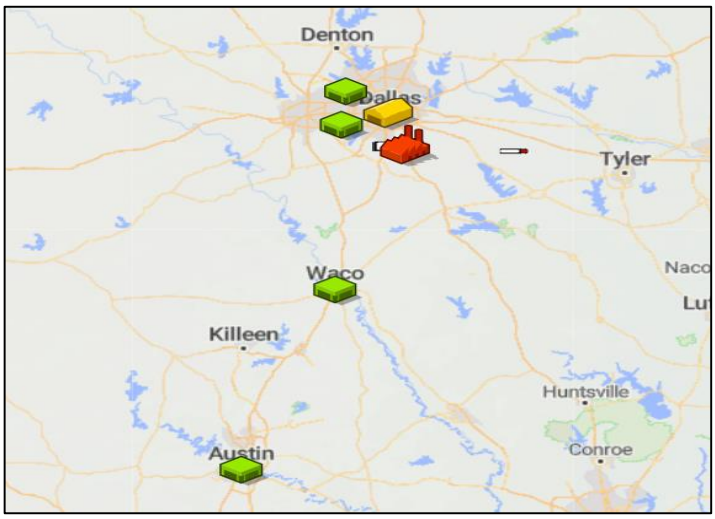

Figure 1: Model Agents in GIS Space.

We assumed the forecast and customer arrival.

Table 1: Forecasted demand and Customer arrival to stores

Stores	Forecasted Demand (30 days)	Customer arrival/day
Austin	150	In a range between 7 to 12
Grapevine	125	
Arlington	145	
Waco	123	

By using process library of Anylogic software, we developed the customer flow in the store as depicted in Figure 2. It has been assumed that each customer entering the store will buy a single product. Time spent by the customers in the store has not been considered.

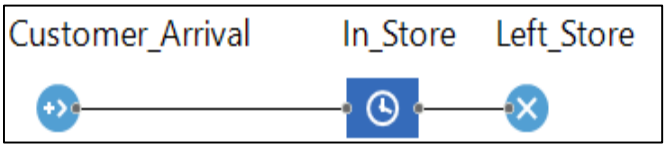

Figure 2: Customer Flow in the Store.

After receiving orders from stores, DC will process those orders. Orders will be queued based on the time of receiving order requests from stores. A single order will be delivered at once.

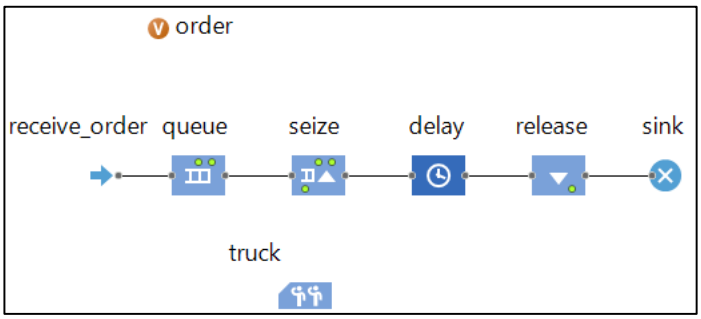

Figure 3: Order Processing in DC.

Delivery of the products was done by using trucks as DC vehicles. In our model, two DC vehicles have been considered. These vehicles followed different states based on its movement. DC generated a message and it was sent to the DC Vehicle agent. This agent then loaded the ordered amounts of products and moved to that respective outlet. Loading time and unloading time had considered uniformly distributed between 1 to 2 hours. After unloading product at the store, it returned to DC. When DSD delivery option is considered, products were delivered to stores by using supplier's truck.

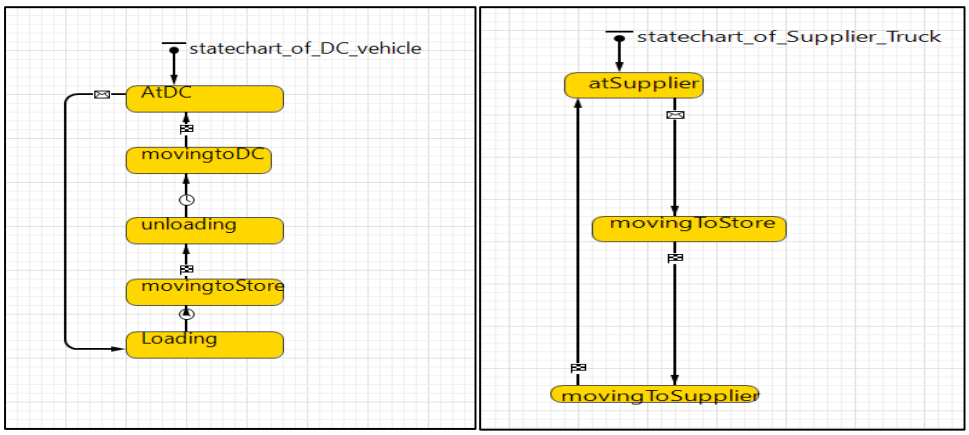

Figure 3: State Chart of DC Vehicle (Left) and Supplier's Vehicle (Right).

When a store will desire to get DSD, it need to check whether it is meeting the desired criterion for it or not. We used an action chart for this purpose. First criterion is whether the order value is meeting supplier's MOV or not and second one is distance range. Based on this action chart, decision variables either one or zero for DSD have been found and delivery steps taken based on that decision variable.

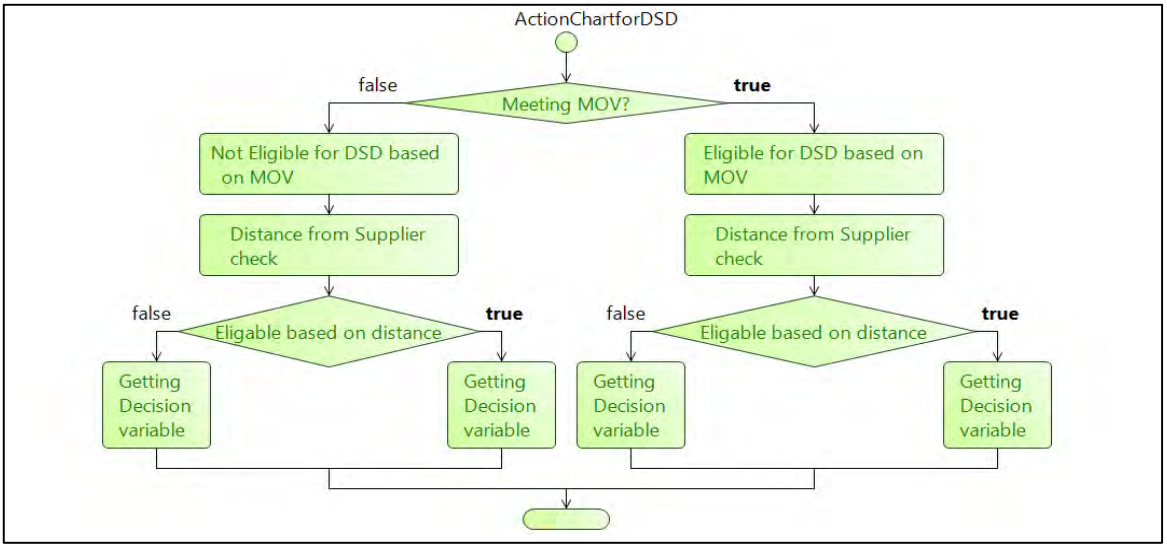

Figure 4:Action Chart for DSD.

We ran the model for 720 hours or 30 days. We are assumed both DC and DSD deliveries are available. To check whether there is any difference between agent-based simulation and discrete event simulation, we also developed a simple discrete event simulation model of simplified version of our case for store Austin and compared the outputs.

RESULTS AND DISCUSSION

In base case where there is only DC delivery available, we ran our model for Q=7 days demand based on forecast and R=7 days review period for all four stores. For DSD delivery option, we assumed every 3 days retailers can get products for the amount of 5 days demand based on customer arrival. But they needed to check whether their order value met MOV or they met distance criterion to be eligible to get the products.

Table 2: Percentage of Satisfied and Dissatisfied Customers with DSD (Hybrid) and without.

Stores	Only DC delivery		DC delivery with DSD option		
	Satisfied Customers (%)	Dissatisfied Customers (%)	Satisfied Customers (%)	Dissatisfied Customers (%)	Total Customer
Austin	47%	53%	100%	0%	405
Grapevine	40%	60%	99%	1%	369
Arlington	45%	55%	100%	0%	354
Waco	48%	52%	100%	0%	346

From the above table we can see that all the stores' performance increased based on customer satisfaction while considering DSD along with DC delivery.

We used discrete event simulation approach for Only DC delivery for Austin store and compared with agent-based approach for the same case. Results in Table 3 did not vary that much.

Table 3: Discrete-Event Vs Agent-Based Simulation Output

Simulation Approach	Satisfied Customer (%)	Dissatisfied Customer (%)	Total Customer
Discrete-Event	55%	45%	379
Agent-Based	47%	53%	405

But it is important to mention that DC, DC vehicles, supplier, were not considered here but only a cyclic flow of product to store based on forecasted demand have been considered. But in real field all the components of supply chain need to be synchronized for products flow. Agent based simulation acts that way.

Based on our objective to use agent-based simulation, impact of hybrid distribution method on store's performance were evaluated and compared with only DC based delivery methods through a series of experiments. We considered eight scenarios for experiment on Austin store. If DSD is chosen, five days stock based on customers arrival is delivered. DSD option will trigger if stock in store is less than three days sales. For Days stock delivery from DC, the maximum days stock is 30 and minimum is 7 days. For customer arrival/day varies within the range of 7 to 12.

Table 4 : Scenarios for Experiment

Scenarios	With/Without DSD	Days' stock delivery from DC	Customer arrival/day
1	DSD	Maximum	Maximum
2	No DSD	Maximum	Maximum
3	DSD	Minimum	Maximum
4	No DSD	Minimum	Maximum
5	DSD	Minimum	Minimum
6	No DSD	Minimum	Minimum
7	DSD	Maximum	Minimum
8	No DSD	Maximum	Minimum

After running the model for different scenarios, we got different results. Model outputs for these experiments are in Figure 6. Here run zero represents scenario one where DSD delivery with DC delivery (hybrid) was considered with maximum stock delivery from DC when customer arrival is maximum at Austin store.

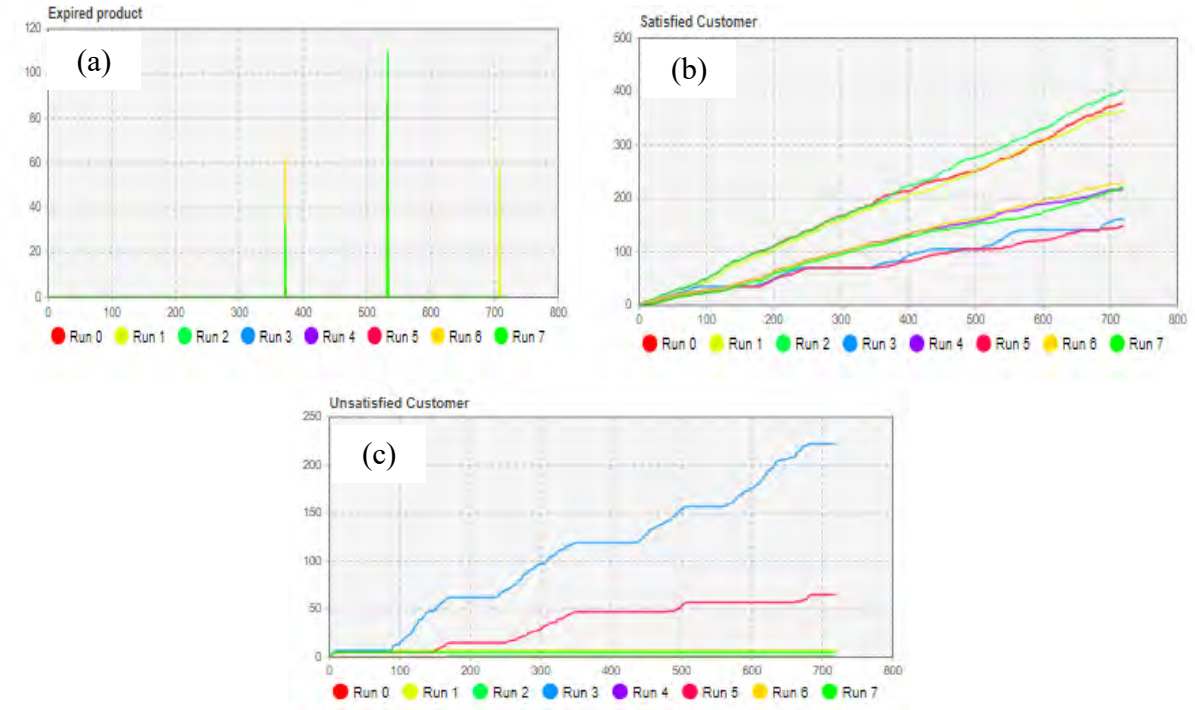

Figure 5: Model Output for (a) Products Expired, (b) Satisfied Customers, and (c) Dissatisfied Customers

From the figure 6, we can see that Run 7, that is scenario 8 with maximum DC stock delivery, minimum customer arrival with no option to choose DSD, resulted in highest expired products around 520th hour or 22nd day. On the other hand, Satisfied customers are the highest for this scenario with very low Dissatisfied customer. As customer arrival and products arrivals are not the same for all the scenarios, it is better to compare based on percentage.

Figure 6 :Expired Product in Austin Store at Different Scenarios.

Figure 7: Percentage of Satisfied Customers at Different Scenarios.

After doing the experiment we can see that for scenario 1,2,7, and 8 products became expired. For these scenarios, day's stock delivery from DC is 30 days that is maximum. In scenario 1 and 2, the number of customer arrival is maximum and for 7 and 8, it is minimum. Though in scenarios 1 and 2, the number of customer arrival is maximum, stocks from DC satisfy the customers. Though the DSD option is available in scenario 1, as the store had enough stock from DC, the necessity of choosing DSD didn't arrive. In scenario1 customer satisfaction is 100% and 2, customer satisfaction is close to 100 percent though it costed product expiration because of over stock. On the other hand, in scenario 7 and 8, store was able to satisfy its minimum

customers with maximum stock and the surplus stocks became expired if passed 15 days. Percentages of expired products are higher in scenario 7 and 8 than scenarios 1 and 2 because in previous two scenarios, customer arrival was minimum. In scenarios 3 and 5, customer satisfaction is hundred percent with zero expired products. This is because of minimum stock delivery from DC with the option of choosing DSD with delivery from DC. When DC deliver the minimum amount of product based on forecast, there is no expiry products but Dissatisfied customers. From these experiments, scenario 5 is the best choice as it provides hundred percent customer satisfaction with zero expiry products.

We ran our model for the previous eight scenarios for the case when supplier will deliver DSD based on MOV not distance and the result have been listed in Table 5.

Table 5:Percentage of Satisfied and Dissatisfied Customers for DSD based on different criteria

Scenario	With/Without DSD	Considering MOV		Considering MOV and Distance	
		Customer Satisfaction (%)	Expired Product (%)	Customer Satisfaction (%)	Expired Product (%)
1	DSD	100%	14%	100%	14%
2	No DSD	98%	15%	98%	15%
3	DSD	100%	0%	100%	0%
4	No DSD	42%	0%	42%	0%
5	**DSD**	**85%**	**0%**	**100%**	**0%**
6	No DSD	70%	0%	70%	0%
7	**DSD**	**98%**	**22%**	**100%**	**25%**
8	No DSD	98%	24%	98%	24%

Result changed for scenario 5 and 7 where the customer arrival is minimum. In these experiments, 5 days sales stock was considered for DSD delivery and product price as $2. Maximum order value In this scenario will be:

$$\textit{Order value} = \textit{Customer arrival/day}*5*\textbf{Price} \quad (2)$$
$$= 7*5*\$2.00 = \$70.00$$

As, it didn't meet the MOV, DSD will not be done. As a result, the percentage of satisfied customer is less for scenario 5 and 7 then the case when both DSD criterion were considered though customer arrival is same for both cases.

To findout the impact of DSD over product's value, we ran our model for DC stock delivery of 20 days with 12 customers/day arrival at Austin store and again only for DSD delivery where Customer arrival is same.

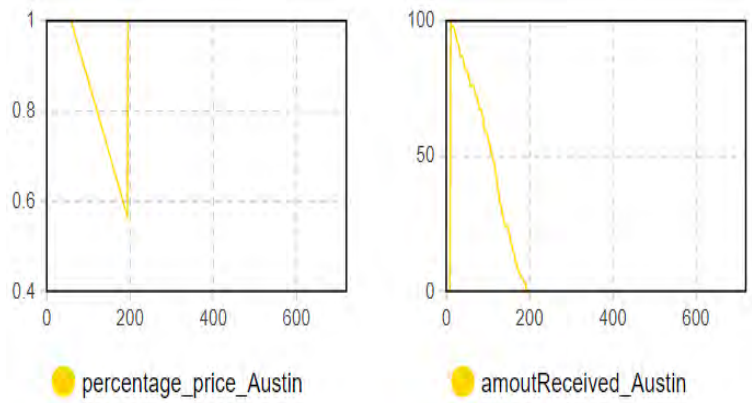

Figure 8 : Percentage of sales value drop in products from DC delivery and their amount

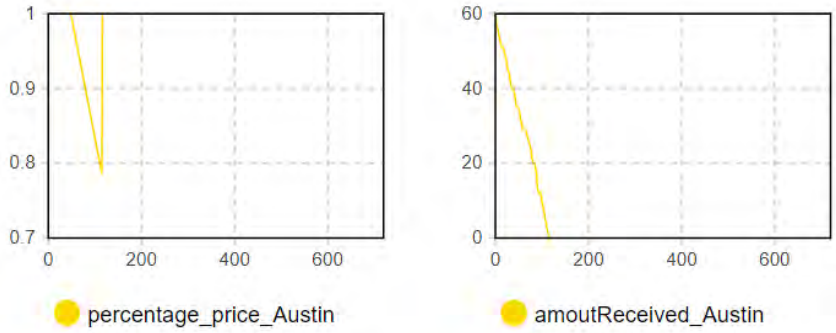

Figure 9: Percentage of sales value drop in products from DSD delivery and their amount

From the above plots, we can see that stores with DSD delivery had the lower dropin percentage of price than DC delivery. Higher amount of product delivered by DC remains in store for longer time and lose value more where only in DSD delivery with frequent and short amount delivery stays less time if the number of customer arrival in store is same.

CONCLUSION

In this paper it has been found that if DC delivery and DSD both options are available then stores should choose hybrid delivery system for meeting increased sales when DC delivery is not enough for satisfying the customers and delivery frequency from DC is high. It is not possible for a retail industry to move altogether from DC delivery policy to DSD policy if it is not meeting it's customer satisfaction and number of expired products are high. They can choose hybrid distribution to meet sudden unexpected demand that may be because of promotion or seasonal feast. Many works considering DC delivery and DSD delivery exists in the research field. But very little work was done considering both methods existence for the same products in the system at the same time. There are many other factors those need to be considered in future work like Impact of back store room of retail stores, effect of environmental and demographical condition of retail stores on hybrid delivery system.

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AN ORGANIZATION OF DISASSEMBLY LINE COMPLEXITIES

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ABSTRACT

With decreasing product life cycles, concern over disposing hazardous materials, the reduced land available for waste disposal, and increasing governmental regulations, remanufacturing products for reuse have received added importance and attention. While the issues and problems surrounding forward assembly lines have been revealed and studied for a sustained period, disassembly operations have distinct challenges or "complexities". We review and analyze the complexities mentioned in the literature and provide a new, comprehensive, strategic-to-tactical organization and analysis. This is beneficial for recognizing the complete spectrum of remanufacturing complexities and their incorporation into disassembly line model formulations, solutions, and professional applications.

INTRODUCTION

Remanufacturing is a growing industry that allows products that have exceeded their usefulness to be refurbished or disassembled into usable modules, components, materials, or disposed. This reuse of resources is a positive response to growing environmental, regulatory pressures and can produce economic benefits. Regulatory policies include those found in the European Union for automotive vehicles (ER Directive 2002/525/EC) and electronic waste (EU Directives 2002/96/EC and 2003/108/EC), Japanese directives to regulate recycling of household appliances and computers (Atasu and Wassenhove, 2012), and e-waste laws in 23 of the United States mandating producer responsibility for end-of-life products (ETC, 2010). Potential economic benefits from remanufacturing are mentioned by both academics and practitioners (e.g., Guide, 2000; Hagerty & Glader, 2011; Morgan & Gagnon, 2013) and are reported to produce U.S. sales of $100 billion (Hagerty and Glader, 2011).

Product disassembly is an important step in the remanufacturing process to determine which products, modules, parts, or materials can be reused, repaired, or disposed (Ozceylan & Paksoy, 2013). Growth in the increasing number of similar products and product families eligible for remanufacturing and resale (e.g., computers and cell phones) enable the design, use, and profitability of disassembly flow lines. Disassembly lines (DL) offer greater throughput with higher productivity and lower costs per unit (Ilgin & Gupta, 2010). In addition, the DL may be suitable for automated, robotic disassembly (e.g., Kalayci & Gupta, 2013b).

However, there is enormous complexity involved with efficient disassembly operations. Guide (2000) highlights the characteristics that significantly complicate the production planning and control activities in remanufacturing. These complications include: uncertain timing and quantity of returns, need to balance returns with demands, disassembly of returned products,

uncertainty in materials recovered from returned items, requirement for a reverse logistics network, complication of material matching restrictions, stochastic routings for materials for remanufacturing operations, and highly variable processing times. Other researchers have noted other significant challenges, issues, and decisions involving remanufacturing systems, such as the selection of order priorities and release mechanisms, lot sizes and priority scheduling rules, capacity restrictions, parts commonality among the same or multiple products, the planning of buffer inventories, scheduling over multiple time periods, product deterioration, integration of forward and reverse manufacturing operations, determination of the appropriate core and component holding costs, pricing of remanufactured products, etc. (e.g., Brennan et al., 1994; Flapper et al., 2002; Voutsinas and Pappas, 2002; Kim et. al., 2007; and Steenbeck and Sarin, 2013).

Priyono et al. (2016) mention that companies can increase their profitability by reducing uncertainties (e.g., complexities). Remanufacturing complexities can occur at the strategic systems level (e.g., closed-loop system (CLSC) design, capacities, or markets), at the numerous tactical stages of processing, and at the distribution level (e.g., product pricing, sales, and inventory). A comprehensive organization and analysis of remanufacturing disassembly system complexities at each level would be useful to facilitate effective economic and operational decisions (e.g., CLSC system design, forecasting sales and shipments, purchasing cores and components, inventory management, process sequence, disassembly line design, production planning and scheduling, task allocation and work balancing, work station design, worker issues, etc.).

Thus, our research effort is to design a comprehensive, strategic-to-tactical organization of disassembly line system complexities and to provide an in-depth analysis. Our research is organized as follows. Section 2 reviews the literature targeting remanufacturing disassembly complexities and existing categorizations of these complexities. Section 3 presents and describes our comprehensive, strategic-to-tactical organization of the complexities. Section 4 will provide a summary and discussion of our findings. Section 5 will describe areas for future research.

LITERATURE REVIEW OF REMANUFACTURING DISASSEMBLY COMPLEXITIES AND THEIR CLASSIFICATIONS

Remanufacturing disassembly difficulties have been identified by various terms - complexities, challenges, complications, considerations, uncertainties, issues, decisions, and even research extensions. We will refer to these burdensome and oftentimes uncertain, but realistic, decisions as “complexities”.

As early as 1994 Brennan, Gupta, and Taleb identified “operations planning issues” confronting both assembly and disassembly operations. These were augmented by a number of research efforts specifically identifying remanufacturing complexities (Guide & Srivastava (1997), Gungor & Gupta (1999b), Guide (2000), Gungor, Gupta, Pochampally & Kamarthi (2000), Flapper et al. (2002), Kizilkaya & Gupta (2004), Kim et al. (2007), Boysen et al. (2008), Ilgin and Gupta (2010), Sousa (2012), Battaia & Dolgui (2013), Gagnon & Morgan (2014), and Priyono et al. (2016). Table 1 in the Appendix provides a comprehensive compilation of these complexities. As can be

seen from that table a significant number of complexities spanning strategic to operational levels have been identified.

Of the 14 studies included in Table 1 only 6 organize and categorize complexities. Gungor, Gupta, Pochampally & Kamarthi (2000), organize *complications* into six categories dealing with the product, disassembly line, parts, demand, task assignments, and others (e.g., work station reliability). Boysen, Fliedner, & Scholl (2008) utilize three major categories (precedence characteristics, objectives, and station and line characteristics) to structure their classification scheme. These are further organized into eleven divisions as shown in Table 1. Ilgin & Gupta (2010) organize *issues* in environmentally conscious manufacturing and product recovery into 4 major categories: product design, reverse & closed loop supply chains, remanufacturing, and disassembly. These major categories are further divided into 25 issues which span strategic to tactical considerations and of which approximately 14 can be related to complexities. Souza (2012) organizes the CLSC *decisions* into 3 categories – strategic (e.g., network design, collection strategy), tactical (e.g., product acquisition, returns disposition), and operational (disassembly sequence and depth of disassembly, scheduling priority rules and routing). Finally, Priyono et al. (2016) classifies disassembly *uncertainties* into 3 sets arranged in order of their occurrence: before disassembly (3 uncertainties), during disassembly (6 uncertainties), or following disassembly (5 uncertainties).

While each these approaches is certainly logical and expansive, their coverage of complexities is not completely exhaustive. Thus, an updated and comprehensive review specifically focused on disassembly operations complexities is necessary to enhance further academic research and professional application. In addition remanufacturing has been studied in a broader context integrating: CLSC network and facility design, locations and capacities (e.g, Tang & Zhou 2006); integrated forward and reverse production planning; assigning returned products and component inventories to one or more disassembly lines; simultaneously balancing and scheduling the disassembly line(s) (e.g., Ozceylan & Paksoy 2013, 2014); and incorporating organizational, process, and labor considerations (Battaia & Dolgui, 2013). Thus, we use the phrase "remanufacturing disassembly line systems" to describe the boundaries of our study.

A CATEGORIZATION AND ANALYSIS OF REMANUFACTURING DISASSEMBLY COMPLEXITIES

For clarity we define "complexities" to include deterministic restrictions (e.g., finite capacities, part quality, and hazardous parts), fuzzy variables, probabilistic values, and stochastic variables. In addition, we consider fuzzy and stochastic variables as uncertain complexities or *uncertainties*.

To uncover the DL complexities and the progress made in addressing them we construct Table 2, (in the Appendix) which organizes and classifies these "complexities" into 10 categories from the strategic to the tactical based on the remanufacturing decision hierarchy proposed by Morgan and Gagnon (2004).

Strategic considerations include those dealing with the design, process span, and economics of the reverse supply chain system (e.g., Ozceylan & Paksoy, 2013, 2014); the assessment and

determination of which products will be disassembled and where (e.g., Ozceylan & Paksoy, 2013, 2014; Kazmierczak et al., 2004); and the design of the disassembly line process (e.g., Agrawal & Tiwari, 2008). Also included in this category are the decisions to create new markets for discarded parts and materials, and for shredding materials (Kazmierczak et al., 2004); the riskier financial decisions dealing with longer planning horizons and capital budgeting uncertainties (Brennan, Gupta & Taleb, 1994; Goksoy, 2010); and the necessary cooperation and communication between OEMs and remanufacturers (Kazmierczak et al., 2004).

Market and demand considerations are the next level of strategic descent. Here we note issues concerning uncertain market demands (e.g., Ozceylan & Paksoy, 2014 and Avikal et al., 2014) and the effects of seasonal demand trends on the cycle time, the number of work stations, the line balance, and the number of workers, etc. (Tuncel et al., 2014). We also note customer product condition requirements – accept product as is, accept some defects, or do not accept any product with defects (e.g., Gungor & Gupta, 2001).

We next address the returned product/part considerations. Gungor & Gupta (2002) address the issue of "will the line balance consider one product, one family of similar products, or several types of products". Herzer & Kara (2015) study the disassembly line balancing problem (DLBP) for two products on two parallel lines. A number of articles focus on uncertain product arrivals e.g., (Kizalkaya & Gupta, 2004, 2005), quality (e.g., Tang & Zhou, 2006) and quantity (e.g., Gungor & Gupta, 1999a). Gungor et al. (2000) mention that design changes to existing products can alter the disassembly sequence and line balance. Finally, Gungor & Gupta (2002) emphasize that non-removable defective parts could result in the product (or portions thereof) being removed from the line entirely.

Narrowing the scope to facility issues Ozceylan & Paksoy (2013, 2014) incorporate finite capacities in their collection and disassembly centers within their reverse logistics supply chain system. In their 2014 publication they utilize "fuzzy" capacities in both the collection and disassembly centers.

Following facility concerns we next address process complexities. These considerations include the importance of developing the disassembly sequence that best achieves the single or multiple objectives (e.g., Gungor & Gupta, 1999b), the use of alternative processing sequences resulting in different line balances (e.g., Brennan, Gupta, & Taleb, 1994), the questions surrounding the (greater) use of automated disassembly (e.g., Kalayci, Polat & Gupta, 2015), the level of disassembly (complete or partial) (e.g., Altekin et al., 2008), an infinite or finite source of parts and/or cores (Altekin et al., 2008; Goksoy, 2010), and imperfect remanufacturing processes that result in yield losses (the part may have been of good quality, but made useless by the process) (Gungor & Gupta, 1999b). Also, addressed are the number of finite machines available to be assigned to work stations (e.g., Tang et al., 2001), the outgoing quality of remanufactured parts/products (e.g., Turowski et al., 2005), the discharge of scrap parts (Ozceylan et al., 2014), and the profits made or costs incurred by the disassembly line and its output (e.g., Altekin et al., 2008).

Descending from entire process considerations the next level concerns disassembly line factors. These considerations include: paced versus unpaced disassembly lines (Gungor & Gupta, 2002);

balanced versus unbalanced lines (Kekre et al., 2003); infinite versus finite buffer inventories between work stations (e.g., McGovern & Gupta, 2006; Kekre et al., 2003; Ketzenberg et al., 2003); dynamically configuring and rebalancing the DL system into one or more DLs for different orders (Tang & Zhou, 2006); single, multiple, or mixed-model line(s) (Gungor & Gupta, 2002); and the need for special tooling for disassembly operations (Kazierczak et al., 2004). As shown in Table 2 balancing the idle time among work stations has become both a very commonplace objective and complexity in disassembly research and is incorporated in a majority of the articles reviewed. Duta et al. (2008) address balancing the idle time at each station in real time.

Narrowing the focus we next address work station considerations. These issues concern the number of workers per station (e.g., Ketzenberg et al., 2003); one or two-sided work stations, important for parallel lines (e.g., Agrawal et al., 2008); and the ability of the worker to move among the work stations along the DL, important for U-shaped lines, (e.g., Agrawal et al., 2008). Also, important are work station reliability (the ability of the work station to meet the cycle time or complete its tasks successfully) (e.g., Gungor & Gupta, 2002) and the fixed cost of opening work stations or operating them (Ozceylan & Paksoy, 2013, 2014).

Task assignments and processing time complexities involve multiple deterministic task times (Duta et al., 2008), stochastic task times (e.g., Bentaha et al., 2015), fuzzy processing times (e.g., Ozceylan & Paksoy, 2014), and sequence-dependent (deterministic) task times (e.g., Kalayci et al., 2015). Also mentioned are task assignments to specific work stations due to special handling needs (e.g., Agrawal & Tiwari, 2008; Kizilkaya et al., 2005; Gungor & Gupta, 2002) and sophisticated procedures for determining the relative weights for multiple criteria for task allocation (Avikal, Mishra, & Jain, 2014). Gungor and Gupta (1999) initially popularized several complexities found in a substantial number of DL research articles. These include prioritizing hazardous or environmentally polluting operations (e.g., McGovern & Gupta, 2005, 2007a, 2007b), prioritizing high demand parts for disassembly (e.g., McGovern & Gupta, 2005, 2006, 2007a, 2007b), balancing the idle time at each work station (e.g., McGovern & Gupta, 2006, 2007a), parts revisiting previous work stations or direction changes (e.g., McGovern & Gupta, 2005, 2006, 2007a, 2007b), parts leaving the line early (disappearing) (e.g., Kizilkaya & Gupta, 2004, 2005), self-skipping work pieces (work piece leaves work station without work) (e.g., Kizilkaya & Gupta, 2004, 2005), skipping work pieces (due to work done at a previous work station, part skips the following work station) (e.g., Kizilkaya & Gupta, 2004, 2005), and exploding work pieces (part separates into two or more work pieces) (e.g., Kizilkaya & Gupta, 2004, 2005).

Worker or human factor considerations have long received attention in the forward assembly literature (e.g., Ghosh & Gagnon, 1989) and now are gaining attention in the remanufacturing literature. Specifically mentioned are human factors such as different worker skill levels resulting in different task times and costs per piece, worker ergonomics and job design, and training for disassembly of valuable future products (e.g., Tang, Zhou & Gao, 2006; Kazmierczak et al., 2004); and performance improvement due to worker "learning" (Gungor and Gupta, 2002). More recently Avikal et al. (2014) study worker assignment balances utilizing "fuzzy" workloads.

The final level of complexities involves how the disassembly system will be scheduled. While the most tactical level, it is by no means simple. The scheduling considerations mentioned in the literature concern the use of feeder lines (Gungor and Gupta, 2001), on time completion and

delivery of lots (Tang et al., 2001), push versus pull (Kanban) scheduling/control (e.g., Kizilikaya & Gupta, 2004, 2005), and disassembly lot/mixed-model scheduling (Agrawal & Tiwari, 2008; Ranky et al. 2003).

Thus, this 10-level, strategic-to-tactical categorization has identified 90 realistic, disassembly line considerations. While many complexities are also relevant to forward assembly lines, 30 (**in bold**) appear to be unique to disassembly lines. Perhaps expected, the task assignment category contains the most complexities (17), followed by disassembly line considerations (16), and process considerations (13). The task assignment/time considerations are also the most frequently mentioned in the literature reviewed (120 citings) followed by process considerations (32) and disassembly considerations (27). The complexities employed most frequently are: balance the idle time among work stations (30), variable task times tied with remove hazardous parts early (16), and remove high demand parts early (14). Interestingly, all these complexities are contained in the task assignment category.

In total the deterministic complexities are employed far more frequently in the literature than the fuzzy, probabilistic, or stochastic varieties (195 vs. 29, 9, and 42 respectively). It is noteworthy that the stochastic values rank second in frequency with usage of fuzzy and probabilistic usage trailing considerably. However, the use of fuzzy variables has increased somewhat since 2013 and may enjoy increased adoption in this research area for several reasons: (1) fuzzy variables can be added to DL models and still be computationally managed and (2) some researchers maintain that fuzzy variable applications (rather than stochastic) more realistically represent the DL problem environment, since stochastic models may not be capable of perfectly representing real-life situations due to a lack of sufficient historical data (Ozceylan and Paksoy, 2014).

SUMMARY AND DISCUSSION OF THE REMANUFACTURING DISASSEMBLY LINE COMPLEXITIES

We have provided what we believe is the first strategic-to-tactical organization of disassembly line system complexities. This 10 level, hierarchical structure offers a systematic means of categorizing and analyzing the complexities. We also contend that the assemblage of these 90 disassembly line complexities is the most comprehensive yet provided. While many of these complexities confront forward assembly operations, 30 were identified as unique to reverse manufacturing or disassembly processes.

The task assignment/time considerations category contain the most complexities and these are the most frequently mentioned in the literature. The complexities employed most frequently (e.g., balancing idle time across work stations, variable task times, remove hazardous parts early, and remove high demand parts early) are interestingly all contained in the task assignment category.

As may be expected, the deterministic complexities are far more common than the uncertain varieties. Articles addressing single products with deterministic formats contain the most complexities with the number of complexities decreasing as multiple products and stochasticity is introduced. The use of fuzzy variables has increased the number of uncertain complexities that are incorporated into DL models. We note the increased use of fuzzy variables since 2013 and we may see expanded usage in the future.

SUGGESTIONS FOR FUTURE RESEARCH

Several studies (Ozceylan & Poksoy 2013, 2014) have expanded the disassembly line balancing problem to include CLSC system facilities, costs, capacities, transports, etc. It may be useful to establish and incorporate the complexities of integrated supply chain systems in future research.

Since disassembly operations are still labor-intensive, research targeting work and worker-related complexities (e.g. # of workers per work station, work station/line design, integrating workers into automated DL systems, complexities with KANBAN systems) remain important and necessary.

Following the suggestions of Hezer and Kara (2015) more research on the impact of fuzzy or stochastic task times on multiple parallel lines, particularly for larger products, is needed.

Which complexities have the greatest impact on disassembly line throughput, efficiency, balancing, cost per unit, etc.? While we can identify 90 complexities, there is no research that indicates which are the most significant in determining disassembly line technical or economic performance. Such knowledge could well be beneficial.

While progress incorporating more complexities in disassembly line research is noted, more research including concerns from professional, remanufacturing disassemblers would be useful; actual survey results would be significant and could indicate the relative priority ranking of the complexities.

Finally, Daniel Guide (2000) has suggested that, while research identifying individual complexities and their impact on line efficiency, workload distribution, process design, product sequencing, etc., is necessary, research is much needed on the effects of the *integration* of various complexities. This may become even more significant as the research efforts combine strategic issues with tactical operations (e.g. disassembly line design with line balancing, determining the number of disassembly lines and their locations, planning disassembly operations, and scheduling job orders for single, multiple or mixed products).

Thus, while significant progress has been accomplished in identifying, organizing, and analyzing disassembly line complexities, important questions and work remain.

APPENDIX

Table 1. References Identifying Remanufacturing Complexities

Reference	Complexities Identified
Brennan, Gupta, & Taleb (1994)	Plant locations must now consider recovery, remanufacturing, and related shipping costs (and perhaps manufacturing, if operations are combined) Excess inventories may occur since demand does not necessarily equal demand Networking problems involving assembly, disassembly, and recycling Resource availability and allocation problems (especially for a plant performing both assembly and disassembly operations Scheduling problems Buffer stock locations Alternative disassembly sequences Difficult to estimate disassembly and storage capacity, since distribution of returns is uncertain
Guide & Srivastava (1997)	Probabilistic recovery rates Unknown conditions of recovered parts Stochastic routings and lead times Part matching problems Complexity of a remanufacturing shop structure Imperfect correlation between supply of cores and demand for remanufactured products Uncertainties in the quantity and timing of returns
Gungor & Gupta (1999)	How far to disassemble to maintain profitability and environmental features Disassembly process planning to find optimal or near optimal process plan to minimize cost of disassembly and best cost/benefit ratio
Guide (2000)	Uncertain timing and quantity of returns Need to balance returns with demands Disassembly of returned products Uncertainty in materials recovered from returned items Requirement for a reverse logistics network Complication of material matching restrictions Stochastic routings for materials for remanufacturing operations Highly variable processing times.
Gungor, Gupta, Pochampally & Kamarthi (2000)	Product Complications: Changing product characteristics Disassembly Line Complications: Various disassembly line configurations Changing disassembly line speeds Part Complications: Quality of incoming products Quantity of incoming products Variable task times Early leaving work pieces Self-skipping work pieces Skipping work pieces Disappearing work pieces Revisiting and exploding work pieces

Table 1. References Identifying Remanufacturing Complexities - Continued

Reference	Complexities Identified
	Demand Complications: Demand complications (for one part only, multiple parts, all parts) Assignment Complications: Tasks must be grouped and assigned to a specific work station Other Complications: Reliability of work station Hazardous parts
Flapper, Fransoo, Broekmeulen, & Inderfurth (2002)	In-line versus off-line rework Single versus multiple stage operations
Kizilkaya & Gupta (2004)	Quality of arrivals Quantity of arrivals Stochastic task times Early leaving work pieces Self-skipping work pieces Disappearing work pieces Revisiting work pieces Exploding work pieces Variable demand of multiple parts at various work stations Hazardous parts Tasks requiring similar working conditions Tasks requiring special tooling Tasks requiring directional changes
Kim, Lee, & Xirouchakis, (2007)	Uncapacitated versus capacitated Product structure type - parts commonality versus none Certainty versus uncertainty One or more products Objective criteria – cost versus profit versus makespan versus output volume versus minimum number of root items used Focused versus integrated – more than one operation or considers inventory buffers Single versus multiple periods
Boysen, Fliedner, & Scholl (2008)	Product/line Specific: Single, multi-, mixed model production Processing Times: Deterministic, dynamic, stochastic Sequence Dependent Task Time Increments Assignment Restrictions: Linked, incompatible, fixed, forbidden, certain type of workstation, Minimum or maximum distance between tasks Objectives: Minimize # of work stations, minimize cycle times, maximize efficiency, minimize cost, maximize profit, smooth station times, balance horizontal work station times, balance between work station times Movement of Work Pieces: Paced versus unpaced line Line Layout: Serial, U-shaped (single or multiple lines)

Table 1. References Identifying Remanufacturing Complexities - Continued

Reference	Complexities Identified
	Parallelization: Parallel lines, work stations, tasks, working places within a station Resource assignment: Equipment design, selection Station-dependent Time Increments: Unproductive activities considered Additional configuration aspects: Allocation and size of buffers, feeder lines, machine positioning, material positioning
Ilgin & Gupta (2010)	Product Design: Product design for environment, disassembly, & recycling Life cycle analysis Material selection Reverse & Closed Loop Supply Chains: Network design Simultaneous consideration of network and product design issues Optimization of transportation Selection of used products Selection and evaluation of suppliers Performance measurement Marketing issues EOL alternative selection Product acquisition Other issues Remanufacturing: Forecasting Production planning Production scheduling Capacity planning Inventory management Effect of Uncertainty Disassembly: Scheduling Sequencing Line balancing DTO systems Automation Ergonomics
Sousa (2012)	Strategic: Network design Collection strategy OEM involvement in remanufacturing Leasing or selling Trade-in and buy-back programs for outmoded products Supply chain coordination – contracts and incentives Impact of recovery activities on new product design Tactical: Acquisition of product returns Returns disposition

Table 1. References Identifying Remanufacturing Complexities - Continued

Reference	Complexities Identified
	Operational: Disassembly planning - sequencing and depth of disassembly Scheduling priority rules, lot sizing, and routing
Battaia & Dolgui (2013)	How to deal with multiple disassembly lines, parallel lines (perhaps assembly and disassembly) with crossover between some work stations Impact of learning and deterioration effects on task attributes Effectiveness of operators with varying work rates Changes in product characteristics Changes in work station characteristics Sequence dependent task times Probability of not completing a task Assigning tasks, equipment, and other resources to work stations simultaneously rather than sequentially Buffer capacity of work stations (excess capacity) Zoning constraints (force or forbid the assignment of certain tasks to a particular work station Distance constraints (minimum or maximum distance between tasks)
Gagnon & Morgan (2014)	Scheduling Difficulties: Parts availability Long lead times Poor quality parts On-time delivery Difficulty in forecasting customer orders Balancing product availability with market demand
Priyono, Ijomah & Bitici (2016)	Prior to Disassembly: Uncertain customer orders Uncertainty of core quality even with sorting Quality, quantity, timing, and type of returns During Disassembly: Optimum level of disassembly Number of cores to disassemble to meet demand Process sequence of disassembly Which parts to remove and which to remain Decision to remanufacture or simply recycle Disassembly yield Subsequent to Disassembly: Purchasing of new parts (quantity, when to order, lead time) Match parts from disassembly, inventory, and new parts Routing of each part during testing, cleaning and reprocessing Product costing and selling prices How much inventory of disassembled parts to hold

Table 2: Classification and Analysis of Remanufacturing Disassembly Line Complexities

	Articles Addressing Complexity[1]	
Strategic Considerations		
Disassembly strategies – by territory, product type, level of disassembly		1
CLSC profits, revenues, and costs		3
CLSC facility process span		2
Total CLSC system transport cost & finite capacities of CLSC facilities		2
Longer financial planning horizon & more difficulties in capital budgeting		1
Create markets for non-profitable parts & materials		1
Number of lines and line mission -		5
Line design – straight, L-shaped, U-shaped, circular, line versus cell, etc.		5
Cooperation/communication/ between remanufacturers and OEMs		1
Totals		21
Market/Demand Considerations		
Uncertain market demand		5
Seasonal trends in demand		1
Condition of remanufactured products		2
Totals		8
Returned Product/Part Considerations		
One type of product, one family of similar products, or several types of products		1
Multiple products assigned to multiple lines		1
Uncertain return of products (arrival rate)		3
Quality of product arrivals		6
Percentage of parts disposed at collection center		2
Percentage of parts disposed at disassembly center before sending to plant	2	
Quantity of returned products		4
Defective parts-		
Removable defective parts		2
Non-removable defective parts (could result in product being removed from the line)		2
Cores disassembled to meet demand		1
Part selection based on CO_2 savings rate		1
Totals		25
Facility Considerations		
Finite facility capacities		3
Totals		3
Process Considerations		
Disassembly process sequencing		1
Alternative processing sequences		2
Use of automated disassembly – how and where		7
KANBAN disassembly process		2
Disassembly level – complete or partial		6
Online or offline disassembly		1
Infinite versus finite sources of parts and cores		2
Minimum release of part quantities from inventory		1
Imperfect manufacturing processes and yield loss –		2
Finite number of machines available to be assigned to work stations per run		2

Table 2: Classification and Analysis of Remanufacturing Disassembly Line Complexities

	Articles Addressing Complexity[1]
Output part quality and yield	2
Waste/scrap handling	2
Profit, revenues, or cost from disassembly line – profits from dissembled parts	2
Totals	32
Disassembly Line Considerations	
Paced or unpaced line	1
Balanced versus unbalanced line	1
Dynamically reconfiguring the line	1
Remedial/corrective line rebalancing after failure	1
Single, multiple, versus mixed-model operations	1
Maximum or minimum number of work stations	2
Allows station paralleling	1
Probability of line stoppage	1
Finite inventory capacities (# of parts in incoming, or parts inventory)	1
Infinite versus finite versus no buffer inventories – locations and capacities	5
Special tooling & limited equipment	2
Preferable, but uncertain line efficiency	1
Preferable, uncertain cycle times	4
Preferable, but uncertain number of work stations	1
Preferable by uncertain workload balance	2
Finite number of machines per type	2
Totals	27
Work Station Considerations	
Number of workers per station	1
One or two sided work stations	2
Variable work station speeds	2
Variable demand for parts at certain work stations	1
Fixed cost to establish or operate a work station	4
Task failures/work station reliability	6
Totals	16
Task Assignment and Time Considerations	
Variable task times (multiple deterministic, fuzzy, or stochastic task times)	16
Sequence dependent task times	6
Disassembly and destructive processing times	1
Work station cycle time constraints jointly satisfied with minimum probability	1
Task assigned to specific workstation For minimizing distance traveled, grouping certain tasks together, availability of special machinery or tooling, minimizing tool changes, or special handling of hazardous parts	4
Stakeholders considerations in task assignments	1
Balance idle time at each work station	30
Remove hazardous parts early	16
Remove high revenue parts early	1
Remove high demand parts early	14
Remove parts easily accessible & precede many others	2

Table 2: Classification and Analysis of Remanufacturing Disassembly Line Complexities

	Articles Addressing Complexity[1]
Disappearing work pieces	4
Parts skipping work stations	4
Self-skipping parts	4
Parts revisiting work stations	4
Exploding work pieces	4
Part direction changes	8
Totals	120
Worker Considerations	
Uncertain operator skill levels	1
Labor cost & labor cost per unit	2
Ergonomics, job design, and training for disassembly of valuable future products	2
Learning effects	1
Fuzzy workload balances	2
Totals	8
Scheduling Considerations	
Use of feeder lines	1
Scheduling multiple or mixed products across one disassembly line	5
Single or multiple products across multiple parallel disassembly and assembly lines or multiple mixed lines	3
On time delivery	1
Totals	10
Grand Total	270

[1.] An article may address more than one complexity
[2.] The number(s) in this column refers to the article(s) as numbered in Table 1.

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ANALYZING CONSUMER PURCHASE AND CONSUMPTION BEHAVIOR IN HIGH RISK FOODS

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ABSTRACT

According to the Centers for Disease Control and Prevention, one in six American become ill or die from foodborne contamination. Flaws in security, quality control, or transportation are some examples of how food may be accidentally or intentionally contaminated. In order to build a secure and resilient food supply chain network, food producers and manufacturers need to have the ability to assess contamination risk as a function of consumer behavior. Specifically, we explore the likelihood of being exposed to contaminated food product as a function of food choice, shopping frequency, and consumption patterns. Using the data from an IRB-approved survey, we characterize consumer risk by demographic information, food choice, shopping frequency, and consumption patterns. A logistic regression model is developed to determine the likelihood of purchasing certain foods that are more susceptible to contamination. The results of this research identify which factors are significant in predicting the likelihood an individual will experience foodborne illness.

INTRODUCTION

In 2011, approximately 48 million Americans became ill, 128,000 were hospitalized, and 3,000 died from contaminated food products [1]. Produce, baked goods, dairy, and meat carry the most risk of foodborne illness [2] and for this reason are denoted as high risk for foodborne illness (HRFI). On average, Americans consume 1.05 cups of fruit, 2.53 cups of vegetables, 1.77 cups of dairy, and 5.68 ounces of protein a day [3]. Several government agencies (i.e., USDA) collect nutrient intake data to track the amount of sugar, starch, vitamins, and minerals consumed in a day. However, this data does not track the source or specific type of food consumed. In addition, past research documents household purchases but not by food type from specific retail locations. [4].

We examine consumption trends of HRFI foods to quantify the likelihood of a food contamination outbreak. This knowledge will inform government agencies, healthcare

workers, and the public on response techniques to arrest the spread of a foodborne outbreak. Additionally, this study may offer critical insights on how to prevent foodborne illness outbreaks altogether by examining trends in purchasing and consumption behavior of the public. To accomplish our research objective, we developed a survey to collect HRFI food purchase and consumption behavior. We construct a statistical model to characterize consumer behavior based on demographic and geographic factors. The relationships generated from the model help identify populations at risk of HRFI food consumption.

LITERATURE REVIEW

The measurement of repeated behavior is often captured in surveys and summarized by frequency. Prior research has targeted different types of frequency studies related to food such as 1) food storage, 2) food preparation, 3) locations of shopping, and 4) number of meals. Collectively, all studies focused on either two points: intent of purchase or customer awareness. Daelman et al. used a survey to measure the frequency of consumer purchases in order to predict consumption. The probability of a product being consumed by an individual is based on the given frequency of purchase [5]. The results of this study revealed a direct correlation between purchase and consumption. This study also examined the effects of food contamination due to unsafe food preparation habits. The research of Daly et al. studied the link between food consumption and obesity. A survey was used to measure consumption frequency for 8 different food types[6]. This research identified food group levels, but did not establish a relationship between rate of purchase and location of consumption. However, Gomez et al. showed that the frequency of dairy consumption among a Spanish population is influenced by perceived healthiness, convenience, naturalness, nostalgia, ease to eat, and tastiness. The findings of this study focused on frequency, but did not relate purchasing frequency to the number of visits to the grocery store.

Kapinos and Yakusheva targeted young adults and their purchasing habits based on eating occasion, location, food purchase, and food purchase by store type. The study concluded that individuals make purchasing decisions based on food quality, pricing variety, availability, travel patterns, and social/cultural influences. Frequency of purchasing was measured by shopping visits in 14 days however; food types purchased during the visit were not measured. [8]. Longnecker, Harper and Kim established a trend among meal frequency to calorie intake [9]. The 1988 Nationwide Food Consumption Survey database of Americans monitored participants for 24 hours to quantify the total calories ingested. The study determines a relationship between meal frequency and calorie intake, but there is no consideration given to what items are being consumed.

METHODOLOGY

Survey design

The survey is designed to address the following objectives: (1) understand the frequency in which consumers shop; (2) know the items purchased on shopping visits; (3) identify whether consumers eat meals at home or outside of the home; and (4) understand the proximity of a consumer's home to their shopping location. A total of twenty-one questions are used to capture this information. Several questions (Table 2) within the survey were used to validate the responses received.

Question	Type of Response
Question 9: In the last 30 days, how many times have you been to the grocery store?	Any numerical value
Question 10: In the last 30 days, how many times did you buy the following food from the grocery store? (dairy, meat, vegetables, bread, baked desserts, and eggs)	Any numerical value
Question 13: Does your purchasing behavior in the last 30 days reflect what you do on a regular basis?	Yes or No

Table 1: Validation Questions

The validation questions insure consistency in behavior of surveyors, which is important because this study focused on shopping frequency. Surveyors with inconsistent shopping behavior are not used in the analysis. If a survey response to question 10 is greater than question 9 or the response to question 13 is no, the response is discarded. A discrepancy between questions 9 and 10 depict an irregular shopping behavior. Answering no to question 13 implies the shopping behavior reported is inconsistent. The survey responses are used to determine the frequency of purchasing high-risk foods, the time from purchase to consumption of these foods, number of meals consumed through different food distribution channels, and differences in these behaviors by socio-economic and demographic factors.

Statistical model

The data collected from the survey was analyzed using Logistic Regression. Logistic Regression Models are used to predict a discrete outcome from a set of predictors that can be a mix of continuous, discrete, or dichotomous variables (Tabachnick and Fidell, 2007). A Logistic Regression model is used in this research to identify the likelihood of a surveyor buying (represented by 1) or not buying (represented by 0) high risk food items. The independent variables are the frequency of going to the store, the buying habits of the customer, demographic information and proximity to the retail product store. The

probability of a consumer purchasing a high risk food can be estimated by equation (1), Where,$\boldsymbol{u = A + B_1X_1 + B_2X_2 + \cdots + B_kX_i}$.

$$\boldsymbol{\hat{Y}_\iota = \frac{e^u}{1 + e^u}} \qquad \textbf{(1)}$$

$\hat{Y}_i$ represents the estimated probability of the i^{th} case, A is a constant, X_j are the predictors and B_k are the coefficients. The logit form of equation (1) is called the log of the odds and is shown in equation (2).

$$\ln\left[\frac{\hat{Y}_i}{1-\hat{Y}_i}\right] = A + B_1X_1 + B_2X_2 + \cdots + B_kX_k \qquad (2)$$

While logistic regression is relatively unconstrained with respect to assumptions about the distribution of the predictors (e.g. predictors do not have to be normally distributed, linearly related, or of equal variance within each group), there are a number of practical issues that must be considered when validating the regression model such as over fitting, multicollinearity, absence of outliers and independence of errors (Tabachnik and Fidell, 2007). The survey is designed and administered so that responses are independent (given to a single individual at one time).

RESULTS

Purchasing behavior

There were 84 responses to the survey. However, only 33 responses satisfied the validation criteria for purchasing behavior. The majority of responses were from women (84%). A large number of respondents were married (53%), with income in the range of $50,000 to $149,00 (65%). The results of the survey show that households visit the grocery store an average of 7.63 times in a thirty day period.

Figure 1 shows the frequency in which items are purchased during these trips. Surveyors are less likely to purchase meat, dairy, vegetable, and eggs more than four times in thirty days. The purchasing trend of eggs was low occurring one time in thirty days.

Figure 1. Frequency of food purchases

Figure 2 illustrates the number of meals consumed outside of the home. Both figures show data skewed to the right indicating that among this sample, eating outside the home does not occur often.

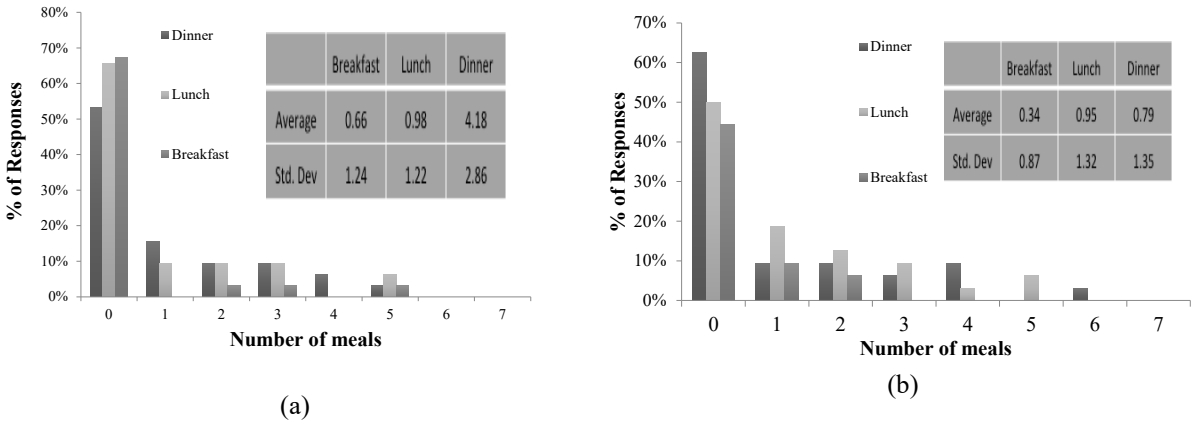

Figure 2. Number of meals purchased from (a) restaurants (b) fast-food establishments

The results of the survey showed that people are more likely to prepare dinner at home every night. On average 4.11 meals were prepared at home. Lunch and breakfast were less likely to be prepared at home.

The survey measured the types of foods consumed at restaurants and fast foods. Table 2 below displays the findings of the high-risk foods consumed. Dairy, veggies, and baked goods are not consumed as much, likely due to those items not typically being sold at fast

food places. Fast food was high for bread, meat and eggs. Restaurant consumption was high for dairy, meat, veggies, and baked goods.

	Fast Food %	Restaurant%
Dairy	8.33	10.86
Eggs	13.46	10.92
Meat	27.56	24.57
Vegetables	21.79	24.57
Bread	21.79	18.29
Baked Goods	7.05	11.43

Table 2: Fast Food vs. Restaurant Consumption

Consumption behavior

The results given for time until initial consumption varied based on the perishability or temperature sensitivity of food items. Vegetable, bread, and dairy had a high percentage of individuals consuming the food in zero to three days from initial purchase. The high percentages of consumption for vegetables, bread, and dairy relates to the rates of perishable food. Eggs are also a perishable item although surveyors did not consume eggs at the same rate as bread, vegetables, and dairy. The distribution of consumption of meat after purchase ranged from five to ten, and twenty days after purchase. Baked desserts had the smallest range. The highest average time until initial consumption occurs for meat products, as shown in Table 3. The results show that baked goods and dairy are the most likely to be consumed within the same day or two days after purchased. Meat has the most variation of consumption among the data. Collectively, the high risk foods are consumed within zero to eight days of purchase.

	Baked Desserts	Bread	Dairy	Eggs	Meat	Vegetables
Average	0.57	1.08	1.28	1.74	3.07	1.53
Standard Deviation	0.93	1.17	1.56	1.70	4.68	1.79
Coefficient of Variation	1.63	1.08	1.22	0.98	1.52	1.17

Table 3: Statistics on Time Until Initial Consumption

Logistic regression

A multinomial logistic regression was conducted to determine the likelihood that a person will purchase a food product a specific number of times. The outcome variable is ordinal since it represents the number of times a person purchased a particular product. The number of possible values for the outcome variable is based on the maximum value observed from the survey data. The data for the model was preprocessed to account for the missing information and lack of distribution among categories in survey data since

surveyors were not required to fill out all the demographic information. Levels within the data were combined based on analysis of the data.

The percentage of respondents that purchase each food type based on demographic factors indicate the following characteristics about purchasers:

- Mostly married women between the range of 25 to 44 years old;
- Seventy-five percent have a college degree;
- Thirty-five percent have an annual income in the range of $50,000 to $ 99,999;

Using SAS Enterprise Guide, a logistic regression was performed for each high risk food type. The classification of variables used in different sequences was zip code, race, education, marital status, and income. Three different models were run using different combinations of the classification variables which are described in Table 4.

Variables	Model 1	Model 2	Model 3
Zip Code	√		
Race	√	√	√
Education	√	√	
Marital Status	√		
Income	√	√	√

Table 4: Model Variables

Table 5 shows the probability for each model based on high risk food type. The *p*-value measures the value of the models in predicting effects of demographic information using ordinal logistic regression. Models 1 and 2 for dairy and meat, and Model 2 for vegetables satisfy the assumptions for the ordinal regression model since the *p*-values are greater than the significance level of *0.05*.

Score Test of Proportional Odds			
	Model 1	Model 2	Model 3
Baked Goods	<.0001	<.0001	<.0001
Bread	<.0001	0.0053	0.0066
Dairy	**0.9894**	**0.7254**	0.0004
Egg	0.008	<.0001	<.0001
Meat	**0.1371**	**0.1747**	0.0172
Vegetables	**0.9886**	<.0001	<.0001

Table 5: Purchasing Model and Classification Variables

The models for the high risk foods egg, bread, and baked goods did not meet the assumptions of the ordinal model. All of the models showed a quasi-separation of data points due to the response by surveyors to purchasing or not purchasing being limited.

Table 6 shows the result of the logistic regression model for Dairy products for Model 1. Table 6 shows there is one predictor that has an effect on purchasing dairy in thirty days. The predictor marital status has a weak relationship to purchasing dairy in thirty days based on the low chi-squared value.

Model 1			
Effect	DF	Chi-Squared	PR>Chi-Squared
Education	3	5.9870	0.1122
Income	4	7.2539	0.1231
Marital Status	2	8.1736	**0.0168**
Race	2	6.0169	0.0494
Zip Code	3	6.2823	0.0987

Table 6: Chi-square Comparison Dairy

Table 7 shows the results of the logistic regression model for vegetable products. The results show that the predictors marital status, race and income have an effect on purchasing vegetables. The higher chi-squared value with income and marital status shows a stronger relationship between purchasing vegetables at the store in thirty days. Race has a high value for the chi-squared value but numerically the relationship is not as strong as marital status, and income.

Model 1			
Effect	DF	Chi-Squared	PR>Chi-Squared
Education	3	8.7362	0.0330
Income	4	20.3510	0.0004
Marital Status	2	20.4544	<.0001
Race	2	13.3621	0.0013
Zip Code	3	10.2165	0.0168

Table 7: Chi-Squared Results for the Model for Vegetables

CONCLUSIONS AND FUTURE WORK

Food is a needed source of energy and nutrients. The majority of foods eaten on a daily basis are high risk foods. Contamination in any of the high risk foods can result in significant health risks. A model to analyze the impact of a contamination outbreak on the general public has the potential to save lives. The model can be used as a warning tool to identify whom is affected by contamination based on geographic and demographic information. The study has produced a method to quantify a way to distinguish purchasing and consumption of high risk foods. Intentional and unintentional contamination of food

occurs on a regular basis. Understanding purchasing and consumption habits will provide consumers a targeted alert and response for a food contamination epidemic. The study related demographic information to purchasing and consumption habits.

The present study has demonstrated that only a few demographic factors are significant to particular high risk food groups. The results of the significant factors are not conclusive to make a generalization on the entire population of United States. The results are inconclusive based on the lack of diversity in demographics and number of responses. The survey received 84 responses. The number of responses for purchasing behavior was reduced to 33 once the validation of the data was completed. In both data set collections, the majority of the respondents are female and married. Literature is limited in purchasing and consumption of high risk foods for a diverse population. There has been no study that looks into demographics as a factor in consumption and purchasing behavior in relation to the likelihood of consuming or purchasing a contaminated product. The current study is analyzing important factors in order to identify a trend in behaviors of purchasing and consumption. The future work of the study is to address the limited data by redistributing the survey. A partnership with a third party will yield a larger collection of data. The demographic categories will be analyzed to find the risk factors that contribute to food purchases and consumption. The removal of the limitations of this study will reveal conclusive results to generalize for an entire population.

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Deterministic Dynamic Lot-Sizing Problems: Inventory Balance Formulations and Extensions

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Abstract

Dynamic lot sizing problem aims to plan the production and distribution of products. In this paper, a generic deterministic dynamic lot sizing problem and its extensions are presented considering productions, inventories, capacities, bill of materials, lead time, back-order, re-manufacturing, supply, and transportation issues. This paper does not exhaust the literature and exclude the solution methods form the paper. We conclude the paper on future directions for the research in dynamic lot sizing.

Keywords: Dynamic Lot Sizing, Inventory, Production, Transportation, Supply Chain, Lead Time, Backorder, Bill of Material

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FACILITY LOCATION/ALLOCATION AND ROUTING DECISIONS USING GOAL PROGRAMMING MODEL AND DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Contrary to the traditional models for the strategic facility location/allocation and routing (FLAR) decisions focusing primarily on cost-efficiency, we introduce an efficiency-driven approach to FLAR decision under the risk of disruptions using data envelopment analysis (DEA) approach. We consider multi-objectives of minimizing the total relevant costs and total routing distance and of maximizing the total amount of covered demand. Combining a goal programming (GP) model with a concept of efficiency score generated by DEA, we propose an innovative procedure for finding the most efficient FLAR decisions. We conduct a case study to evaluate the proposed procedure and demonstrate that our proposed procedure performs very well and can help the practitioners and decision-makers to evaluate FLAR decisions fairly.

Keywords: Facility Location/Allocation and Routing, Risk of disruptions, Data Envelopment Analysis, Goal Programming Model

INTRODUCTION

Due to today's globalized, more complex supply chain systems, and highly-uncertain business environment, supply chains have become susceptible to disruptions (see Peng et al. [14]). A significant stream of research on supply chain network structure related to disruption management focuses on facility location/allocation and routing (FLAR) decisions. As a result, FLAR decisions under disruption risks have received increasing attention and have become one of the main issues in the area of logistics and supply management. FLAR decisions inherently consist of two kinds of decision plans. One is a strategic decision plan on the facility location, while the other one is an operational decision plan on the allocation of the facility to the customers and on the routing decision. The routing decision includes (see Daskin [2]) (i) which customers to assign to which routes and (ii) in what order customers should be served on each route. The traditional models for the strategic FLAR design focused primarily on cost-efficiency, assuming that the facilities are supposed to work and ignoring the fact that the facilities are under the risk of disruptions.

As Nagy and Salhi [13], who survey the state of the art in FLAR, stated, facility location/allocation (FLA) and routing are interrelated areas. Maranzana [12] points out that "the location of factories, warehouses and supply points in general … is often influenced by transport costs." Rand [15] insists that "many practitioners are aware of the danger of sub-optimizing by separating depot location and vehicle routing." But both academics and practitioners often solve facility location-allocation problems, without consideration of underlying routing. In fact, various types of FLA models have been developed to answer the questions simultaneously such as how many facilities to locate, where to locate facilities, and how to distribute the items to the customers concerning

different location criteria, assuming all customers are directly linked to a facility. Thus, FLAR models are clearly and simultaneously related to FLA problems and routing problems. Schneider and Drexl [16] define the standard FLAR as a deterministic, static, discrete, single-echelon, single-objective FLAR problem in which each customer must be visited exactly once for the delivery of a good from a facility, and in which no inventory decisions are relevant. They review the literature on the standard FLAR literature published since the survey by Nagy and Salhi [13]. Following Schneider and Drexl [16], Drexl and Schneider [3] discuss variants and extension of the standard FLAR, which include problems with stochastic and fuzzy data, multi-period planning horizon, continuous location in the plane, multi-objective, more complex requests or route structures, such as pickup-and-delivery requests or routes with load transfers, and inventory decisions.

As many references cited in Current et al. [1], Farahani et al. [5&6], Fang and Li [4], and Manzini and Gebennini [11] demonstrate, the FLA problems are inherently multi-objective, where those objectives sometimes conflict with each other in nature (see Lee et al. [10]). The traditional FLAR models deal with the objective of cost-minimization, whereas demand-oriented objectives focus on measuring the 'proximity or closeness' of the facilities. The profit maximization objective may be achieved by either cost minimization or maximization of demand satisfied/covered, or both. Current et al. [1] emphasize the importance of multi-objective facility location-allocation (MOFLA) problems after observing the substantial growth of the literature on MOFLA problems. Thus, the growing attention and interest in these problems are due to the recognition of the need to consider more objectives/criteria to achieve closer solutions to reality.

Multi-objective programming (MOP) technique provides an analytical framework where a variety of objectives can be focused on simultaneously so that a decision maker can use to provide optimal solutions. But most of the MOP techniques require decision-makers' judgment to provide weights to the deviational variables in the objective function to appropriately reflect the importance and desirability of deviations from the various target values. As the number of performance measures increases, solving the MOP model will yield a great number of alternative options. The reason is that each different weight factor set for performance measures may generate a different option. But no standard procedure is available to assign values to the weight factors in a way that guarantees the decision-makers find the most desirable solution. Evaluating alternatives generated by solving MOP model can be viewed as a multiple-criteria decision-making (MCDM) problem, requiring a systematic solution evaluation system.

When the facilities are under the risk of disruptions, the expected demand covered/satisfied (*EDC*) would be one of the most important outputs. Contrary to the conventional total cost minimization approaches, we will formulate the FLAR problem as the goal-programming (GP) model with the objective of simultaneously maximizing *EDC* and minimizing the total relevant cost (*TRC*) and total routing distance (*TRD*). Solving the GP model with these three performance measures will generate a number of alternative options as the weight given to each performance measure. The subsequent question is which option is the most efficient one. Regarding efficiency, we generally define the efficiency to be the ratio of a single output to a single input. This paper utilizes data envelopment analysis (DEA) methodology, which yields relative efficiency scores (ESs) of comparable units, decision-making units (DMUs) employing multiple outputs and inputs. To denote the relative efficiency for each DMU, DEA produces an ES that is defined as the ratio of the sum of weighted outputs to the sum of weighted inputs. The proposed procedure is different

from the approach of Klimberg et al. [9], in that we generate the inputs and outputs of DMUs directly by solving GP model for various values of weight factor, whereas Klimberg et al. [9] assume those inputs and outputs are known.

The objective of this paper is to present and demonstrate how to combine DEA technique and GP model for the efficient FLAR decisions and patterns to help practitioners as well as decision-makers who are responsible for the strategic and operational decision plans. We solve the FLAR problem for various values of weights given to the performance measures, *EDC*, *TRC*, and *TRD*. Considering each generated alternative option for a given set of weight as a DMU, we evaluate all alternative options by utilizing DEA techniques to find the efficiency of each DMU and identify the most relatively efficient FLAR schemes. In this way, decision-makers evaluate and identify efficient and robust FLAR decisions without any subjective judgment. Furthermore, once decision-makers identify efficient FLAR patterns through the proposed procedure, they can modify their operational decisions without sacrificing the efficiency heavily under unexpected disruptions. We demonstrate our procedure through a case study.

BACKGROUND

To accommodate the three goals in one objective function, we use a goal programming (GP) approach as a tool for designing the effective FLAR. The typical GP model allows the decision maker to assign weights to the deviational variables in the objective function to better reflect the importance and desirability of deviations from the various goals. See Hong [8] for detailed equations and goal programming model.

DEA is an approach for identifying best practices of peer decision-making units (DMUs) in the presence of multiple inputs and outputs. DEA allows each DMU to be evaluated with its most favorable weights due to its nature of the self-evaluation. Phase 1 is the self-evaluation phase where DEA scores are calculated. In the second phase, the multipliers arising from phase 1 are applied to all DMUs to get the cross-evaluation score for each of DMUs (see Zhu [18]).

Performance evaluation or measurement often depends upon by the context. One could ask "what is the relative attractiveness of a particular DMU when compared to others?" Following in this vein, Seiford and Zhu [17] propose the context-dependent/stratification DEA method to measure the attractiveness score and progress of DMUs on a given evaluation context. For this, they stratify DMUs into different efficiency levels. Zhu [18] shows how to compute the attractiveness score for each DMU in the ℓ^{th} stratification (E^{ℓ}) against DMUs in the $(\ell+1)^{th}$and lower levels as the evaluation context. In this way, the context- dependent DEA can have more discriminating power on each stratification level. Then, we compute the average attractiveness score (AAS) for DMU_q in E^1. We adopt the DEA-based stratification method as well as the cross-efficiency method to find the most efficient FLAR schemes.

NUMERICAL EXAMPLE AND OBSERVATIONS

To demonstrate the applicability of the mathematical model and the proposed framework to evaluate FLAR schemes, we show a numerical example using the case study that Hong [7] conducts for locating disaster recovery centers (DRCs) to help South Carolina flood survivors in

2015. They utilize the Federal Emergency Management Agency (FEMA) database which shows the major natural disaster declaration that South Carolina has experienced. The database also provides a list of counties where a major disaster was declared. Hong [7] assumes that when a major disaster is declared, the facility in that county is damaged and shut down. They choose one city from each clustered county based on a centroid approach and assume that all population within the clustered county exists in that city. Based on the historical record and the assumption, the risk probabilities, p_j, for each site (a county or a clustered county) are calculated. In this paper, we select and use the ten (10) sites out of twenty (20) sites and list those sites along with demand, risk probability, and fixed cost for constructing and operating facility at each site. For our numerical example, we hypothetically predetermine and list other input parameters in Table 2.

We solve the GP model for various values of $\boldsymbol{\alpha}$, where each weight changes between 0 and 1 with an increment of 0.1. There are sixty-six (66) configurations arising out of the combinations of the setting of $\boldsymbol{\alpha}$. After 66 runs, we reduce 66 configurations into eleven (11) consolidated configurations, based on the values of the performance measures. In Table 3, we report these schemes along with the values of three performance values, *EDC, TRC,* and *TRD*, and corresponding values of efficiency score, cross efficiency score, and AAS. In Table 4, we present the location-allocation-routing for DRCs for the four (4) efficient schemes shown in Table 3. We depict these four schemes in Figure 1.

From Table 3, we see that the scheme #2 with the perfect ES of 1.000, the second highest CES of 0.941, and the highest AAS of 1.958 generates 1,517, $1,906.18, 680 as the optimal values of *EDC*, *TRC*, and *TRD*, respectively. From Table 4 and Figure 1, the optimal locations of two DRCs for the #2 are {Anderson, Beaufort} and the optimal allocation-routing sequence (ARS) from DRC {Anderson} is {Anderson-Greenwood-Lexington-McCormick-Anderson} or just a reverse sequence, that is, {Anderson-McCormick- Lexington-Greenwood-Anderson}. The optimal ARS from the other DRC {Beaufort} is {Beaufort-Hampton-Bennettsville-Conway-Georgetown-Moncks Corner-Beaufort} or a reverse sequence of it. The scheme #19 with the perfect ES of 1.000, the highest CES of 0.984, and the second highest of 1.854, finds {Anderson, Hampton} as the locations of DRCs. Note that the optimal routing sequences of the two most efficient schemes, #2 and #19, are same except the location of one DRC, as the same *TRDs* of the two schemes indicate. The other two efficient schemes #26 and #57 also find {Anderson, Hampton} as the locations of DRCs as the scheme #19 finds. As shown in Figure 1, these two schemes generate higher *TRDs,* but lower *TRCs* and higher *EDCs* than #19.

Table 1. Data for Facility Location-Allocation-Routing Problem

No	City	County	POP, D_m (K)	p_j	f_j ($K)
1	Anderson	Anderson/Oconee/Pickens	373	0.125	800
2	Beaufort	Beaufort/Jasper	187	0.063	950
3	Bennettsville	Marlboro/Darlington/Chesterfield	96	0.375	750
4	Conway	Horry	269	0.375	600
5	Georgetown	Georgetown/Williamsburg	93	0.438	650

6	Greenwood	Greenwood/Abbeville	92	0.125	900
7	Hampton	Hampton/Allendale	33	0.188	600
8	Lexington	Lexington/Newberry/Saluda	318	0.313	850
9	McCormick	McCormick/Edgefield	35	0.250	800
10	Moncks Corner	Berkeley	178	0.313	700

Table 2. Input Data Used for the Case Study

Symbol	Meaning	Value
b_j	A minimum number of sites that facility j can cover	2, $\forall j$
B_j	A maximum number of sites that facility j can cover	6, $\forall j$
CAP_j^{max}	Capacity for facility j	1,000, $\forall j$
F^{max}	Maximum number of DRCs to be built	2
ℓ	Unit penalty cost for the demand uncovered/unsatisfied	$1.00

Table 3. Numerical Results

Scheme	EDC	TRC	TRD	ES	CES	AAS
1	1,526	$1,897.37	1,682	0.934	0.854	N/A
2	1,517	$1,906.18	680	1.000*	0.941	1.958*
11	1,303	$1,870.18	680	0.868	0.822	N/A
12	1,526	$1,897.37	1,562	0.934	0.860	N/A
19	1,410	$1,663.18	680	1.000*	0.984*	1.854
22	1,526	$1,897.37	1,260	0.935	0.880	N/A
26	1,419	$1,654.36	925	1.000*	0.956	N/A
31	1,484	$1,739.96	1,250	0.990	0.925	1.444
39	1,484	$1,739.96	1,327	0.990	0.919	N/A
57	1,422	$1,651.71	1,183	1.000*	0.934	1.246
66	1,232	$1,641.12	1,586	0.872	0.791	N/A

Table 4. Location-Allocation-Routing for Efficient Schemes

Scheme	DRC	Site 1	Site 2	Site 3	Site 4	Site 5
2	***Anderson***	Greenwood	Lexington	McCormick		
	Beaufort	Hampton	Bennettsville	Conway	Georgetown	Moncks Corner
19	***Anderson***	Greenwood	Lexington	McCormick		
	Hampton	Beaufort	Moncks Corner	Georgetown	Conway	Bennettsville
26	***Anderson***	Bennettsville	Conway	Georgetown	McCormick	Greenwood
	Hampton	Beaufort	Moncks Corner	Lexington		
57	***Anderson***	Lexington	Bennettsville	Moncks Corner	McCormick	
	Hampton	Beaufort	Georgetown	Conway	Greenwood	

In this paper, *TRD* is regarded as an independent performance measure and could be considered a component of *TRC* if the shipping cost per mile, *c*, is fixed or known. Now, let TRC' denote the *TRC* plus total shipping cost (*TSC*), which is given by

$$TRC' = TRC + c * TRD. \quad (1)$$

Then, we may compare the ratio of *EDC* to TRC', which is called an efficiency (or a productivity), for the schemes. That is,

$$Eff = \frac{EDC}{TRC'}. \quad (2)$$

Note that the *TRC* is affected by the amount of ℓ, the unit penalty cost for the demand uncovered/unsatisfied. In Table 5, we compute *Eff* in (2) for several values of *c* and ℓ for the FLAR schemes in Table 3. The two highest values of *Eff* are denoted by '*'. We observe that the two most efficient schemes generated by GP and DEA, #2 and #19, always produce a higher *Effs* than any other schemes. As ℓ increases, the scheme #2, yielding a higher *EDC* than #19, yields a higher value of *Eff* than #19. Note that an increase in the unit shipping cost, *c*, does not affect the order of *Effs* for the #2 and #19 due to the same *TRDs* of 680. Two other efficient schemes, #26 and #57, generated by GP and DEA, do not hold the third and fourth positions as *c* and/or ℓ increase.

SUMMARY AND CONCLUSIONS

In this paper, we study a facility location-allocation-routing (FLAR) design problem under the risk of disruptions. We consider three major performance metrics: the expected demand covered/satisfied (*EDC*), the total relevant cost (*TRC*) and the total routing distance (*TRD*). We develop a GP model for the FLAR problem, simultaneously considering these three performance measures. Considering *EDC* as an output and *TRC* and *TRD* as two inputs, several DEA techniques, such as m-DEA, DEA-based stratification/context-dependent DEA method, and cross-efficiency methods, are applied to find the efficient and the most efficient FLAR network schemes among various alternatives generated by solving the GP model. Using a case study, we observe that the proposed procedure of combining the GP model and DEA methods works very well, regarding identifying efficient schemes. The proposed approach to the FLAR design problem would provide many insights to practitioners as well as researchers.

For future research, it would enhance this research if the concept of backup facilities for the case of shutdown of the facility is considered. That is how to mitigate the impact of disruptions on the supply chain network system. In this paper, we assume all the routes are 100% reliable. In reality, the roads in the routes are not 100% reliable. Thus, it would surely enhance this research if the risk probabilities of routes are also considered simultaneously. It would also be interesting to include other goals, such as minimizing the maximum coverage distance on the route and minimizing the maximum demand-weighted coverage distance.

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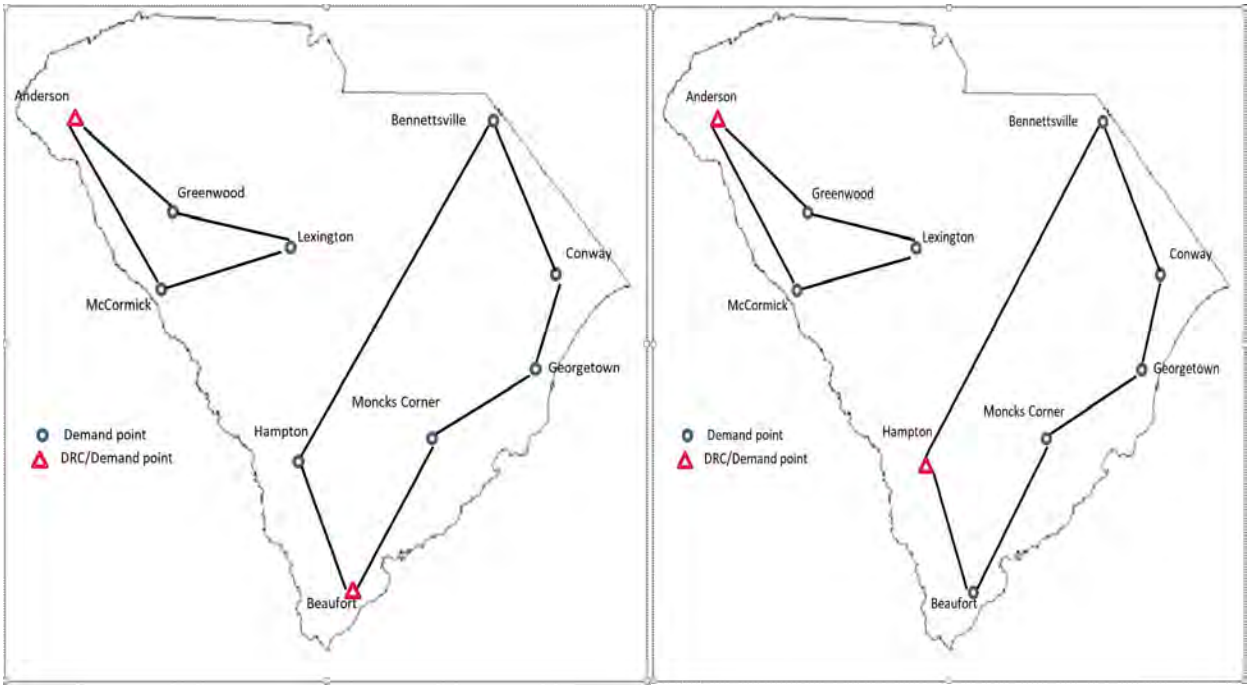
Table 5. Comparison of Efficiency

		c	ℓ	**c**	ℓ	**c**	ℓ	**c**	ℓ
		$ 0.50	$ 0.50	$ 0.50	$ 1.00	$ 0.50	$ 2.00	$ 0.50	$ 3.00
Scheme	EDC	TRC'	Efficiency	TRC'	Efficiency	TRC'	Efficiency	TRC'	Efficiency
1	1526	$ 2,664.37	0.573	$ 2,738.37	0.557	$ 2,886.37	0.529	$ 3,034.37	0.503
2	1517	$ 2,167.68	0.700*	$ 2,246.18	0.675*	$ 2,403.18	0.631*	$ 2,560.18	0.593*
11	1303	$ 2,024.68	0.644	$ 2,210.18	0.590	$ 2,581.18	0.505	$ 2,952.18	0.441
12	1526	$ 2,604.37	0.586	$ 2,678.37	0.570	$ 2,826.37	0.540	$ 2,974.37	0.513
19	1410	$ 1,871.18	0.754*	$ 2,003.18	0.704*	$ 2,267.18	0.622*	$ 2,531.18	0.557*
22	1526	$ 2,453.37	0.622	$ 2,527.37	0.604	$ 2,675.37	0.570	$ 2,823.37	0.540
26	1419	$ 1,989.36	0.713	$ 2,116.86	0.670	$ 2,371.86	0.598	$ 2,626.86	0.540
31	1484	$ 2,269.96	0.654	$ 2,364.96	0.627	$ 2,554.96	0.581	$ 2,744.96	0.541
39	1484	$ 2,308.46	0.643	$ 2,403.46	0.617	$ 2,593.46	0.572	$ 2,783.46	0.533
57	1422	$ 2,117.21	0.672	$ 2,243.21	0.634	$ 2,495.21	0.570	$ 2,747.21	0.518
66	1232	$ 2,213.12	0.557	$ 2,434.12	0.506	$ 2,876.12	0.428	$ 3,318.12	0.371

		c	ℓ	c	ℓ	c	ℓ	c	ℓ
		$ 1.00	$ 0.50	$ 1.00	$ 1.00	$ 1.00	$ 2.00	$ 1.00	$ 3.00
Scheme	EDC	TRC'	Efficiency	TRC'	Efficiency	TRC'	Efficiency	TRC'	Efficiency
1	1526	$ 3,505.37	0.435	$ 3,579.37	0.426	$ 3,727.37	0.409	$ 3,875.37	0.394
2	1517	$ 2,507.68	0.605*	$ 2,586.18	0.587*	$ 2,743.18	0.553*	$ 2,900.18	0.523*
11	1303	$ 2,364.68	0.551	$ 2,550.18	0.511	$ 2,921.18	0.446	$ 3,292.18	0.396
12	1526	$ 3,385.37	0.451	$ 3,459.37	0.441	$ 3,607.37	0.423	$ 3,755.37	0.406
19	1410	$ 2,211.18	0.638*	$ 2,343.18	0.602*	$ 2,607.18	0.541*	$ 2,871.18	0.491*
22	1526	$ 3,083.37	0.495	$ 3,157.37	0.483	$ 3,305.37	0.462	$ 3,453.37	0.442
26	1419	$ 2,451.86	0.579	$ 2,579.36	0.550	$ 2,834.36	0.501	$ 3,089.36	0.459
31	1484	$ 2,894.96	0.513	$ 2,989.96	0.496	$ 3,179.96	0.467	$ 3,369.96	0.440
39	1484	$ 2,971.96	0.499	$ 3,066.96	0.484	$ 3,256.96	0.456	$ 3,446.96	0.431
57	1422	$ 2,708.71	0.525	$ 2,834.71	0.502	$ 3,086.71	0.461	$ 3,338.71	0.426
66	1232	$ 3,006.12	0.410	$ 3,227.12	0.382	$ 3,669.12	0.336	$ 4,111.12	0.300

Figure 1: Efficient Facility Location-Allocation-Routing Network Schemes

(Scheme #2) (Scheme #19)

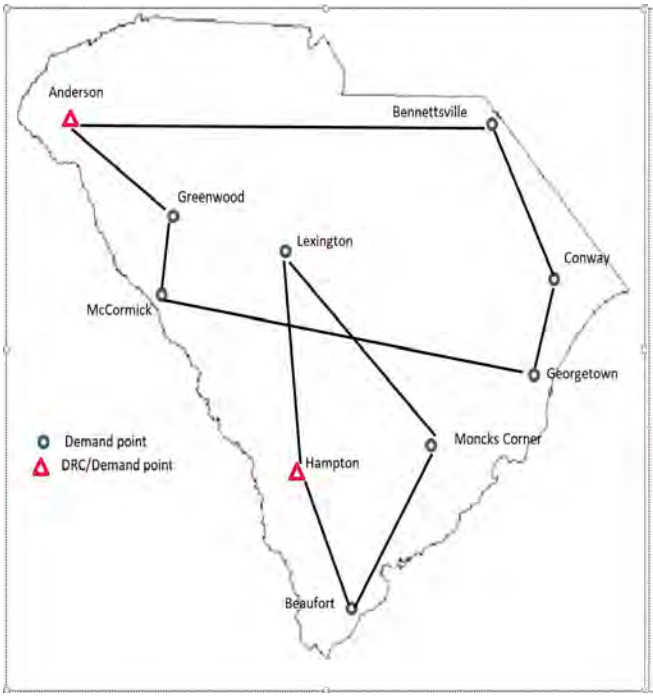


(Continued on next page)

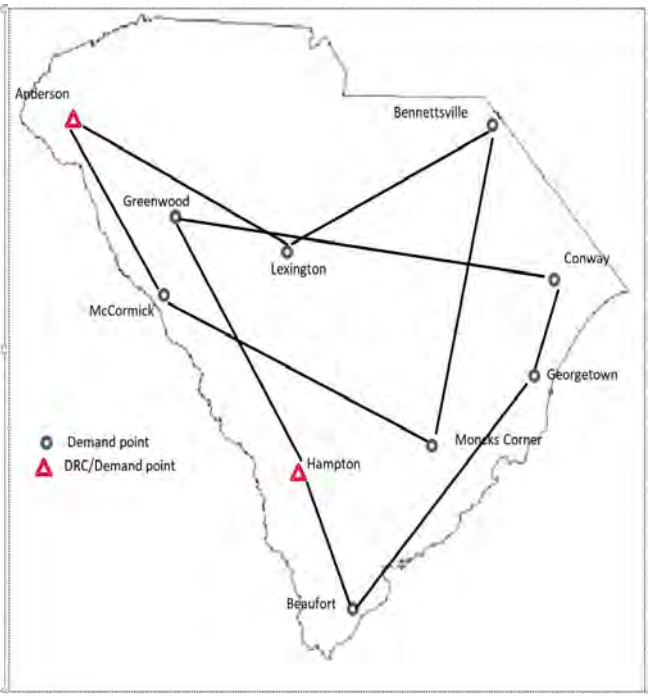
Figure 1: Efficient Facility Location-Allocation-Routing Network Schemes

(Continued from the previous page)

(Scheme #26)



(Scheme #57)



LINKING STRUCTURE, DYNAMIC CAPABILITIES AND PERFORMANCE IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

This paper investigates a framework that portrays firm performance as an outcome of appropriate alignment between a firm's structural choice of placing the top supply chain management (SCM) executive at a higher hierarchical position, supply chain alertness and supply chain agility. The results from a sample of 121 firms provide statistically significance evidence for the contention that a firm that places the top SCM executive at a higher hierarchical position, develops better alertness to identify changes for SCM and operations, and then use these identified changes to implement and execute agility-embedded practices will experience higher levels of firm performance.

1. INTRODUCTION

To ensure that challenges in today's turbulent environment are effectively addressed, a firm's supply chain management (SCM) must emphasize developing dynamic capabilities in the form of alertness and agility (Li et al., 2008; Li et al., 2017). Supply chain alertness and agility are based on the supply chain's capability to rapidly identify and respond to sudden changes in demand or supply (Li et al., 2008). To date, researchers have found that change-dealing capabilities lead to performance enhancements when these capabilities are properly arranged into a series of bundled routines, and organizational structure serves as an important means for institutionalizing these capability-embedded routines (Romme, 2003; Teece, 2007). Understanding the structural drivers of supply chain alertness and agility is thus critical for advancing SCM theory relating to these outcomes.

As SCM has been recognized as a source of competitive advantage, a phenomenon regarding the structure of SCM organization is emerging: more and more firms are placing SCM executives in the organizational upper echelons with positions at the senior vice president and executive vice president levels (Groysberg et al. 2011). Although existing studies on the effect of designating a top SCM executive to top management teams have identified the important role of this structural change in influencing SCM (Hendricks, et al., 2015; Li et al., 2019; Roh et al., 2016), we know little about how this structural choice drives supply chain alertness and agility. This gap is surprising given that supply chain alertness and agility are critical to firms in creating and sustaining competitive advantage.

To close this gap in the literature, this study empirically examines the relationships among the hierarchical position of a firm's top SCM executive, supply chain alertness, supply chain agility,

and firm performance. Our article proceeds as follows. In section 2, we review the literature on the structural choice of placing top SCM executives at higher hierarchical positions, supply chain alertness and agility. Building on the literature, we develop theoretical hypotheses linking theses constructs. In section 3, we describe the empirical study, the methodology for hypothesis testing, and testing results. We conclude this paper in section 4.

2. HYPOTHESIS DEVELOPMENT

Organizational structure is the way responsibility and power are allocated, and work procedures are carried out, among organizational members (Germain, 1996; Gerwin and Kolodny, 1992). The placement of top SCM executives to a higher hierarchical position is a strategic structural change, which elevates the power and the role of SCM in value-creating SCM activities (Wagner and Kemmerling, 2014). For example, in 2008, Starbucks Corporation promoted Peter Gibbons to the position of executive vice president of global supply chain operations. Gibbons identified cost inefficiencies in the supply chain and saw that less than half of the goods were being delivered to its stores on time because of the nature of outsourcing agreements with contract manufacturers and third-party logistics Reorganizing the supply chain under Gibbons' direction helped to reduce transportation costs and lead times (Cooke 2010).

Supply chain alertness refers to a firm's capability to detect changes in a timely manner, either from the external macro-business environment or from its current supply chain operations (Li *et al*., 2008, 2017). A firm needs to be able to identify strategic changes that affect their supply chains, including economic progress or difficulties, political and social change, demographic trends, technological advances, threats and opportunities in the marketplace and among competitors (Christopher and Holweg, 2011; Christopher and Ryals, 2014). At the supply chain operational level, firms with alertness have better supply chain visibility and warning capability. Supply chain alertness is vital for supply chain visibility, whereby a firm can see goods and information flows from one end of the supply chain to the other (Christopher and Peck, 2004). Supply chain visibility is crucial to alleviate the negative impact of the bullwhip effect (Lee *et al*., 1997). Warning capability plays an important role in reducing the severity of supply chain disruption (Craighead *et al*., 2007). By virtue of identifying operational risks in a timely manner, alertness reduces potential financial losses caused by the bullwhip effect in supply chain disruptions.

Supply chain agility refers to the capability of a supply chain to respond to actual changes in a timely manner by adapting supply chain processes (Lee, 2004). Supply chain agility manifests in an adaptation capability that allows implementation of different processes and application of different facilities to achieve the same goals (Swafford *et al*., 2006). In addition, the concept of speed is inherent to supply chain agility (Manuj and Mentzer, 2008).

The hierarchical position of top SCM executives can contribute to supply chain alertness, and supply chain agility in four aspects. First, the first core responsibility of top SCM executives is to serve as the functional leader of the SCM organization. With a supply chain executive positioned to a higher hierarchical level that can oversee "whole chain" processes, the firm will be more alert to changes arising from end-to-end supply chain operations.

Second, sitting at a higher hierarchical position, top SCM executives are charged with developing domain expertise, as well as setting a shared vision and agenda for sub-functions under the supply chain organizational umbrella (Wagner and Kemmerling, 2014), which requires top SCM executives to continuously identify changes in macro-business environment and develop agile supply chain in response to those changes that support the goals of the firm's businesses and the larger enterprise.

Third, being placed at a higher hierarchical position, top SCM executives need to develop strategic partnerships with the business units that the SCM organization supports (Demeester et al., 2014). In this boundary spanning role, top SCM executives and other business leaders are co-creators in the formulation of business strategy, policies, and processes. Thus, collectively, business leaders and top SCM executives can make the business case for investments and resources to build SCM effectiveness on supply chain dynamic capabilities, such as supply chain agility.

Forth, Supply chain agility requires efficiency and effectiveness in supply chain integration, collaboration and risk management (Braunscheidel and Suresh, 2009). Placing the top SCM executive to a higher position can contribute to supply chain integration, collaboration and risk management. A highly-placed SCM executive can better translate business requirements into supply chain actions, and supply chain constraints and sensitivities into meaningful business terms than he or she could from outside the top management team (Groysberg et al., 2011). A successful SCM executive secures buy-in from, and alignment with, the other subunits, thereby building an operating governance across the diverse membership and boundaries to get tasks accomplished (Demeester et al., 2014).

Based on above discussion, we advance the following hypotheses:

H1: *The hierarchical position of top SCM executive is positively related to a firm's supply chain alertness.*

H2: *The hierarchical position of top SCM executive is positively related to a firm's supply chain agility.*

A firm's supply chain agility is concerned with being able to create value by taking advantage of business opportunities, maintaining congruence with a turbulent environment, sustaining competitiveness, and ultimately surviving (Swafford et al., 2006). These identified changes in external business environment through supply chain alertness provides firms with an orientation toward adapting supply chains to structural shifts in the marketplace and, thus, sustain their wealth creating performance (Brandon-Jones *et al*., 2014). If companies cannot identify these changes in a timely manner and adapt their supply chains correspondently, they will not stay competitive for very long (Sambamurthy et al., 2003; Lee, 2004).

Supply chain alertness is also developed in a set of organizational practices that exhibit demand and supply change tracking in supply chain operations. Operational alertness is key indicator for a supply chain's capability to deal with emergencies in supply. Li et al (2017) implies that supply chain alertness has become more critical in the past few years because sudden shocks to supply

chains have increased in frequency. While the threat from natural disasters, terrorism, wars, epidemics, and computer viruses has intensified in recent years, partly because supply lines now traverse the globe, Pettit et al (2013) pointed out that most supply chains are incapable of coping with emergencies because they cannot detect them in time. Therefore, we advance the following hypothesis:

H3: *Supply chain alertness is positively related to a firm's supply chain agility.*

From the above discussion, we also can assert that supply chain alertness is the precursor of supply chain agility. It is through watching and tracking changes that SCM executives find initiatives and directions for adapting SCM and operations in an agile response. Thus, we have the following hypothesis:

H4*: Supply chain alertness mediates the linkage between the hierarchical position of top SCM executive and supply chain agility.*

Prior studies have shown that supply chain agility exerts positive influence on a firm's financial performance (Li et al., 2015). Following the existing literature, we advance the following hypothesis:

H5: *Supply chain agility exerts positive influence on firm performance*

3. RESEARCH METHOD

3.1. Sample

Our data was collected from surveys that were administered to firms on the the membership list of the local chapter of the Association for Operations Management (APICS) located in a large Midwestern city in U.S.A. In sum, 121 useable surveys were returned.

3.2. Measures

Hierarchical position of top SCM executive. We measure the hierarchical position of the highest-ranked SCM executive on the proximity of his/her hierarchical position to the CEO. Those executives with fewer layers between themselves and the CEOs were thought to have greater power than those with more hierarchical layers separating themselves from their CEOs.

Supply chain alertness and supply chain agility. We assessed supply chain alertness along 5 items adapted from the instrument developed by Li et al. (2017), and assessed supply chain agility along 7 items adapted from the instrument developed by Swafford et al. (2006). Respondents answered on a 7-point scale (1=incapable, 7=extremely capable).

Firm's financial performance: Following the literature (e.g., Narasimhan and Kim, 2002), we asked respondents to provide scores for 3 items on a 7-point scale (1=well below industry average, 7=well above industry average).

3.3. Results of Hypothesis Testing

The structural equation path model fit the data fairly well: $\chi^2 = 13.24$, $p < .001$; CFI = .94; TLI = .87; SRMR = .06. As can be seen in Figure 2, the top SCM executive's hierarchical position positively influenced supply chain alertness ($b = .19$, $SE = .04$, $p < .001$) and positively influenced supply chain agility ($b = .12$, $SE = .04$, $p < .001$). In addition, Supply chain alertness positively influenced supply chain agility ($b = .48$, $SE = .08$, $p < .001$) and supply chain agility positively influenced firm financial performance ($b = .43$, $SE = .09$, $p < .001$). Therefore, Hypotheses 1, 2, 3, 5 are supported.

Next, we examined the indirect effects of the top SCM executive's hierarchical position with supply chain agility via supply chain alertness for Hypotheses 4. Because indirect effects tend to violate normality (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002), we bootstrapped 2,000 samples from our initial 146 responses for generating 95% bias-corrected confidence intervals for our indirect effect estimates. The top SCM executive's hierarchical position was found to have an indirect influence on supply chain agility via supply chain alertness (*Indirect effect* = .67, *95%CI* [.35, 1.04]). A direct effect was also found for the top SCM executive's hierarchical position with supply chain agility (*Direct effect* = 0.88, *95% CI* [.05, 1.21]). Overall, an indirect effect was found which supported Hypothesis 4.

4. CONCLUSION

The analysis provides empirical support for the structure-supply chain dynamic capabilities-firm performance linkages. The sequential model has not been tested or supported in its entirety in the past. The current research, therefore, provides useful implications for both academics and practitioners. Academics can reference empirical support of the structure-dynamic capabilities-performance paradigm in SCM context. Such support enhances understanding of the complex interrelationships inherent in the SCM environment and provides clarification of a holistic model describing linkages among major components of that environment. Practitioners may utilize this knowledge to improve decision-making processes, incorporating the key findings to ensure that important strategic, tactical, and operational decisions consider the linkages explored here and understand the importance of aligning structural and supply chain to best influence performance.

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Revisiting the Newsvendor and Traveling Salesman in a Healthcare Disaster or Pandemic Response

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Revisiting the Newsvendor and Traveling Salesman in a Healthcare Disaster or Pandemic Response

Healthcare related disasters have the ability to create vast amounts of destruction and provide a significant challenge to medical professionals, government and non-government organizations during a limited critical time period. The availability of medical supplies and inventory during an event remains a significant challenge to supply chain professionals and planners. The World Health Organization is unable to predict the length of time to for a pandemic to develop (Australian Government, 2010.) This further exacerbates inventory forecasting to determine the appropriate stock levels.

The challenge then becomes to react to a pandemic or similar mass casualty event in a timely manner with the appropriate medical supplies. There are three streams of literature that are helpful while examining this phenomenon. The first is supply chain agility or "Value chain" as it has been identified by Swafford et al. (2006). Also, Gligor and Holcomb (2012) provide a literature review that overviews the area of supply chain ability to react quickly in a possible pandemic like event will require an agile supply chain. A final portion of agility research deals with the complexity of the supply chain with numerous studies on the impacts of supply chain performance due to its complexity.

It is important to identify the value of the possible solution or tool that might be developed for the practitioner. The Centers for Disease Control and Prevention (CDC) lists three other pandemic flu occurrences since the 1918 Spanish Flu: 1957, 1968 and 2009. In the first two cases, there were over 1,000,000 fatalities world-wide each time. In 2009, the H1N1 virus infected over 60 million people and was responsible for 575,400 deaths worldwide (CDC, 2017.) The point that without timely intervention, to include the supply chain response, could have resulted in a pandemic.

Therefore, it is critical that the healthcare supply chain be equipped with the tools and techniques to adequately respond to these situations. Currently, the United States system does a good job of providing "flu shots" to the populous during the peak periods of the year. While not perfect, the supply chain usually only suffers temporary shortages or stockouts (Dereyan, 2015.)

But again, the flu vaccine supply chain is operating with a mostly known customer base and physical delivery system across the same few, known months each year.

Given the importance of the supply chain to react to an actual or a possible pandemic or pandemic like event, the agility of the supply chain becomes a critical factor in assessing its readiness. The supply chain literature on agility provides many useful models of the components that are needed to react to a dynamic market place. Most of these are transferable to not only the healthcare sector in general, but specifically situations that are often time critical and geographically remote. However, the models in the literature are very board and are building theory in most cases. While a few of the studies (E.g., Sharma, 2014 and Dhaigude, 2017) are applied, they too tend to validate theory with their models. The most recent example of Dubey et al. (2017) attempts to apply specific measure to agile supply chains, but is not fully developed in their conference proceeding. Therefore, there is a gap in the application of useful models that can help practitioners and academics to better address real world health types of crises.

While looking for useful tools for practitioners, a number of articles on healthcare disasters and humanitarian relief/disaster responsiveness provided a broad set of example type models. Ganguly et al. (2017) applied a fuzzy logic-based approach as a tool to help in the decision making process. Hale and Moberg (2005) also looked at preparation planning, storage site location, distance to event and inventory models. While those articles focus more on preparation, the goal of helping the healthcare responder has a slightly different stream of literature. Barbarosoglu et al. (2002) identified that the ability to react to a crisis in a timely manner would involve the use of various modes of transportation. Another approach was done by Afshar and Haghani (2012) when they modeled a real-time, large-scale disaster's relief operations. As the complexity of the models grow, the use of various forms of integer programing becomes problematic. The time, cost and complexity make many viable solutions useless in the real world setting. A different approach was done to examine emergency logistics response by Banomyong and Sopadang (2010.) While the previous models all attempted to find the optimized solution, their approach was to use Monte Carlo simulation to help refine the planning and preparation process. Most academics are attempting to create very complex and often all-encompassing solutions to the problem. The implication is that regardless of the topic, healthcare or sustainability, journal articles are tending towards complex solutions that may not be applicable to real-world, time-sensitive situations.

Based on the literature, the next logical step in the research was to determine if the gap in the literature is problematic to practitioners or not. Therefore, a series interviews were conducted with various healthcare practitioners (supply chain and providers), first responders, military supply chain professional with relief experience, other governmental agency and finally non-government organizations. The series of interviews included what tools where they using and what types of tools would they likely use while doing relief planning and operations.

Based upon gaps in the literature and responses from the practitioners, it became clear that there was an opportunity to develop a solution. This research analyzed this specific, critical situation and developed a mathematical framework using both the multi-product newsvendor and traveling salesman models to determine optimal ordering of perishable biopharmaceutical products while maximizing overage while minimizing transportation costs. These models were chosen for a number of reasons: 1) both are well developed tools in the literature and in practice, 2) a combination should provide a better heuristic solution, and 3) any resulting solution should be easily adapted to the likely tools available to practitioners. The result would be to provide an improved process for medical facilities to use a quantitative model for quick justification to make order quantity decisions.

The objective of this research was to model the rapid inventory replenishment in the healthcare system when faced with a healthcare-related disaster. The two research questions were developed based on the literature and practitioner responses:

- R1: how to determine optimal inventory levels of vaccines in order to prepare for distribution during a pandemic by using a multi-product newsvendor model
- R2: how to apply those quantities into a traveling salesman model to maximize coverage while simultaneously minimizing transportation costs.

To address these research questions, a two-step approach was utilized to analyze rapid inventory replenishment. First, a multi-product newsvendor model was applied to find the optimum quantities of medication to minimize the shortage and surplus at each treatment center. Next, the optimal quantities were implemented into a traveling salesman problem to calculate the best possible coverage of a region while minimizing transportation costs. Using the multi-product newsvendor model allows for a mathematical option for healthcare administrators to analyze the optimal ordering quantity to achieve proper coverage. The follow up step of using

the traveling salesman problem allows treatment centers to maximize coverage while minimizing transportation costs.

Assumptions

- Readily available vaccination
- Fully functional supply chain network
- Multiple mobile treatment centers in a region (i.e. DFW area)
- Cost of each vaccine is the same
- Penalty cost applies if there is a shortage (loss of life) or a surplus (wasted medicine) of vaccines at a mobile treatment center
- Demand is stochastic

Step 1 – Multi-Product Newsvendor

- r = 0,1,2…$|R|$ = index of regions where 0 = vaccine distributor
- i_r=1,2,…$|I_r|$ = i^{th} treatment center of r^{th} region; i_r = {(1,2 for r = 1,2,3), (1 for r = 0)
- $p_{i_r}^r$ = Cost per unit of shortage of vaccine in each treatment center i in region r
- $w_{i_r}^r$ = Shortage quantity of vaccine units in each treatment center i in region r $(D_{i_r}^r - q_{i_r}^r)$
- $v_{i_r}^r$ = Cost per unit of holding vaccine in each treatment center i in region r
- $z_{i_r}^r$ = Excess quantity of vaccine units in each treatment center i in region r $(q_{i_r}^r - D_{i_r}^r)$
- $c_{i_r}^r$ = Cost per unit of vaccine in each treatment center i in region r
- $q_{i_r}^r$ = Quantity of vaccine capacity acquired by each treatment center i in region r
- $D_{i_r}^r = N(\mu_{i_r}^r, (p_{i_r}^r)^2)$ demand follows normal distribution with mean μ and standard deviation σ in each treatment center i in region r

Stage 1:

- $G(q_{i_r}^{*r}) = arg\ min\ (q_{i_r}^r)$ (1)
- s.t $q_{i_r}^r \geq 0$ (2)

Stage 2:

- $\Pi = Min.\ v_{i_r}^r\ z_{i_r}^r + p_{i_r}^r\ w_{i_r}^r$ (3)
- s.t. $z_{i_r}^r \geq q_{i_r}^r - D_{i_r}^r \quad \forall r \neq 0$ (4)
- $w_{i_r}^r \geq D_{i_r}^r - q_{i_r}^r \quad \forall r \neq 0$ (5)
- $z_{i_r}^r, w_{i_r}^r, q_{i_r}^r \geq 0, \quad \forall r, i$ (6)
- Where, $G(q_{i_r}^r) = E[\Pi] + \sum_{r=1}^{|R|} \sum_{i=1}^{|I|} c_{i_r}^r\ q_{i_r}^r$

Step 2 – Traveling Salesman Problem

- r= 0,1,2…$|R|$ = index of regions where 0 = vaccine distributor
- i_r=1,2,…$|I_r|$ = i^{th} treatment center of r^{th} region; i_r ={(1,2 for r = 1,2,3), (1 for r = 0)
- $q_{i_r}^{*r}$ = Optimal quantity of the vaccine needed in each treatment center i in region r
- m_{i_r,j_r}^r ={(1 if treatment center j is immediately followed by treatment center i in a route), (0 otherwise)
- d_{i_r,j_r}^r = Distance of treatment center i from treatment center j
- $\sum_{r=1}^{3} \sum_{i=1}^{2} q_{i_r}^r = K$ = Maximum capacity of the small fleet per treatment
- $n_{i_r}^r$ = Total amount of vaccine delivered on the route that includes up to treatment center i in region r including treatment center i

- $Z = Min. \sum_{r=0}^{3} \sum_{i_r}^{|I_r|} d_{i_r,j_r}^r\ m_{i_r,j_r}^r$
- s.t. $\sum_{r=0}^{3} \sum_{i_r}^{|I_r|} m_{i_r,j_r}^r = 1, \quad \forall_{j_r}$

- $\sum_{r=0}^{3} \sum_{i_r}^{|I_r|} m_{i_r,j_r}^r = 1, \quad \forall_{i_r}$
- $q_{i_r}^{*r} \leq n_{i_r}^r \leq K, \ \forall_{i_r}$
- $n_{i_r}^r \leq K + (q_{i_r}^{*r} - K)\ m_{i_r,j_r}^r, \quad \forall_{i_r}$
- $n_{j_r}^r \geq n_{i_r}^r + q_{j_r}^{*r} - K + K\ m_{i_r,j_r}^r + (K - q_{j_r}^{*r} - q_{i_r}^{*r})\ m_{i_r,j_r}^r, \ \forall_{i_r,j_r}$
- $n_{i_r}^r \geq 0, \quad \forall_{i_r}$
- $m_{i_r,j_r}^r \in \{0,1\}, \forall_{i_r,j_r}, \ i_r \neq j_r$

The results of the two step approach is to provide a relatively simple new mathematical basis that can be quickly and easily input into Excel or other common spreadsheet software by practitioners to dramatically improve stock levels and replenishments. The goal of this abstract is to gather feedback to improve the model before finalizing it for publication and distribution to healthcare supply chain organizations in a format that they can use.

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RISK MANAGEMENT INTEGRATION AND SUPPLY CHAIN PERFORMANCE IN RELATION TO ISO 9001 CERTIFICATION: A PRELIMINARY EMPIRICAL ANALYSIS

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ABSTRACT

This research develops a model for characterizing the relationship of supply chain (SC) performance to SC risk management integration (RMI) and compares ISO 9001 certified firms with firms that are not certified. A structural equation model is used to model the RMI measure as a mediator between SC logistics performance (LP) and both SC cost performance (CP) and SC service performance (SP). Further, CP and SP are related to overall firm performance (FP) in the proposed model. Based on the participation of 140 SC managers, we find that LP is positively related to RMI, CP and SP and that SP and CP are positively related to FP in both certified and non-certified firms. However, we find that, for ISO 9001 firms, RMI partially mediates the relationship of LP with both CP and SP, while for firms that are not ISO 9001 certified, RMI does not mediate these relationships at all. The study findings suggest that ISO 9001 certified firms are capable of leveraging their SC risk management integration efforts to impact positively on CP and SP, whereas non-certified firms are not.

KEYWORDS: risk management, supply chain management, logistics performance, firm performance, ISO 9001

INTRODUCTION

Supply chain disruptions represent a serious threat for supply chain managers [1]. For example, supply chain managers have recently experienced significant challenges in preventing inferior counterfeit products from impacting their organizations and from reaching customers [2]. Such risks, if realized, have the potential to disrupt the operations of suppliers, manufacturers, and downstream stakeholders in the supply chain, negatively impacting on service and cost performance. Development of resilience capabilities to operational disruptions is shown to have a positive impact on recovery and performance in the supply chain [3]

Many organizations have developed approaches for avoiding or mitigating risk. However, only recently has there been movement toward a standard for supply chain risk management. The ISO 9001:2015 standard, for example, requires certified organizations to demonstrate risk-based thinking [4]. While global interest in quality programs such as TQM and ISO 9001 has been increasing for some time, there are many recent notable examples of the increasing incidence of supply chain risk disruptions that impact on quality and the bottom line. Therefore, standards such as ISO 9001:2015, with its focus on risk management, have the potential to be a standard for the active management of both supply chain quality and risk. The present study examines if superior risk-based thinking, such as is required in the latest ISO 9001 standard, is associated with positive performance outcomes in US supply chains, specifically in relation to risk management integration across the supply chain. Therefore, this research adds to the literature by characterizing the relationship of ISO 9001 certification with supply chain risk management integration.

Next, we provide background on supply chain risk related supply chain performance. We then develop our model and propose a set of hypotheses, explain the study methodology, and present our findings. We conclude by offering theoretical and managerial implications for scholars and supply chain managers.

LITERATURE REVIEW

Interest in the impact and mitigation of risk in the supply chain has recently experienced significant growth in the research literature. There has been a pronounced and sustained rise in the number of articles on the subject [5]. Classifications of supply chain risks among researchers have included: controllable and uncontrollable risks, environmental risks, financial, information, intellectual property, and reputation risks, process and technology risks, logistics, supply and demand risks [6-15].

It is clear from the literature that SC risks can present in different ways and are costly to the supply chain organizations when they occur [16]. Therefore, effective mitigation of such risks is critical to the bottom line. The simplest generic approach for risk management described in the literature involves several steps, including: identification of potential risks, estimating their likelihood of occurrence, assessing the severity of impact on the supply chain should they occur, engaging a real-time response when the risk event occurs, and then monitoring the effectiveness of the mitigation action [5, 17]. A mature risk management process is characterized by coordinated organizational actions taken to avoid the occurrence of a risk event and effective supply chain mitigation of risk events that are difficult to avoid, to minimize the negative impact on SC service and cost.

The literature reports that organizational structure and characteristics may also contribute to risk management success. Organizations characterized by agility and flexibility, in addition to systematic contingency planning, are better able to manage risks in general [18]. A total quality management (TQM) culture has been associated in the literature with innovative, change-oriented and adhocratic organizations [19]**.** These organizations have an external orientation on the well-being of the organization and a structure of flexibility and change, that may contribute, by extension, to more successful management of supply chain risk. Florio [20] found that TQM

practice is positively associated with risk management maturity. ISO 9001 certification, a standard for meeting quality management system requirements, incorporates the principles of TQM into its certification criteria. Thus, one would expect TQM principles and practices to be present in organizations that have achieved ISO 9001 certification. Hence, ISO 9001 certification may be able to signal risk management integration capabilities because of the attention the standard brings to improving process management through the principles of TQM. This is particularly true for the latest iteration of the standard, ISO 9001:2015. The 2015 version of the ISO 9001 standard explicitly incorporates risk management in the quality management system. This added emphasis on risk-based thinking recognizes that disruptions due to realized risk events impact negatively on customer satisfaction and must be proactively managed. Clearly supply chain performance is impacted by organizational structure and quality culture.

Operationally speaking, overall supply chain performance is also related to logistics performance, particularly in relation to collaboration among supply chain members. Fugate, Mentzer [21] report that high levels of logistics performance are positively associated with organizational performance. Organizational performance was defined by financial measures such as sales growth, return on sales, return on assets, return on investment, etc. Also, Mandal, Sarathy [22] found that integrated logistics capabilities impacted positively on supply chain flexibility and performance. Alam, Bagchi [23] found that logistics integration has a positive effect on supply chain performance. In a survey of the supply chain literature spanning 1989 to 2012, Kache and Seuring [24] found positive relationships between supply chain performance, integration and collaboration. They also found a link between collaboration/integration and risk/performance. In turn, better logistics performance can help to reduce supply chain costs and improve supply chain service, which can result in better overall firm performance. Liu and Lai [25] found that cost competitiveness positively impacted on firm financial performance in a study of third-party logistics providers. However, the relationship of logistics performance to overall firm performance isn't always a direct one in the literature. For example, Prajogo, Oke [26] found that supply chain logistics integration and firm competitive performance were fully mediated by firm lean production processes and inbound supply performance.

Unexpected disruptions in the supply chain can impact negatively on cost and service outcomes in relation to logistics activities. The occurrence of risk events in the supply chain increases uncertainty, which can logically result in decreased service performance and increased supply chain related costs. Organizations act in response to uncertainty by specializing and standardizing different tasks [27]. Standardization improves consistency, providing superior visibility into inventory and service issues. Greater consistency results in lower supply chain costs and increased supply chain service performance [28]. According to Myers and Cheung [29], as global markets grow increasingly more consistent (i.e., less variable and more efficient), competition occurs between entire value chains. Therefore, top managers seek to reduce costs and improve service performance so that the overall supply chain may gain competitive advantage. This is shown to result in improved overall firm performance [30-33].

Based on the literature previously noted, it would also be expected that organizations demonstrating risk-based thinking, particularly ISO 9001 certified firms, could have advantages over organizations that do not have an ISO 9001 structured focus that engenders risk-based thinking. This is also because organizations with more mature process monitoring and

improvement practices appear to have more mature risk management programs [20]. Risk management maturity is also associated with better integration of supply chain members because it facilitates more rapid identification and better mitigation of risk events. Zhao, Huo [15] report that supply chain integration is an important driver for schedule attainment, competitive performance, and customer satisfaction; supply chain risks decreases as supply chain integration increases [15]. By extension, organizations that exhibit a greater level of supply chain risk integration are likely to be more focused on risks in general.

One aspect that should be considered when comparing organizations in relation to risk management and supply chain performance is organization size. Zawawi, Wahab [34] found that logistics capability has a significant positive relationship with logistics performance and that this relationship is impacted by firm size. Park, Kim [35] report that larger firms achieved quality certification compliance monitoring and measurement better than smaller firms. Lee and Palmer [36] report that smaller organizations are more likely than larger ones to seek a quality certification due to external pressures. Further, larger firms appear to be better able to manage risk events than smaller firms [37-39]. Smaller firms lack the resources to develop a proactive approach, and instead are more apt to simply react to risk events after the fact [40].

MODEL DEVELOPMENT

Based on the literature review of the prior section, the following set of hypotheses are developed.

Logistics Performance and Risk Management Integration

The literature demonstrates that supply chain LP is improved by inter-firm logistics integration, which impacts on supply chain cost and service, leading to improved firm performance [21, 23, 24, 41]. Firms with better LP and integration can be better prepared to absorb the shock of a supply chain disruption by engaging in RMI practices [18, 42, 43]. Therefore, the following hypotheses are proposed:

H1a. LP directly and positively contributes to CP.
H1b. LP directly and positively contributes to RMI.
H1c. LP directly and positively contributes to SP.

The Role of Supply Chain Risk Management Integration as an Enabler of SC Performance

Risk disruption within the supply chain brings with it higher levels of uncertainty and manifests itself in decreased service levels and increased costs to a firm experiencing it. From a contingency perspective, managers respond to uncertainty through improved RMI [27]. Greater consistency enables supply chain benefits with lower costs and increased service levels [28]. Therefore, improved supply chain RMI is expected to lead to increased service and cost benefits [44]. To this point, the following hypotheses are proposed:

H2a. RMI directly and positively contributes to CP.
H2b. RMI directly and positively contributes to SP.

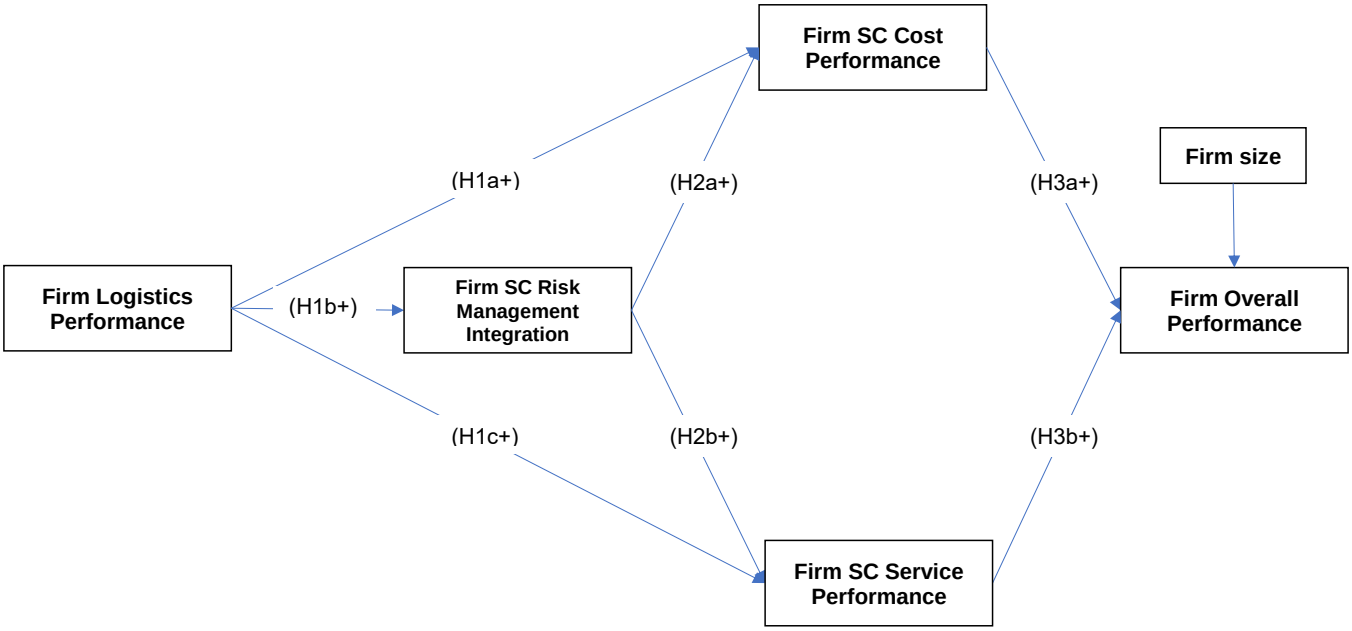
Service and Cost Performance as an Enabler of Overall Firm Performance

There are numerous studies that link supplier integration and improvements in supply chain CP and SP to greater overall FP [30-33]. Therefore, it is logical to posit that as a firm improves supply chain service and/or improves supply chain cost, overall firm performance would improve. From this the following hypotheses are developed.

H3a. CP directly and positively contributes to overall FP.
H3b. SP directly and positively contributes to overall FP.

The resulting theoretical model is displayed in Figure 1. We propose a model that positively relates SC logistics performance (LP) to SC cost performance (CP), SC risk management integration (RMI) and SC service performance (SP). Further, we propose that RMI contributes positively to CP and SP. By extension, CP and SP are positively related to firm performance (FP). The size of the organization in yearly revenues is included in the model as a control variable. This model is examined for the case of respondents from ISO 9001 certified organizations and also the case of respondents from organizations that are not ISO 9001 certified.

Figure 1. Proposed theoretical model



METHODOLOGY

Construct Measures and Sample

This research employed an online survey to assess multiple constructs and empirically test a set of hypotheses. All measures were developed using items established in prior work (Refer to Table I). Specifically, our LP scale was adapted from the works of Chopra and Meindl [45] and Bozarth and Handfield [46]. Our measure of RMI was developed based on prior work in the area of risk management maturity [20]. Both scales were measured using a seven-point Likert scale (1 strongly disagree to 7 strongly agree). In order to effectively assess three distinct areas of performance pertinent to our study, a series of previously validated items were used to measure firm CP, firm SP, and overall FP [45, 47]. All three of the performance measures were considered in relation to the firm's competitors and used a seven-point Likert scale (1 much worse - to 7 much better than competitors).

Table I. Survey Scale Items

Item/*Construct*
Supply Chain Logistics Performance (LP)
Compared to our major competitors:
LP1. Our fill rate is better.
LP2. Our cycle time is better.
LP3. Our perfect order performance is better.
LP4. Our inventory turns are better.
Supply Chain Risk Management Integration (RMI)
RMI1. We follow a 4-step process for risk identification, analysis, education/planning, and treatment.
RMI2. We prioritize risk events based on severity of impact to our organization.
RMI3. We involve our suppliers in identification and mitigation of potential SC risks.
RMI4. We work with our customers to identify and mitigate potential SC risks.
Firm Supply Chain Cost Performance (CP)
Compared to our major competitors:
CP1. Our total inventory cost is lower.
CP2. Our stock-out cost is lower.
CP3. Our emergency actions costs are lower.
CP4. Our cash-to-cash cycle is shorter.
Firm Supply Chain Service Performance (SP)
Compared to our major competitors:
SP1. Our information system is more responsive to our SC needs.
SP2. Our financial transactions with SC partners run more smoothly.
SP3. We have superior service flexibility.
SP4. Our SC product/service flow is more visible.
Firm Overall Performance (FP)
Compared to our major competitors:
FP1. Our sales volume is better.
FP2. Our profit margin is better.
FP3. Our return on investment (ROI) is better.
FP4. Our quality is better.

In an effort to further strengthen our survey instrument, a two-step process was followed to ensure content and face validity of the items and constructs being assessed [48]. In step one, the survey was sent to SC practitioners and experts for item review and feedback. In step two, we completed a pilot study to better assess the survey empirically. Both qualitative feedback and empirical data were collected during this process leading to minimal changes to the final survey. Next, the survey was sent by email to a list of contacts provided by the Institute for Supply Management (ISM), the Council for Supply Chain Management Professionals (CSCMP), and the Association for Healthcare Resource and Materials Management (AHRMM). See Table II for a detailed breakdown of the survey participant demographics.

Table II. Survey Demographics

Respondent Job Title	**No.**
Top level manager	44
Mid-level manager	76
Entry level manager	17
Other	3
Total	**140**
Organization's Yearly Revenue	**No.**
Less than 10 million	19
10 million to 1 billion	55
More than 1 billion	57
n/a	9
Total	**140**
Organization's ISO 9001 Certification	**No.**
ISO 9001 Certified	63
Not ISO 9001 Certified	77
Total	**140**

In all, the survey was sent to 1,741 SC professionals representing diverse organizations across multiple industries. This effort resulted in 140 completed questionnaires representing a response rate of 8%. Respondents included top-level managers (31.4%), mid-level managers (54.3%), and entry-level managers (12.1%). Annual revenue was used as an indicator of organization size with small organizations having revenue less than $10 million (13.6%), mid-size organizations with revenue between $10 million and $1 billion (39.3%), and large organizations generating revenue in excess of $1 billion (40.7%). Finally, ISO 9001 certified organizations represented 45% of the sample, while the remaining 55% included non-certified organizations.

Non-response Bias and Common Method Bias

Early versus late respondents were compared to evaluate non-response bias [49]. The first and last quartiles of survey responses were tested for differences in construct means. The resulting p-values were 0.284 for the LP construct, 0.851 for RMI, 0.146 for CP, 0.225 for SP and 0.284 for the FP construct. The test results indicated that there were no significant differences between the

mean construct responses obtained from the first and last quartiles across all five constructs, suggesting that non-response bias was not a threat to the integrity of the survey data.

Harman's single factor test was used to assess the potential for common method bias (CMB) [50, 51]. A factor analysis was performed using all the different survey items included in the study to determine if most of the variance in the model was accounted for by one general factor. Since the percentage of variance explained by a single factor was less than 50 percent (the maximum percentage of variability explained by a single factor was equal to 44.7%), CMB was not deemed an issue [51].

Descriptive Statistics

Descriptive statistics for all constructs and survey items are presented in Table III. Survey responses were grouped depending on whether organizations were ISO 9001 certified.

Table III. Survey Scale Items Descriptive Statistics

	Not ISO 9001 Certified (*n* = 77)		**ISO 9001 Certified** (*n* = 63)	
Item/*Construct*	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
LP	***4.961***	***1.378***	***5.410***	***1.152***
LP1	5.130	1.481	5.476	1.229
LP2	4.922	1.554	5.556	1.215
LP3	4.935	1.408	5.365	1.235
LP4	4.857	1.668	5.279	1.427
RMI	***4.968***	***1.267***	***5.591***	***1.026***
RMI1	4.455	1.846	5.016	1.746
RMI2	5.697	1.386	5.667	1.368
RMI3	5.065	1.633	5.825	1.199
RMI4	4.714	1.629	5.839	1.308
CP	***4.610***	***1.159***	***4.889***	***1.141***
CP1	4.545	1.410	4.778	1.301
CP2	4.571	1.282	4.857	1.268
CP3	4.740	1.240	4.952	1.224
CP4	4.584	1.291	4.968	1.270
SP	***4.950***	***1.122***	***5.357***	***1.005***
SP1	4.724	1.429	5.079	1.168
SP2	4.805	1.052	5.254	1.270
SP3	5.247	1.387	5.587	1.213
SP4	5.026	1.495	5.516	1.141
FP	***4.987***	***0.963***	***5.540***	***0.963***
FP1	4.779	1.420	5.197	1.400
FP2	4.805	1.159	5.426	1.161
FP3	4.803	1.307	5.426	1.161
FP4	5.553	1.310	6.081	0.946

In order to assess the proposed theoretical model, the internal consistency, convergent validity and discriminant validity of the constructs as well as the reliability of the individual indicators were analyzed across both groups.

Item Reliability

First, outer loadings were examined to evaluate the reliability of the survey items. Table IV displays the outer loadings of the different items. All outer loadings were statistically significant. All but four survey items across both groups had loadings above the suggested cutoff of 0.70 [52]. Even though four of the items had loadings between 0.60 and 0.70, they were retained since their deletion was not required to increase composite reliabilities above the suggested threshold values. Overall, the results of this portion of the analysis indicated an acceptable level of reliability for the different survey items.

Table IV. Outer Loadings

	Not ISO 9001 Certified		**ISO 9001 Certified**	
Item	**Outer Loading**	***p***	**Outer Loading**	***p***
LP1	0.932	< 0.001	0.912	< 0.001
LP2	0.954	< 0.001	0.918	< 0.001
LP3	0.892	< 0.001	0.924	< 0.001
LP4	0.836	< 0.001	0.849	< 0.001
RMI1	0.685	< 0.001	0.712	< 0.001
RMI2	0.709	< 0.001	0.734	< 0.001
RMI3	0.875	< 0.001	0.784	< 0.001
RMI4	0.735	< 0.001	0.676	< 0.001
CP1	0.909	< 0.001	0.915	< 0.001
CP2	0.905	< 0.001	0.948	< 0.001
CP3	0.849	< 0.001	0.842	< 0.001
CP4	0.883	< 0.001	0.898	< 0.001
SP1	0.886	< 0.001	0.836	< 0.001
SP2	0.789	< 0.001	0.865	< 0.001
SP3	0.816	< 0.001	0.745	< 0.001
SP4	0.846	< 0.001	0.908	< 0.001
FP1	0.604	< 0.001	0.719	< 0.001
FP2	0.850	< 0.001	0.929	< 0.001
FP3	0.865	< 0.001	0.892	< 0.001
FP4	0.633	< 0.001	0.765	< 0.001

Construct Reliability and Convergent Validity

Cronbach's α, reliability coefficient ρ_A and composite reliability estimates were used to evaluate the internal consistency of the research constructs for both groups [53]. All the different estimates were above the 0.70 cut-off recommended by Hair, Hult [52] (Refer to Table V),

suggesting adequate internal consistency across all five constructs. Convergent validity was established using Average Variance Extracted (AVE) estimates. As shown in Table V, the AVE values were above the 0.50 cut-off recommended by Hair, Hult [52]. The results indicate that all model constructs explained over half of the variance of their indicators, suggesting adequate convergent validity for the five research constructs across both groups.

Table V. Construct reliability and validity

	Not ISO 9001 Certified				ISO 9001 Certified			
Construct	**Cronbach's α**	**ρ_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**	**Cronbach's α**	**ρ_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**
LP	0.925	0.927	0.947	0.818	0.923	0.924	0.945	0.812
RMI	0.748	0.777	0.840	0.570	0.706	0.702	0.817	0.529
CP	0.909	0.914	0.936	0.787	0.923	0.926	0.946	0.813
SP	0.854	0.856	0.902	0.697	0.861	0.880	0.906	0.707
FP	0.733	0.790	0.832	0.559	0.848	0.879	0.898	0.690

Discriminant Validity

Cross-loadings, the Fornell-Larcker criterion, and heterotrait-monotrait (HTMT) ratio of correlations approach were used to evaluate the discriminant validity of the model constructs for both groups. While a few cross-loadings were relatively high (For example, FP3 in the not ISO 9001 certified group or CP3 in the ISO 9001 certified group), the loadings on the hypothesized model construct were higher than the loadings on the remaining constructs for each individual indicator across both groups (Refer to Table VI). Cross-loadings thus provide initial evidence for the constructs' discriminant validity [52].

Table VI. Discriminant validity: Cross-loadings

	Not ISO 9001 Certified					ISO 9001 Certified				
	Construct					Construct				
Item	**LP**	**RMI**	**CP**	**SP**	**FP**	**LP**	**RMI**	**CP**	**SP**	**FP**
LP1	**0.932**	0.514	0.747	0.738	0.676	**0.912**	0.283	0.521	0.621	0.521
LP2	**0.954**	0.538	0.806	0.702	0.637	**0.918**	0.306	0.557	0.591	0.530
LP3	**0.892**	0.540	0.597	0.739	0.654	**0.924**	0.298	0.613	0.641	0.614
LP4	**0.836**	0.545	0.710	0.692	0.597	**0.849**	0.382	0.647	0.615	0.666
RMI1	0.362	**0.685**	0.315	0.246	0.320	0.271	**0.712**	0.475	0.415	0.347
RMI2	0.369	**0.709**	0.422	0.219	0.323	0.098	**0.734**	0.343	0.251	0.277
RMI3	0.537	**0.875**	0.482	0.474	0.470	0.309	**0.784**	0.402	0.344	0.396
RMI4	0.481	**0.735**	0.436	0.405	0.413	0.297	**0.676**	0.362	0.429	0.357
CP1	0.742	0.512	**0.909**	0.604	0.640	0.588	0.513	**0.915**	0.598	0.643
CP2	0.754	0.495	**0.905**	0.650	0.671	0.597	0.504	**0.948**	0.714	0.610
CP3	0.593	0.440	**0.849**	0.491	0.593	0.555	0.441	**0.842**	0.715	0.529
CP4	0.713	0.517	**0.883**	0.646	0.632	0.613	0.538	**0.898**	0.608	0.565
SP1	0.663	0.436	0.605	**0.886**	0.596	0.505	0.498	0.510	**0.836**	0.606
SP2	0.566	0.356	0.454	**0.789**	0.579	0.634	0.382	0.662	**0.865**	0.550
SP3	0.707	0.356	0.591	**0.816**	0.543	0.480	0.321	0.579	**0.745**	0.387
SP4	0.707	0.406	0.602	**0.846**	0.525	0.669	0.496	0.696	**0.908**	0.623
FP1	0.163	0.148	0.323	0.239	**0.604**	0.347	0.220	0.379	0.440	**0.719**
FP2	0.527	0.425	0.639	0.502	**0.850**	0.621	0.380	0.676	0.574	**0.929**
FP3	0.691	0.462	0.715	0.629	**0.865**	0.575	0.434	0.633	0.597	**0.892**
FP4	0.601	0.452	0.351	0.582	**0.633**	0.590	0.563	0.421	0.552	**0.765**

Note: Primary loadings for each indicator are shown in bold.

Next, the Fornell-Larcker method was used to further analyze whether the constructs met the conditions for discriminant validity [54]. As shown in Table VII, the square roots of the AVEs for each of the five model constructs was higher than the correlations of the construct with the other latent variables included in the theoretical model, further suggesting that all constructs are valid measures of unique concepts across both groups.

Table VII. Discriminant validity: Fornell-Larcker criterion

	Not ISO 9001 Certified					ISO 9001 Certified				
Construct	**LP**	**RMI**	**CB**	**SB**	**FP**	**LP**	**RMI**	**CB**	**SB**	**FP**
LP	**0.904**					**0.901**				
RMI	0.591	**0.755**				0.354	**0.727**			
CB	0.794	0.555	**0.887**			0.652	0.554	**0.902**		
SB	0.794	0.466	0.677	**0.835**		0.686	0.511	0.728	**0.841**	
FP	0.709	0.515	0.716	0.671	**0.748**	0.651	0.482	0.652	0.654	**0.831**

Note: Square root of the AVE on diagonals in bold.

Finally, the HTMT ratio of correlations method was used to determine whether the HTMT values were lower than the suggested threshold of 0.90 [55]. As displayed in Table VIII, for each combination of constructs none of the HTMT estimates were above 0.90, suggesting adequate discriminant validity across constructs [55].

Table VIII. Discriminant validity: Heterotrait-Monotrait (HTMT) criterion

	Not ISO 9001 Certified					ISO 9001 Certified				
Construct	**LP**	**RMI**	**CB**	**SB**	**FP**	**LP**	**RMI**	**CB**	**SB**	**FP**
LP										
RMI	0.697					0.416				
CB	0.859	0.664				0.703	0.671			
SB	0.892	0.557	0.762			0.763	0.625	0.821		
FP	0.828	0.666	0.833	0.829		0.723	0.609	0.718	0.752	

Collinearity

The model was also checked for collinearity problems. Variance Inflation Factor (VIF) values were calculated for all combinations of exogenous (or predictor) constructs (represented by the rows in Table IX) and endogenous constructs (represented by the columns in Table IX). Collinearity was not deemed an issue since all the resulting VIF estimates were below the threshold of five recommended by Hair, Hult [52].

Table IX. Variance Inflation Factor (VIF) values

	Not ISO 9001 Certified				ISO 9001 Certified			
Construct	**RMI**	**CB**	**SB**	**FP**	**RMI**	**CB**	**SB**	**FP**
LP	1.000	1.535	1.535		1.000	1.143	1.143	
RMI		1.535	1.535			1.143	1.143	
CB				1.861				2.133
SB				1.872				2.139

RESULTS

Hypotheses Testing

Next, the proposed structural equation model was tested. A summary of the test results is presented in Table X. The research hypotheses were simultaneously tested in SmartPLS [56]. A bootstrap resampling method with 5,000 resamples was used to assess the level of significance of the standardized path coefficients estimated. Organization size, which was included as control variable in the model, was not significant at the 0.05 level.

Table X. Summary of hypotheses testing

		Not ISO 9001 Certified			ISO 9001 Certified		
	Path	**St. Weight**	***p***	**Conclusion**	**St. Weight**	***p***	**Conclusion**
H1a:	LP → CP	0.715	< 0.001	Supported	0.521	< 0.001	Supported
H1b:	LP → RMI	0.591	< 0.001	Supported	0.354	0.002	Supported
H1c:	LP → SP	0.796	< 0.001	Supported	0.578	< 0.001	Supported
H2a:	RMI → CP	0.132	0.162	Not Supported	0.370	< 0.001	Supported
H2b:	RMI → SP	-0.004	0.977	Not Supported	0.307	0.009	Supported
H3a:	CP → FP	0.462	< 0.001	Supported	0.378	0.016	Supported
H3b:	SP → FP	0.372	0.005	Supported	0.377	0.010	Supported

In the case of non-certified firms, SC logistics performance was found to have a significant direct positive effect on SC risk management integration, cost performance and service performance. The findings therefore provide support for H1a, H1b and H1c at the 0.001 level of significance.

On the other hand, SC risk management integration was found to have an insignificant direct positive effect on both SC cost performance and SC service performance. Thus, H2a and H2b are not supported for the non-certified group. With respect to firm overall performance, both SC cost performance and SC service performance were found to have a significant positive effect. H3a is therefore supported at the 0.001 level of significance, while H3b is supported at the 0.01 level of significance.

Similarly, SC logistics performance was found to have a significant direct positive effect on SC risk management integration, cost performance and service performance in ISO 9001 certified firms. The findings therefore provide support for H1a and H1c at the 0.001 level of significance, as well as for H1b at the 0.01 level of significance.

In the case of ISO 9001 certified firms, SC risk management integration was found to have a significant direct positive effect on both SC cost performance and SC service performance. Thus, H2a and H2b are supported for the certified group. Finally, both SC cost performance and SC service performance were found to have a significant positive effect. H3a and H3b are therefore supported at the 0.05 level of significance.

Mediation Analyses

Based on the results of hypothesis H1a and H1c obtained from both groups, the role of SC risk management integration in the link between SC logistics performance and SC cost and service performance was examined in more detail. Table XI displays the results of the mediation analysis.

Table XI. Summary of mediation analysis

	Not ISO 9001 Certified				ISO 9001 Certified			
Effect	**Direct**	**Indirect**	**Total**	**Conclusion**	**Direct**	**Indirect**	**Total**	**Conclusion**
LP → CP	0.715***	0.078	0.794***	No Mediation	0.521***	0.131**	0.652***	Partial Mediation
LP → SP	0.796***	-0.003	0.794***	No Mediation	0.578***	0.109*	0.686***	Partial Mediation

Notes: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In the case of non-certified firms, the mediation analysis results suggest that SC risk management integration does not mediate the relationship between SC logistics performance and SC cost and service performance. The insignificant indirect effects indicate that SC risk management integration does not help explain the effect of SC logistics performance on both SC cost and service performance in non-certified firms.

On the other hand, the mediation analysis results indicate that SC risk management integration partially mediates the relationship between SC logistics performance and SC cost and service performance in ISO 9001 certified firms. Statistically significant indirect effects suggest that SC risk management integration helps explain a substantial portion of the effect of SC logistics performance on both SC cost performance and SC service performance and, ultimately, on firm overall performance. In the case of ISO 9001 certified firms, the study findings therefore confirm the critical mediating role of SC risk management integration.

DISCUSSION

With the continued growth of global supply chains, the interest in supply chain risk management has generated increasing attention from both industry, government and academia. The recent increase in ISO 9001 focus on risk-based thinking in the 2015 standard underscores the threat posed by costly supply chain disruptions [4]. Standards that focus on risk management have the potential to signal active management of both supply chain quality and risk for those who adopt them. The present study examines whether superior risk-based thinking and risk management integration, in particular related to ISO 9001, is associated with positive performance outcomes in US supply chains.

Our study considers the role of risk management practices within logistics performance efforts and the subsequent impact on critical areas of SC performance. Specifically, a structural equation model that examines the relationships among SC logistics performance (LP), SC risk management integration (RMI), SC service performance (SP), SC cost performance (CP) and overall firm performance (FP) was developed and empirically tested. Our findings indicate a higher level of LP is associated with greater RMI. Further, RMI appears to partially mediate the relationship between LP efforts and both CP and SP for ISO 9001 certified firms, but not for non-certified firms. This finding suggests that ISO 9001 certified firms are capable of leveraging their SC risk management integration efforts to impact positively on CP and SP, whereas non-certified firms are not.

This research makes the following contributions. First, the literature has recently seen an increase in interest among scholars toward understanding the impact of risk and how to better manage risk in the SC [5]. Our study considers risk management efforts in relation to risk-based thinking and therefore contributes to the extant literature on risk management in the SC. Second, interest in standards that promote risk-based thinking, such as ISO 9001:2015, is increasing. This is due, in part, to the desire for a signaling mechanism that customers may use to filter suppliers from among the myriad suppliers around the globe that they may engage with in commerce. Therefore, this research contributes to the literature by exploring the value of the ISO 9001 standard to promote risk-based thinking and risk management integration practices in the supply chain.

MANAGERIAL IMPLICATIONS

This study suggests that ISO 9001 can play a positive mediating role between logistics performance and the SC performance measures related to cost and service. To summarize the measures used, LP is measured in this study by fill rate, cycle time, perfect order performance, and inventory turns. CP is measured by total inventory cost, stock-out cost, emergency action cost, and cash-to-cash cycle. SP is measured by responsiveness of information system, smoothness of financial transactions, service flexibility, and process flow visibility. RMI is characterized by the implementation of a structured risk management process with proper risk prioritization, and the involvement of both suppliers and customers in the identification and mitigation planning for SC risks. This study suggests that ISO 9001 provides a framework for structured risk management processes and collaboration with SC partners to positively impact the relationship of LP with the CP and SP outcomes.

Good coordination and collaboration in the supply chain leads to lowering of costs and increases in product availability and profit for the supply chain members. However, supply chain collaboration and integration are not simple to realize in practice. Supply chain members often have differing goals and incentives and may be reluctant to share information [45]. Collaboration, in general, can be very challenging [57]. Key factors that inhibit SC collaboration include trust issues, dependency and power [58]. Kembro, Näslund [59] report on the difficulties with sharing information across multi-tier supply chains. They find difficulty with a lack of an overarching purpose and process in working toward a common goal. It is also difficult to develop strong relationships, contracts and information sharing with an increasing number of relationships. They contend that it will depend on the nature of the supply chain as to the ease of collaboration. In chains where a powerful firm can dictate standards, it is more likely that collaboration beyond simple paired relationships is possible.

Nonetheless, collaboration is more likely when risk avoidance and mitigation are involved. ISO 9001 may provide a common standard for collaboration regarding risk management. The ISO 9001 requirement for risk-based thinking makes preventative action planning outlined in the prior standard much more explicit and center stage. The new standard now expects risk management to be part of the strategic and operational planning process. Companies must be able to identify risks and take appropriate actions in proportion to the potential effect, making risk planning and execution much more proactive and integrative [60, 61]. It is suggested that companies use the plan-do-check-act cycle to support risk-based thinking at every stage [62]. A

study by Chiarini [63] involving ISO 9001:2015 experts and European SME managers characterizes the types of risks that managers consider relative to the standard. The risk sources leading to disruptions that are most often of concern to managers include the production of non-conforming products, poorly trained workers lacking skills and awareness, the potential for supplier non-conforming product to impact customers downstream, and the lack of risk-based assessment for suppliers with earlier certifications. Inappropriate ERP systems are also seen as a potential source of disruption. Acts of God (e.g., flooding and fire) are considered serious threats that are hard to avoid, but should be mitigated with efficient recovery plans. Some helpful practices cited in the Chiarini [63] study included co-design with customers to help reduce mistakes and implementing QFD related to customer new product design, performing deep supplier evaluation to detect potential financial health problems, and selecting suppliers that are ISO 9001:2015 certified.

LIMITATIONS AND FUTURE RESEARCH

The current study has a number of limitations to be addressed in future research. First, our survey data called for the subjective perceptions of managers in relation to RMI, LP, and the other SC performance measures. Although we used an approach well established in prior studies [64], future research should consider more objective measures such as cost, secondary data from customer satisfaction surveys, and other relevant firm metrics. Second, our study assesses a dynamic process at a single point in time. A more complete understanding of the relationships among the constructs may be accomplished using a longitudinal approach. Third, we do not distinguish between firms certified to the ISO 9001:2008 and ISO 9001:2015 standards. Both are well-represented and included in this study. However, the sample size was not large enough to refine the study to one or the other. Future research could focus exclusively on ISO 9001:2015 firms to explore aspects of the standards in relation to SC collaboration and risk management integration.

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SUPPLY CHAIN MANAGER'S ASSESSMENT OF COLLABORATION: THE MODERATING ROLE OF INTEGRATION TOOLS

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ABSTRACT

Business leaders today seek greater insight on issues that impact firm performance including collaboration and efficiency; along with those issues that help facilitate integration. Supply chain activities require managers to develop inter-organizational relationships. Tools which facilitate relationship building can have a significant performance impact through improved customer responsiveness and improved efficiency as a result of the reduction of wasted effort. Firms need a better understanding of the impact of collaborative activities and integration tools including Collaborative Planning Forecasting and Replenishment (CPFR), Vendor Managed Inventory (VMI), or Just-in-Time (JIT) practices. Therefore, the construct integration tools awareness was created given that a number of processes/technologies facilitate integrated supply chain decision-making which can have a pronounced impact on firm performance. As an exploratory study our model examined the collaborative activities firms engage in, including joint decision making and process resource collaboration to determine their impact on firm efficiency and firm performance and integration tool awareness moderates these relationships. After pilot testing the survey, it was administered via *Qualtrics*. The analysis of panel data from 105 supply chain managers was conducted using Structural Equation Modeling. This study indicates the continued importance of the manager's willingness to collaborate with key partners as a means of improving firm performance and efficiency, moreover integration tools play a key role in these relationships. Contributions to the supply chain literature include the assessment of integration tools awareness on the relationship between collaboration activities and firm performance.

WHICH IS IT, JUST-IN-TIME OR LEAN? OUR CLEAR PREFERENCE: OPERATIONS SCIENCE

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ABSTRACT

Academics and practitioners use operations management extensively. This paper discusses the similarities and differences between terms describing a few broad domains within the operations management realm. We recognize major areas of overlap and suggest that what the overlapping concepts teach about operations management has become more important than the original terms themselves. Also, by insisting on a mutually exclusive usage of these terms we limit our understanding of operations science and limit the ability to solve problems.

INTRODUCTION

Heizer and Render [11] state that, "JIT reduces costs associated with excess inventory, cuts variability and waste, and improves throughput." In reference to JIT, the Toyota production system (TPS) and lean they suggest that the essential difference between JIT and lean is that lean understands the customer.

In 2019, most would agree that JIT and lean are not significantly different in the depth of undersanding of customer needs. Heizer and Render [11] go on to say that, "all three approaches reduce waste in the production process." This suggests that organizations implementing JIT, TPS, or lean add more value, with great efficiency than do other firms. Some main attributes appear in all of these continuous improvement philosophies. These elements include waste reduction, value added activities, removal of variability, better throughput, and quality improvement. We propose that the essential elements are shared, and that JIT and Lean are both saying the same thing.

While each ideology has some unique variation in tools that are used most frequently, there is little difference in the two approaches. Although JIT is frequently referenced in manufacturing firms, nothing in the definition suggests that it is useful only in manufacturing environments. Rather we argue that the major concepts that make up JIT or lean are essential for any successful, continuously-improving firm; therefore, neither term is crucial, to the exclusion of the other, in understanding the contributions of operations science to the firm. The important issue is whether these two terms bring the concepts they promise: waste reduction, value added activities, removal of variability, improved throughput, and high quality.

Discussions of these operations concepts, philosophies and approaches often devolve into a compare/contrast debate about which school(s) of thought spawned each, their common lineage, and fine points of distinction in implementation. These distinctions are getting smaller and

smaller. We propose adoption of a new name for this collective body of knowledge: "operations science."

OPERATIONS SCIENCE

Webster's defines science as, "knowledge about or study of the natural world based on facts learned through experiments and observation." Proven operations facts and techniques learned through experiments and observations harken back at least as far as Frederick Taylor's work in scientific management. A new "operations science" field would encompass all subsequent efforts that have gone to the further step of documenting knowledge gained, thereby securing a given advancement and providing a foothold for gaining more.

Practitioners operate in the pragmatic world of real results. Often practitioners are finding that the language of operations is a hindrance rather than an aid. An example is the story of Mr. George Nazi, who has led large implementation information and communications technology (ICT) projects from within corporations at several levels of the telecommunications supply chain. Over the course of two decades, Mr. Nazi has found the most effective approach to be drawing useful operational approaches from many of these schools of thought, without letting vernacular be an impediment. He advises avoiding over-constraining operations discussion that seeks to either (a) use one approach to the exclusion of another, or (b) attribute any specific practice or technique according to its academically proper taxonomy (G. Nazi, personal communication, February 22, 2018).

Ultimately, Mr. Nazi has come to refer to the collective approaches as "operations science." We propose the adoption of this term as a means of more effectively bridging the learning exchange between practice and the academy.

THE DISCIPLINES

Toyota Production System

The Toyota Production System (TPS) was developed by Toyota in the 20th century. This system extensively developed principles that have informed operations science since the 60's. TPS has been the historical precedent for most modern operations techniques, including JIT and Lean. This system is frequently referred to as the world leader in innovative quality even today, although TPS itself is rarely referred to as a direct application.

Toyota focused on waste reduction. Ohno [14], a former Toyota vice president, provides a list of famous "wastes" (muda, mura, and muri) that have informed practitioners for decades:

1. Defects and/or rework
2. Overproduction
3. Waiting
4. Not Engaging Employees
5. Transportation
6. Inventory
7. Motion
8. Excessive Processing / Packaging

This emphasis on waste reduction conceptually mirrors identifying value added activities. All processes should add value. Adding value is the positive form of the elimination of waste.

Central to TPS is continuous improvement coupled with employee participation. Toyota relies on their workers to provide intellectual inputs for change and fuels continuous improvement that is special and has enjoyed especially positive results. Furthermore, the broad approach to waste reduction common to all of these forms suggests that sustainable production could reduce waste by minimizing waste of all-important inputs of energy, wastewater, and air [4].

Another central concept for TPS is increased throughput. A throughput time of 20.5 hours remains highly competitive in industry [9, p. 636]. This stems from relentless continuous improvement, which has resulted from a management commitment to acting on ideas from a workforce trained in quality tools and chartered to find extensive and meaningful improvement opportunities.

High quality was always an important issue for TPS and by the 90's was an essential part of Toyota's rise in the competitive auto industry. Aspects of this approach to high, and ever increasing quality, includes continuous improvement, respect for people and standard work practices. Japanese principles such as Kaizen and kanban systems have become mainstream for JIT or lean manufacturers, regardless of what their overall system is named. Open communications with suppliers allows for efficiency improvement reduced variability within the supply chain, in turn facilitating more level production and ultimately greater profitability [12].

Just in Time (JIT)

JIT is a methodology that aims at eliminating waste and continuously improving the manufacturing process [16] [17]. According to Bortolatti et al. [3], JIT traces its origins from the Toyota Production System from which it inherited a number of tools and techniques. Traditionally JIT has been found to be universally effective in repetitive and non-repetitive production contexts. Bortolotti et al. [3] argue that an educational debate rages about whether or not JIT is applicable in non-repetitive environments. Their research shows that that JIT has statistically significant impact on both efficiency and responsiveness in both environments.

There is general agreement on what JIT is and how to measure it. The set of techniques used includes small lot size, pull production, production smoothing, set-up time reduction, cellular manufacturing and JIT supply [5] [7] [9] [16] [18].

JIT has been described as an "inventory strategy" [10]. However, limiting the application of JIT to strictly inventory control is needlessly restrictive. A broader, more useful definition allows that JIT is a production model created to meet demand without creating a surplus. This type of approach is seen as early as the 1920's where Henry Ford discusses a system that sounds remarkably like a JIT system in his book, *My Life and Work* [8]. In this work, he describes in some detail the process by which the use of inventory controls the manufacturing system with less waste. The idea germinated with him but reached its fruition at Toyota and the Toyota

Production system (TPS) from which JIT evolved. All of the wastes that Ohno identifies – not only those relating to inventory – are attacked with the JIT system.

This broader definition of JIT – elimination of waste – is the one picked up by practitioners of lean, and we can view JIT as the older brother of lean. Operations textbooks of today have a dilemma when dealing with the inherent overlap. One way to handle it is to focus on some of the value added activities involved in the concept itself. For example, Heizer and Render focus on the problem identification that evolved as a part of JIT as have others A better way to handle it is to consider all these collections of tools (JIT, Lean, TPS, lean 6 sigma, agile, lean agile, TQM) as operations science.

Everyday managers who desire to reduce waste or add value will always identify quality as an underlying concept. Ironically, most who discuss quality suggest that JIT is an essential portion of any quality program. Likewise, those who discuss JIT or lean suggest that quality is an essential aspect of their concept. It appears that the more one understands quality the closer they come to the essential understanding of the other major operations science concepts of JIT or Lean.

Lean

Lean management is an integrated socio technical system that involves the simultaneous use of many practices that could be grouped into four bundles, namely just in time (JIT), total quality management (TQM), human resource management (HRM) and total productive maintenance (TPM) [3] [18].

Lean practitioners attempt to fully dismantle a supply chain, question the necessity of every element, and reassemble it in a way that maximizes stability and standardization. There is a tendency toward a more all-encompassing assessment, vs. the Six Sigma laser-focus on a single element. Emphasis is on categorization of all activities into one of two mutually exclusive groups: adding value, or being wasteful.

Stone [19] chronicles specific periods of maturation of the research and academic discussion of lean, categorizing the topics published in specific scholarly articles, described as:

- Discovery phase (1970-1990 – 11 scholarly articles)
- Dissemination phase (1991-1996 – 31 scholarly articles)
- Implementation phase (1997-2001 – 28 scholarly articles)
- Enterprise phase (2001-2005 – 56 scholarly articles)
- Performance phase (2006-2009 – 67 scholarly articles)

He explains, “Simply stated, the lean thinking paradigm differentiates between waste and value within an organization. [141] Womack and Jones (1996, p. 15) defined waste ‘as any human activity which absorbs resources but creates no value’. Value defined as ‘a capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer’ (p. 311). Lean thinking in action is the continuous identification and elimination of waste from an organization’s processes, leaving only value added activities in the value stream” ([98] Rother

and Shook 1999). In summary, the act of identifying and eliminating waste are the hallmarks of the lean thinking paradigm."

The Lean methodology introduced value stream mapping (VSM) as an implementation practice, not explicitly applied in earlier forms of operations science. The essence of Lean tracks directly back to Toyota [20], and practitioners of Lean focus on identifying muda, as it falls into eight forms of waste identified by Ohno and referenced previously. Lean has continued to influence multiple business disciplines. Arora and Soral [1] observe,

> "Lean accounting does not require the traditional management accounting methods like standard costing, activity-based costing, variance reporting, cost plus pricing, complex traditional control system and confusing financial reports. These are replaced by performance measurement chart, value stream costing, box score, plain language financial statement, value-based pricing, etc."

The cornerstone of Lean is the philosophy of intense focus on value to the customer; any step or action throughout an entire supply chain that does not add value in the eyes of the customer is categorized as waste. Waste and value added activities, being mutually exclusive, run in exact correlation under Lean practices. The Lean methodology errs on the side of inventory as a necessary evil, and the necessity for lead times to be minimized – if lead times are being lengthened, they are only cloaking a waste somewhere upstream in the supply chain.

In managing complexity, Lean incorporates the concepts of (a) a throughput rate paced by the customer, as in takt time and Little's Law, and (b) pull, consistent with Kanban and JIT.

Solving problems, not hiding them, is paramount for the Lean management system, pulling in a cultural dimension that confronts a work environment that must accept free and open identification of problems. Quality at the source [6] [13].

THE OVERLAP

The overlap in these groups of techniques is considerable. First, waste reduction or its brother, value added activities, are in the vast majority of discussions of what makes up these two. Second, the broad acceptance of high quality as a foundational paradigm is clear. Third is the overlap with respect to throughput and variability. Shah and Ward [18] develop a list of lean practices from the literature. This list includes at least 10 elements that are directly JIT or Quality. In fact, two of the four bundles used to describe lean systems were JIT and Quality.

Papadopoulou and Ozbayrak [15] point to inherent overlaps due to the common heritage JIT and lean share in the Toyota Production System, and suggest it is difficult to sort out because much of the literature at the time was anecdotal.

Lean production's core thrust is the use of operations science practices (including JIT and Quality systems) to create a streamlined, high quality system producing finished products at the pace of customer demand with little or no waste [18]. J.T. Black [2] suggests that the evolution from the TPS to lean production occurred as a redesign of the mass production system. He suggests that the use of U-shaped subassembly manufacturing cells and four design rules essential to TPS implementation, are in fact synonymous with lean production.

CONCLUSIONS

We have discussed terms frequently used in operations management. A great deal of overlap is shown and we propose using the term Operations Science (George Nazi, Feb 2018) in place of the more restrictive terms seen in the modern applications today, such as operations management, supply chain management, lean, JIT, logistics management, agile or six sigma. The authors propose that a useful curriculum change would be to rename Operations Management courses in the core curriculum to Operations Science courses. The science of operations can capture all of the concepts from the Toyota Production System, JIT, and Lean, not just the ones indigenous to each term.

Mr. Nazi continues to succeed as an executive supporting large enterprises in complex industries that use hardware, software and services in many different forms. When asked to roll out a complicated project that had many complex, interdependent parts, and being familiar with the language associated with all these topics included above, his personal preference was to apply JIT and statistical process control, and to describe them as such. He exploited the terminology overlap when his project sponsor recommended that the most politically astute approach would be to propose it to the CEO using the terminology of Agile. The essence of the need was a process focused on high quality and waste reduction. He used the term "Operations Science" to refer to all the moves he did to ensure the hoped-for result, regardless of whether his training suggested the use of one term or the other.

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Data Analytics and Statistics Instruction (DASI) - Invited sessions only

Analytics Instruction using Real-world Big Data and IBM Watson Analytics in the Classroom

Regular Session

Dr. Robert Andrews [1], ***Prof. Kevin Lertwachara*** [2], ***Prof. Leida Chen*** [2], ***Prof. Eric Kisling*** [3], ***Dr. Mauro Falasca*** [3]

1. *Virginia Commonwealth University,* ***2.*** *Cal Poly,* ***3.*** *East Carolina University*

Session begins with a discussion of using Big Data from real-world sources in Business Analytics courses to give students exposure to working with real life data that are not necessarily small, outdated and/or too 'clean.' Focus will be on preparing students with prerequisite knowledge such as data wrangling, structuring lesson plans for teaching business analytics techniques with Big Data and communicating the analysis results to non-technical audience. The goal is on telling a story with data rather than just doing number crunching. Pedagogical and technical issues and lessons learned will be presented along with Big Data examples. The session will finish by reporting on the experience of using IBM Watson Analytics as a data analysis computational tool in multiple courses at East Carolina University.

Decision Science Issues: The Role of Values in Analytics Based Decision-making & Teaching Large Online Classes

Regular Session

Dr. Robert Andrews [1], ***Dr. Cliff Ragsdale*** [2], ***Dr. Barbara Hoopes*** [2]

1. *Virginia Commonwealth University,* ***2.*** *Virginia Tech*

Much of the focus in analytics education centers on data wrangling and algorithms for extracting actionable insight from data. Consideration of what decision makers want (and ought to want) is often overlooked. The session will begin with a consideration of the central role of values in decision-making and its missing status in analytics education. The session will end by addressing teaching large online classes. A particular focus will be on classes in the data science area, which can be especially challenging since the field is essentially a "moving target" because the field is developing as we teach it.

Examples of Student Projects with Data that have Big Impact

Regular Session

Dr. Robert Andrews [1], ***Dr. Peter Aiken*** [1], ***Dr. Barbara Hoopes*** [2], ***Dr. Cliff Ragsdale*** [2]

1. *Virginia Commonwealth University,* ***2.*** *Virginia Tech*

Presentation of three different situations where student projects have had big impact.
(1) In the Commonwealth of Virginia, universities have been matching classes of graduate students in an initiative to leverage the Commonwealth's data. The program 'employs' classes of graduate students to munge and then analyze various data challenges faced by state agencies. Several million dollars of savings have been attributed to the program and the students benefit from real world experiences.
(2) An Executive MBA Program held a small "BI Bake-off" event similar to Gartner Group's annual Business Intelligence showcase. This type of event is a unique way to motivate and engage students in applying machine learning, data mining, visualization, data storytelling, and the like. More than a competition, it is an opportunity for the students to dig in, analyze some real data, and show what they have learned.
(3) "How Simple Linear Regression Changed the Congressional Budget Process" tells the story of how a project with some MSBA-BA students really did use SLR to change the congressional budgeting process. Even in a world of "big data" there are still problems where "little data" can have a big impact.

Experience with and Advice for Teaching Statistics and Analytics with Excel, R and Python

Regular Session

Dr. Robert Andrews [1], ***Prof. Leslie Hendrix*** [2], ***Prof. Joan Donohue*** [2], ***Dr. Zhixin Kang*** [3], ***Prof. Kellie Keeling*** [4]

1. *Virginia Commonwealth University,* ***2.*** *University of South Carolina,* ***3.*** *UNC Pembroke,* ***4.*** *University of Denver*

Presenters relate their experiences with

1. incorporating R into a newly re-vamped undergraduate Statistics for Business and Economics course;
2. teaching R and Python for online MBA classes that includes a discussion of how to assess online students' learning outcomes for using R and Python; and
3. developing an Excel/Python/R Comparison Guide to reduce confusion for students across classes by using a guide that presents some common tasks such as reading in, summarizing, and graphing data across the three software programs.

Factors that Impact a Good Result for a Quantitative Course or Data Analysis

Regular Session

Dr. Robert Andrews [1], ***Dr. Ping Wang*** [2], ***Prof. Wilma Andrews*** [1]

1. *Virginia Commonwealth University,* ***2.*** *James Madison University*

Since studies have revealed students' positive attitudes toward business statistics significantly impact course performance, this session reports on efforts to actively engage students inside and outside of classes. Findings will be reported for four surveys of students' attitudes from the first day to the last day of the semester. For a data analysis to have a good result, it must effectively tell a story that will be understood by the target audience. Good data visualization plays an important role in effective communication. Dataviz is a hot topic in the presentation world and an area students need to be better at in their professional roles. Resources will be given that will help faculty and students learn how to better visualize data.

Interactive Discussion of Resources Most Valuable to a Data, Analytics or Statistics Instructor

Regular Session

Dr. Robert Andrews [1], ***Ms. Nicole Defazio*** [2], ***Prof. Kellie Keeling*** [3], ***Ms. Noelle Bathurst*** [4], ***Mr. Kevin Potcner*** [5], ***Prof. William Miller*** [6], ***Mr. Patrick Barbera*** [7]

1. *Virginia Commonwealth University,* ***2.*** *Minitab,* ***3.*** *University of Denver,* ***4.*** *McGraw-Hill Education,* ***5.*** *JMP,* ***6.*** *Georgia College & State University,* ***7.*** *Pearson*

Panel lead discussion of resources that provide the most help to instructors of courses in data, analytics and statistics. The panel includes representatives from potential providers of resources (leaders from the DSI DASI SIG, software providers, and authors & publishers of text material). The publishers and software providers strive to provide resources that will assist with instruction. In addition to conference sessions, a goal for the Data, Analytics and Statistics Instruction Specific Interest Group is to provide instructional resources on the DSI website, such as a list of suitable course project databases.

Operationalizing Python for Machine Learning and the Classroom

Regular Session

Dr. Charles Apigian [1]

1. *Middle Tenn. State*

The challenge that many run into when teaching predictive analytics and machine learning is not only teaching the topics, but also the programming language that is needed to execute the techniques. Python continues to gain momentum for use in different machine learning models and data cleansing techniques and is now a viable tool to use in data science. This presentation looks at not only using Python to build models, but also operationalizing its use to indicate a business driven process for data cleansing, transforming, fitting, predicting, and understanding models used in machine learning.

Statistics Instruction: Truncated Poisson, Hypothesis Testing & Student Engagement with Q/A Games

Regular Session

Dr. Robert Andrews [1], ***Prof. Clint Harshaw*** [2], ***Prof. Clay Harshaw*** [3], ***Prof. Reza Kheirandish*** [4], ***Ms. Leslie Dutt*** [5]

1. *Virginia Commonwealth University,* ***2.*** *Presbyterian College,* ***3.*** *Winston-Salem State Univ.,* ***4.*** *Clayton State University,* ***5.*** *James Madison University*

(1) Some real-world scenarios, such as the number of items purchased at a checkout, may guarantee that the count of occurrences is greater than zero, which can be modeled by the "truncated" Poisson. The presentation focuses on intuitive instructional techniques to develop the distribution function, derive its mean and variance, simulate random variates in R, and estimate the modified parameter using sample data.

(2) Hypothesis Testing, despite its popularity, is a controversial topic. Thoughtful and intelligent statisticians and researchers have major disagreements about its value. In addition to a brief overview of the controversy, the results of a pilot study on Hypothesis Testing literacy among academics and practitioners will be compared to results in the literature.

(3) Students can feel frustrated when they feel they understand lectures, but don't know how to use what they have learned for solving problems and answering questions. The presentation will show how a Q/A response game like Kahoot! can be used to keep students engaged. Assessments of students' learning outcomes with and without Kahoot! will be discussed.

Value of Software for Teaching Variable Reduction and Healthcare Quality

Regular Session

Dr. Robert Andrews [1], ***Mr. Kevin Potcner*** [2], ***Dr. Rose Sebastianelli*** [3]

1. *Virginia Commonwealth University,* ***2.*** *JMP,* ***3.*** *University of Scranton*

Presenters demonstrate how the JMP and Minitab computational software packages can be used effectively to teach students data manipulation and quality management procedures in introductory classes. Many real-world business data sets have many variables and dimension reduction by creating a few new variables that explain the majority of the variability of a much larger number of variables is useful and can be understood without advanced statistical knowledge. Similarly, the same is true for being able to identify clusters of observed entities with similar characteristics. Quality in the healthcare industry is especially important. Maintaining and improving quality can be accomplished through proper analysis of appropriate data. Many business statistics classes mainly focus on procedures for data from a fixed population, but business situations, like healthcare, have data generated by a process. Business students should be able to understand process improvement methods and analyze quality related data.

Experience with and Advice for Teaching Statistics and Analytics with Excel, R and Python

Session Presenters:

Leslie Hendrix
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Kellie Keeling
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Session Chair and Organizer:

Robert L. Andrews,
Virginia Commonwealth University,
randrews@vcu.edu

Presented in a **Data, Analytics and Statistics Instruction** session at SEDSI 2019.

ABSTRACT

Presenters relate their experiences with

1. incorporating R into a newly re-vamped undergraduate Statistics for Business and Economics course;
2. teaching R and Python for online MBA classes that includes a discussion of how to assess online students' learning outcomes for using R and Python; and
3. developing an Excel/Python/R Comparison Guide to reduce confusion for students across classes by using the guide that presents some common tasks such as reading in, summarizing, and graphing data across the three software programs.

Teaching Variable Reduction Techniques in Introductory Statistics Courses

DRAFT January 11th, 2019

Kevin Potcner | JMP Academic Ambassador
kevin.Potcner@jmp.com

Teaching Variable Reduction in Introductory Statistics Courses

Statistical techniques that deal with dimensionality reduction have been traditionally reserved for more advanced classes and thus not included in the typical Intro Stat courses. Data analysis efforts that these techniques are quite useful for are becoming rather common place in today's business environments. As a result, it is the presenter's belief that students taking a one or two semester statistical class should be exposed to these tools. And since these techniques do not require having a background in inferential statistical (i.e., p values, confidence intervals, etc.) but in fact rather basic concepts such as averages, variation, and correlation, it is also the presenter's belief that students in an Intro Stat course can easily handle the concepts and successfully apply the tools to myriad situations. In this talk, the presenter will illustrate how he has been teaching these techniques to students early in their education of the statistical sciences.

Variable Reduction & Selection

Creating Composite Scores


Wine Quality

Wine Quality

2 Visual Characteristics + Quality Score

A	B	C	D
Wine	Visual_Quality	Visual_Color	Visual_Clarity
A	5.21	5.02	4.81
B	5.51	5.41	4.98
C	4.90	4.79	4.52
D	6.40	6.07	5.38
E	6.14	5.92	5.29
F	6.20	5.84	5.10
G	6.05	5.85	5.29
H	5.69	5.41	5.11
I	6.72	6.56	5.41
J	6.07	5.89	5.44
K	5.92	5.41	5.16
L	5.78	5.63	5.33
M	5.69	5.38	5.20
N	4.59	4.55	4.47
O	6.30	5.97	5.33
P	6.32	6.11	5.27

Wine Quality

4 Pre-Agitation Aroma Characteristics + Quality Score

A	E	F	G	H	I
Wine	Pre-Ag Aroma_Quality	Pre-Ag Aroma_Intensity	Pre-Ag Aroma_Fruit	Pre-Ag Aroma_Flower	Pre-Ag Aroma_Spice
A	4.81	5.00	4.38	4.28	3.70
B	4.71	4.86	4.56	3.96	4.07
C	4.60	4.80	4.41	3.93	4.18
D	5.43	5.59	5.13	4.16	4.01
E	5.21	5.21	4.98	4.13	4.04
F	4.89	5.12	4.43	4.19	4.19
G	4.67	4.87	4.83	3.90	4.09
H	5.02	4.89	4.59	3.85	3.68
I	4.60	5.08	4.73	4.12	3.81
J	5.15	5.12	4.84	4.19	3.95
K	5.18	4.91	4.86	4.00	4.04
L	5.19	5.04	5.06	4.27	3.66
M	4.85	5.08	4.72	3.96	3.90
N	4.79	4.64	4.56	3.89	3.81
O	5.17	5.69	4.82	3.83	4.37
P	4.74	5.68	4.53	4.05	4.64

Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score

A	J	K	L	M	N	O
Wine	Post-Ag Aroma_Quality	Post-Ag Aroma_Intensity	Post-Ag Aroma_Fruit	Post-Ag Aroma_Flower	Post-Ag Aroma_Spice	Post-Ag Aroma_Persistence
A	4.99	5.39	4.55	4.42	3.75	4.81
B	4.91	5.27	4.75	4.22	4.23	4.80
C	4.86	5.18	4.41	4.08	4.18	4.56
D	5.40	5.54	5.15	4.25	4.16	5.30
E	5.51	5.47	5.02	4.16	4.34	5.23
F	5.07	5.64	4.51	4.34	4.46	5.13
G	5.36	5.35	5.01	4.02	4.13	4.93
H	5.31	5.20	4.90	4.04	4.01	4.67
I	5.43	5.38	4.89	4.11	4.38	5.11
J	5.38	5.35	4.86	4.26	4.29	5.05
K	5.29	5.29	5.13	4.25	4.01	4.95
L	5.49	5.42	5.18	4.14	4.23	5.28
M	5.43	5.37	4.93	4.32	3.92	4.89
N	5.15	4.85	4.49	3.93	4.11	4.33
O	5.09	5.77	4.85	3.78	4.43	4.96
P	4.90	5.71	4.61	4.09	4.65	5.16

Wine Quality

8 Taste Characteristics + Quality Score

A	P	Q	R	S	T	U	V	W	X
Wine	Taste_Quality	Taste_Intensity	Taste_Acidity	Taste_Astringency	Taste_Body	Taste_Balance	Taste_Smoothness	Taste_Bitterness	Taste_Harmony
A	5.21	4.86	4.15	4.13	4.67	4.94	4.48	3.95	4.97
B	5.54	5.08	4.19	4.25	4.62	5.31	4.66	3.99	5.12
C	4.46	4.48	5.20	4.19	4.52	4.35	3.70	3.92	4.00
D	5.75	5.64	4.59	4.55	4.79	5.50	5.05	4.04	5.65
E	5.71	5.66	4.57	4.59	4.77	5.48	4.84	3.92	5.56
F	5.40	5.30	4.21	4.65	4.82	5.18	4.79	3.98	5.30
G	5.22	5.14	4.31	4.41	4.75	5.14	4.84	3.94	5.26
H	5.20	4.86	4.33	4.24	4.71	5.18	4.51	4.20	4.97
I	5.91	5.68	4.11	4.57	4.77	5.42	5.22	4.06	5.77
J	5.64	5.30	4.32	4.66	4.96	5.29	4.81	4.13	5.29
K	5.76	5.22	4.39	4.36	4.71	5.32	4.99	4.01	5.21
L	5.50	5.32	4.59	4.29	4.92	5.31	4.84	4.15	5.28
M	5.47	5.04	4.41	4.29	4.86	5.17	4.59	4.13	5.05
N	4.36	4.18	4.23	3.96	4.25	4.47	3.83	3.68	4.08
O	4.64	5.07	4.41	4.60	4.99	4.56	4.07	4.27	4.74
P	4.86	5.32	4.57	4.67	4.69	4.76	4.28	4.66	4.98

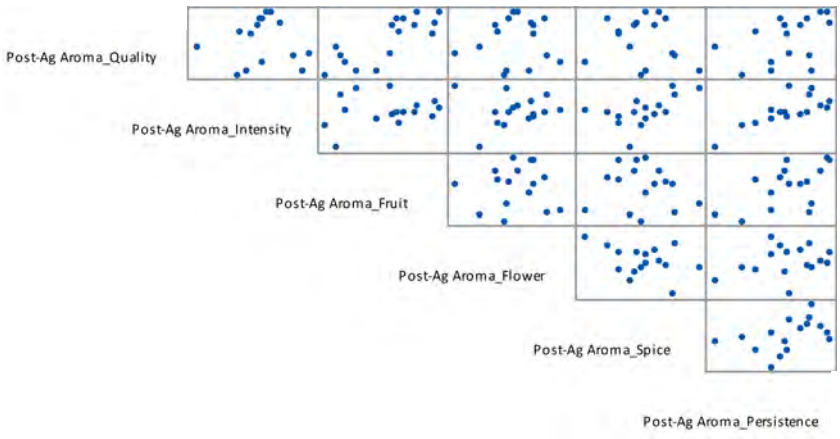
Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score

A	J	K	L	M	N	O
Wine	Post-Ag Aroma_Quality	Post-Ag Aroma_Intensity	Post-Ag Aroma_Fruit	Post-Ag Aroma_Flower	Post-Ag Aroma_Spice	Post-Ag Aroma_Persistence
A	4.99	5.39	4.55	4.42	3.75	4.81
B	4.91	5.27	4.75	4.22	4.23	4.80
C	4.86	5.18	4.41	4.08	4.18	4.56
D	5.40	5.54	5.15	4.25	4.16	5.30
E	5.51	5.47	5.02	4.16	4.34	5.23
F	5.07	5.64	4.51	4.34	4.46	5.13
G	5.36	5.35	5.01	4.02	4.13	4.93
H	5.31	5.20	4.90	4.04	4.01	4.67
I	5.43	5.38	4.89	4.11	4.38	5.11
J	5.38	5.35	4.86	4.26	4.29	5.05
K	5.29	5.29	5.13	4.25	4.01	4.95
L	5.49	5.42	5.18	4.14	4.23	5.28
M	5.43	5.37	4.93	4.32	3.92	4.89
N	5.15	4.85	4.49	3.93	4.11	4.33
O	5.09	5.77	4.85	3.78	4.43	4.96
P	4.90	5.71	4.61	4.09	4.65	5.16

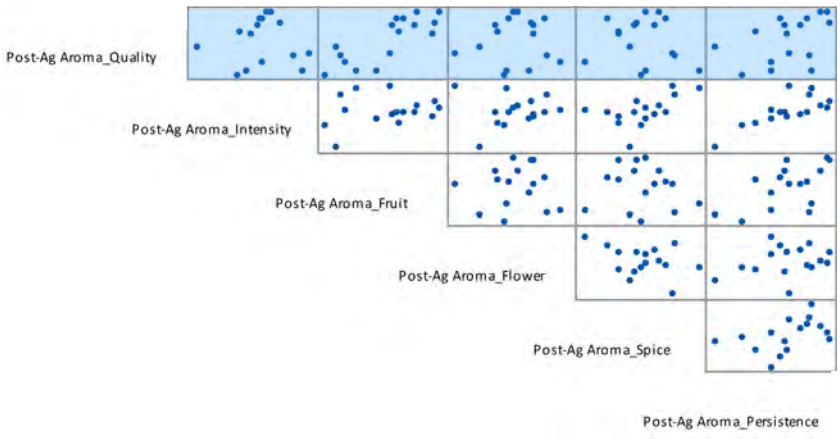
Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score



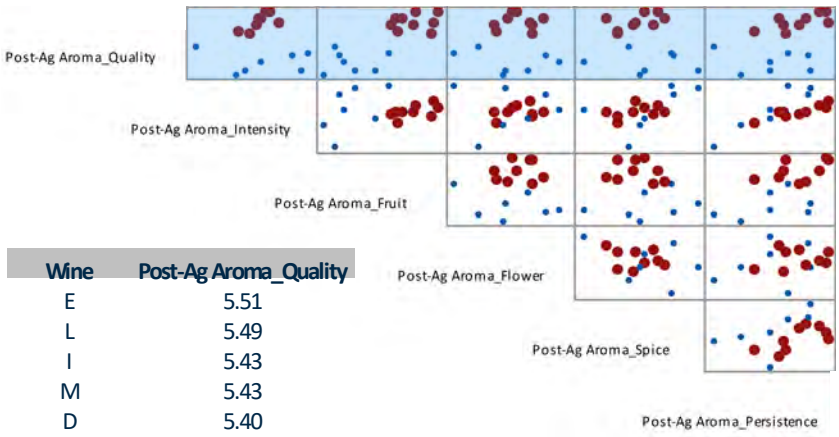
Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score



Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score



Wine	Post-Ag Aroma_Quality
E	5.51
L	5.49
I	5.43
M	5.43
D	5.40
J	5.38
G	5.36
H	5.31
K	5.29

Wine Quality

A	B	E	J	P
Wine	Visual_Quality	Pre-Ag Aroma_Quality	Post-Ag Aroma_Quality	Taste_Quality
A	5.21	4.81	4.99	5.21
B	5.51	4.71	4.91	5.54
C	4.90	4.60	4.86	4.46
D	6.40	5.43	5.40	5.75
E	6.14	5.21	5.51	5.71
F	6.20	4.89	5.07	5.40
G	6.05	4.67	5.36	5.22
H	5.69	5.02	5.31	5.20
I	6.72	4.60	5.43	5.91
J	6.07	5.15	5.38	5.64
K	5.92	5.18	5.29	5.76
L	5.78	5.19	5.49	5.50
M	5.69	4.85	5.43	5.47
N	4.59	4.79	5.15	4.36
O	6.30	5.17	5.09	4.64
P	6.32	4.74	4.90	4.86

Wine Quality

A	B	E	J	P	Y
Wine	Visual_Quality	Pre-Ag Aroma_Quality	Post-Ag Aroma_Quality	Taste_Quality	Overall Quality
A	5.21	4.81	4.99	5.21	5.10
B	5.51	4.71	4.91	5.54	5.26
C	4.90	4.60	4.86	4.46	4.62
D	6.40	5.43	5.40	5.75	5.68
E	6.14	5.21	5.51	5.71	5.63
F	6.20	4.89	5.07	5.40	5.32
G	6.05	4.67	5.36	5.22	5.26
H	5.69	5.02	5.31	5.20	5.25
I	6.72	4.60	5.43	5.91	5.68
J	6.07	5.15	5.38	5.64	5.54
K	5.92	5.18	5.29	5.76	5.57
L	5.78	5.19	5.49	5.50	5.48
M	5.69	4.85	5.43	5.47	5.39
N	4.59	4.79	5.15	4.36	4.65
O	6.30	5.17	5.09	4.64	4.99
P	6.32	4.74	4.90	4.86	5.00

Wine Quality

A	B	E	J	P	Y
Wine	Visual_Quality	Pre-Ag Aroma_Quality	Post-Ag Aroma_Quality	Taste_Quality	Overall Quality
A	5.21	4.81	4.99	5.21	5.10
B	5.51	4.71	4.91	5.54	5.26
C	4.90	4.60	4.86	4.46	4.62
D	6.40	5.43	5.40	5.75	5.68
E	6.14	5.21	5.51	5.71	5.63
F	6.20	4.89	5.07	5.40	5.32
G	6.05	4.67	5.36	5.22	5.26
H	5.69	5.02	5.31	5.20	5.25
I	6.72	4.60	5.43	5.91	5.68
J	6.07	5.15	5.38	5.64	5.54
K	5.92	5.18	5.29	5.76	5.57
L	5.78	5.19	5.49	5.50	5.48
M	5.69	4.85	5.43	5.47	5.39
N	4.59	4.79	5.15	4.36	4.65
O	6.30	5.17	5.09	4.64	4.99
P	6.32	4.74	4.90	4.86	5.00

Overall Quality = 0.10 • *Visual Quality*
+ 0.15 • *Pre-Ag Aroma Quality*
+ 0.25 • *Post-Ag Aroma Quality*
+ 0.50 • *Taste Quality*

Wine Quality

A	B	E	J	P	Y
Wine	Visual_Quality	Pre-Ag Aroma_Quality	Post-Ag Aroma_Quality	Taste_Quality	Overall Quality
A	5.21	4.81	4.99	5.21	5.10
B	5.51	4.71	4.91	5.54	5.26
C	4.90	4.60	4.86	4.46	4.62
D	6.40	5.43	5.40	5.75	5.68
E	6.14	5.21	5.51	5.71	5.63
F	6.20	4.89	5.07	5.40	5.32
G	6.05	4.67	5.36	5.22	5.26
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I	6.72	4.60	5.43	5.91	5.68
J	6.07	5.15	5.38	5.64	5.54
K	5.92	5.18	5.29	5.76	5.57
L	5.78	5.19	5.49	5.50	5.48
M	5.69	4.85	5.43	5.47	5.39
N	4.59	4.79	5.15	4.36	4.65
O	6.30	5.17	5.09	4.64	4.99
P	6.32	4.74	4.90	4.86	5.00

$$\begin{aligned}\textbf{Overall Quality} = \; & 0.10 \bullet \textit{4.90} \\ & + 0.15 \bullet \textit{4.60} \\ & + 0.25 \bullet \textit{4.86} \\ & + 0.50 \bullet \textit{4.46} \;\; = \mathbf{4.62}\end{aligned}$$

Wine Quality

A		Z	AA
Wine		Recommended Price	Actual Price
A		13.10	15.00
B		17.80	17.00
C		12.00	15.00
D		23.90	17.00
E		19.30	17.00
F		11.00	14.00
G		9.50	13.00
H	...	11.70	16.00
I		26.10	19.00
J		18.00	18.00
K		14.40	12.00
L		16.60	16.00
M		17.10	19.00
N		14.50	11.00
O		14.00	10.00
P		15.80	13.00

Wine Quality

A	Z	AA	AB
Wine	Recommended Price	Actual Price	Price Diff
A	13.10	15.00	-1.90
B	17.80	17.00	0.80
C	12.00	15.00	-3.00
D	23.90	17.00	6.90
E	19.30	17.00	2.30
F	11.00	14.00	-3.00
G	9.50	13.00	-3.50
H	11.70	16.00	-4.30
I	26.10	19.00	7.10
J	18.00	18.00	0.00
K	14.40	12.00	2.40
L	16.60	16.00	0.60
M	17.10	19.00	-1.90
N	14.50	11.00	3.50
O	14.00	10.00	4.00
P	15.80	13.00	2.80

. . .

Price Diff = Recommended Price – Actual Price

Wine Quality

Created 2 Variables that incorporate information contained across 25 variables

Wine Quality

Wine Quality

4 Pre-Agitation Aroma Characteristics + Quality Score

A	E	F	G	H	I
Wine	Pre-Ag Aroma_Quality	Pre-Ag Aroma_Intensity	Pre-Ag Aroma_Fruit	Pre-Ag Aroma_Flower	Pre-Ag Aroma_Spice
A	4.81	5.00	4.38	4.28	3.70
B	4.71	4.86	4.56	3.96	4.07
C	4.60	4.80	4.41	3.93	4.18
D	5.43	5.59	5.13	4.16	4.01
E	5.21	5.21	4.98	4.13	4.04
F	4.89	5.12	4.43	4.19	4.19
G	4.67	4.87	4.83	3.90	4.09
H	5.02	4.89	4.59	3.85	3.68
I	4.60	5.08	4.73	4.12	3.81
J	5.15	5.12	4.84	4.19	3.95
K	5.18	4.91	4.86	4.00	4.04
L	5.19	5.04	5.06	4.27	3.66
M	4.85	5.08	4.72	3.96	3.90
N	4.79	4.64	4.56	3.89	3.81
O	5.17	5.69	4.82	3.83	4.37
P	4.74	5.68	4.53	4.05	4.64

Wine Quality

5 Post-Agitation Aroma Characteristics + Quality Score

A	J	K	L	M	N	O
Wine	Post-Ag Aroma_Quality	Post-Ag Aroma_Intensity	Post-Ag Aroma_Fruit	Post-Ag Aroma_Flower	Post-Ag Aroma_Spice	Post-Ag Aroma_Persistence
A	4.99	5.39	4.55	4.42	3.75	4.81
B	4.91	5.27	4.75	4.22	4.23	4.80
C	4.86	5.18	4.41	4.08	4.18	4.56
D	5.40	5.54	5.15	4.25	4.16	5.30
E	5.51	5.47	5.02	4.16	4.34	5.23
F	5.07	5.64	4.51	4.34	4.46	5.13
G	5.36	5.35	5.01	4.02	4.13	4.93
H	5.31	5.20	4.90	4.04	4.01	4.67
I	5.43	5.38	4.89	4.11	4.38	5.11
J	5.38	5.35	4.86	4.26	4.29	5.05
K	5.29	5.29	5.13	4.25	4.01	4.95
L	5.49	5.42	5.18	4.14	4.23	5.28
M	5.43	5.37	4.93	4.32	3.92	4.89
N	5.15	4.85	4.49	3.93	4.11	4.33
O	5.09	5.77	4.85	3.78	4.43	4.96
P	4.90	5.71	4.61	4.09	4.65	5.16

Wine Quality

A	G	L
Wine	Pre-Ag Aroma_Fruit	Post-Ag Aroma_Fruit
A	4.38	4.55
B	4.56	4.75
C	4.41	4.41
D	5.13	5.15
E	4.98	5.02
F	4.43	4.51
G	4.83	5.01
H	4.59	4.90
I	4.73	4.89
J	4.84	4.86
K	4.86	5.13
L	5.06	5.18
M	4.72	4.93
N	4.56	4.49
O	4.82	4.85
P	4.53	4.61

Wine Quality

A	G	L	
Wine	Pre-Ag Aroma_Fruit	Post-Ag Aroma_Fruit	Fruit Aroma
A	4.38	4.55	4.50
B	4.56	4.75	4.69
C	4.41	4.41	4.41
D	5.13	5.15	5.14
E	4.98	5.02	5.01
F	4.43	4.51	4.49
G	4.83	5.01	4.96
H	4.59	4.90	4.81
I	4.73	4.89	4.84
J	4.84	4.86	4.85
K	4.86	5.13	5.05
L	5.06	5.18	5.14
M	4.72	4.93	4.87
N	4.56	4.49	4.51
O	4.82	4.85	4.84
P	4.53	4.61	4.59

$$\textbf{Overall Fruit Aroma} = 0.30 \bullet \textit{Pre-Ag Aroma\_Fruit} + 0.70 \bullet \textit{Post-Ag Aroma\_Fruit}$$

Variable Reduction & Selection

Methods

- Select the most important or representative variables based on subject matter expertise and/or prior knowledge of the system/process under study
- Select variables aligned with the preference and needs of the consumers of the analysis work
- Remove variables that are correlated with others variables
- Create composite variables
  - Subject matter expertise and interpretation
  - Needs and objectives of the analysis
  - Through a statistical procedure (e.g., Principal Component Analysis)

Variable Reduction & Selection

Correlation and Cluster Variables

Executive Dashboard for Home-Improvement Retailer

Executive Dashboard for Home-Improvement Retailer

Senior marketing executives of a home-improvement retailer have requested the development of a dashboard that would provide them with visibility into the economic environment and consumer's engagement with home-improvement related activities. It was determined that a dashboard displaying 4-5 metrics would be a concise way for the executives to get a read on the current economic conditions and consumer's engagement as they plan marketing and sales strategies for the upcoming quarter. Some preliminary analysis and research work identified 11 key economic and engagement metrics that are candidates for the dashboard.

Monthly values from Jan2009 to Dec 2013 for each of the 11 economic and engagement metrics were collected and organized in a worksheet. All the variables were standardized to have a mean of 0 and a standard deviation of 1 so that they are all on the same scale.

Select 4-5 variables that represent the information and features contained across all 11 variables.

Executive Dashboard

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Year	Month	Date	S&P	Cons Conf	Emp Level	Home Sales	Money Supply	Short Term Savings	Mid-to-Long Term Savings	Disp Income	Spending on HI	HI Shopping	Comp Spec Shopping
2	2011	Jan	Jan-11	-0.85	-0.13	-2.2	-1.7	-1.79	-1.75	-1.74	-1.83	-1.72	-1.66	-1.87
3	2011	Feb	Feb-11	-0.63	0.62	-1.96	-1.53	-1.78	-1.67	-1.71	-1.59	-1.77	-1.49	-1.15
4	2011	Mar	Mar-11	-0.73	-0.24	-1.53	-0.46	-1.57	-1.55	-1.69	-1.52	-1.6	-0.93	-1.47
5	2011	Apr	Apr-11	-0.58	-0.07	-1.19	-0.11	-1.53	-1.42	-1.58	-1.46	-1.42	-1.64	-1.61
6	2011	May	May-11	-0.53	-0.45	-1.01	-0.46	-1.47	-1.47	-1.39	-1.35	-1.39	-1.01	-1.13
7	2011	Jun	Jun-11	-0.83	-0.88	-0.96	-0.46	-1.38	-1.31	-1.19	-1.17	-0.94	-0.71	-0.78
8	2011	Jul	Jul-11	-0.59	-0.71	-0.84	-0.64	-1.22	-1.08	-1	-0.93	-1.09	-0.71	-0.84
9	2011	Aug	Aug-11	-1.41	-2.24	-0.86	-0.99	-0.78	-0.91	-0.81	-0.91	-0.86	-1.06	-1.12
10	2011	Sep	Sep-11	-1.46	-2.04	-0.78	-1.17	-0.79	-0.81	-0.61	-1	-0.78	0.46	0
11	2011	Oct	Oct-11	-1.29	-2.61	-0.54	-0.99	-0.67	-0.75	-0.53	-1	-0.76	-1.22	-1.21
12	2011	Nov	Nov-11	-1.18	-1.05	-0.5	-1.35	-0.52	-0.65	-0.54	-1.06	-0.71	-0.23	-0.16
13	2011	Dec	Dec-11	-1.07	-0.13	-0.69	-1.17	-0.34	-0.56	-0.55	-0.78	-0.55	-0.76	-0.93
14	2012	Jan	Jan-12	-0.75	-0.47	-1.05	-1.35	-0.34	-0.48	-0.53	-0.41	-0.55	-0.85	-0.45
15	2012	Feb	Feb-12	-0.45	0.57	-0.69	-0.11	-0.4	-0.32	-0.49	-0.13	-0.44	-1.33	-0.77
16	2012	Mar	Mar-12	-0.24	0.36	-0.33	0.6	-0.18	-0.19	-0.45	0	-0.37	-0.76	-0.38
17	2012	Apr	Apr-12	-0.25	0.27	-0.05	0.6	-0.09	-0.12	-0.35	0.09	-0.24	0.26	-0.2
18	2012	May	May-12	-0.5	-0.17	0.31	0.78	-0.17	-0.16	-0.19	0.05	-0.02	0.58	0.06
19	2012	Jun	Jun-12	-0.62	-0.35	0.55	0.6	-0.1	-0.04	-0.04	0.16	0.19	0.3	-0.09
20	2012	Jul	Jul-12	-0.41	-0.07	0.51	0.42	0.07	-0.01	0.09	0.08	0.2	0.43	0.21
21	2012	Aug	Aug-12	-0.15	-0.5	0.23	0.07	0.16	0.08	0.19	0.06	0.16	-0.93	-0.62
22	2012	Sep	Sep-12	0.08	0.44	0.61	-0.11	0.25	0.23	0.3	0.28	0.53	0.1	0.07
23	2012	Oct	Oct-12	0.05	0.73	0.96	-0.29	0.49	0.29	0.44	0.44	0.33	0.62	0.77
24	2012	Nov	Nov-12	-0.21	0.56	0.72	-0.46	0.49	0.65	0.61	0.66	0.71	0.48	0.32
25	2012	Dec	Dec-12	-0.04	-0.15	0.48	-0.46	0.88	0.8	0.78	0.98	0.73	1.14	0.89
26	2013	Jan	Jan-13	0.28	-0.8	-0.23	0.25	0.77	0.75	0.78	0.76	0.33	0.78	0.57
27	2013	Feb	Feb-13	0.47	0.2	0.07	0.95	0.66	0.78	0.69	0.51	0.46	-0.1	0
28	2013	Mar	Mar-13	0.69	-0.43	0.3	1.84	0.83	0.96	0.59	0.64	0.45	0.84	0.77
29	2013	Apr	Apr-13	0.8	0.3	0.8	2.2	1.02	0.95	0.68	0.62	0.63	1.04	1.54
30	2013	May	May-13	1.21	0.85	1.15	1.66	0.92	0.89	0.9	0.77	0.97	1.11	0.93
31	2013	Jun	Jun-13	1.09	1.66	1.35	2.2	0.94	1	1.13	0.9	0.99	0.23	0.78
32	2013	Jul	Jul-13	1.37	1.55	1.48	0.42	1.03	1.04	1.22	1.02	1.1	0.36	1
33	2013	Aug	Aug-13	1.39	1.63	1.19	0.07	1.02	1.16	1.25	1.31	1.12	0.28	0.64
34	2013	Sep	Sep-13	1.48	1.47	1.25	0.07	1.1	1.26	1.26	1.52	1.36	1.86	1.96
35	2013	Oct	Oct-13	1.66	0.66	1.01	0.95	1.37	1.38	1.35	1.41	1.49	1.93	1.81
36	2013	Nov	Nov-13	2.02	0.45	1.32	0.25	1.32	1.51	1.49	1.47	1.59	1.38	1.29
37	2013	Dec	Dec-13	2.17	1.19	1.14	-0.11	1.76	1.53	1.62	1.39	1.86	1.22	1.17

Monthly values from Jan 2011 – Dec 2013

Executive Dashboard

	A	B	C
1	**Year**	**Month**	**Date**
2	2011	Jan	Jan-11
3	2011	Feb	Feb-11
4	2011	Mar	Mar-11
5	2011	Apr	Apr-11
6	2011	May	May-11
7	2011	Jun	Jun-11
8	2011	Jul	Jul-11
9	2011	Aug	Aug-11

Executive Dashboard

C	D	E	F	G
Date	S&P	Cons Conf	Emp Level	Home Sales
Jan-11	-0.85	-0.13	-2.2	-1.7
Feb-11	-0.63	0.62	-1.96	-1.53
Mar-11	-0.73	-0.24	-1.53	-0.46
Apr-11	-0.58	-0.07	-1.19	-0.11
May-11	-0.53	-0.45	-1.01	-0.46
Jun-11	-0.83	-0.88	-0.96	-0.46
Jul-11	-0.59	-0.71	-0.84	-0.64
Aug-11	-1.41	-2.24	-0.86	-0.99

Executive Dashboard

C	H	I	J
Date	Money Supply	Short Term Savings	Mid-to-Long Term Savings
Jan-11	-1.79	-1.75	-1.74
Feb-11	-1.78	-1.67	-1.71
Mar-11	-1.57	-1.55	-1.69
Apr-11	-1.53	-1.42	-1.58
May-11	-1.47	-1.47	-1.39
Jun-11	-1.38	-1.31	-1.19
Jul-11	-1.22	-1.08	-1
Aug-11	-0.78	-0.91	-0.81

Executive Dashboard

C	K	L	M	N
Date	Disp Income	Spending on HI	HI Shopping	Comp Spec Shopping
Jan-11	-1.83	-1.72	-1.66	-1.87
Feb-11	-1.59	-1.77	-1.49	-1.15
Mar-11	-1.52	-1.6	-0.93	-1.47
Apr-11	-1.46	-1.42	-1.64	-1.61
May-11	-1.35	-1.39	-1.01	-1.13
Jun-11	-1.17	-0.94	-0.71	-0.78
Jul-11	-0.93	-1.09	-0.71	-0.84
Aug-11	-0.91	-0.86	-1.06	-1.12

⋮

Executive Dashboard

Examine the relationships and correlations between all the variables…

Executive Dashboard

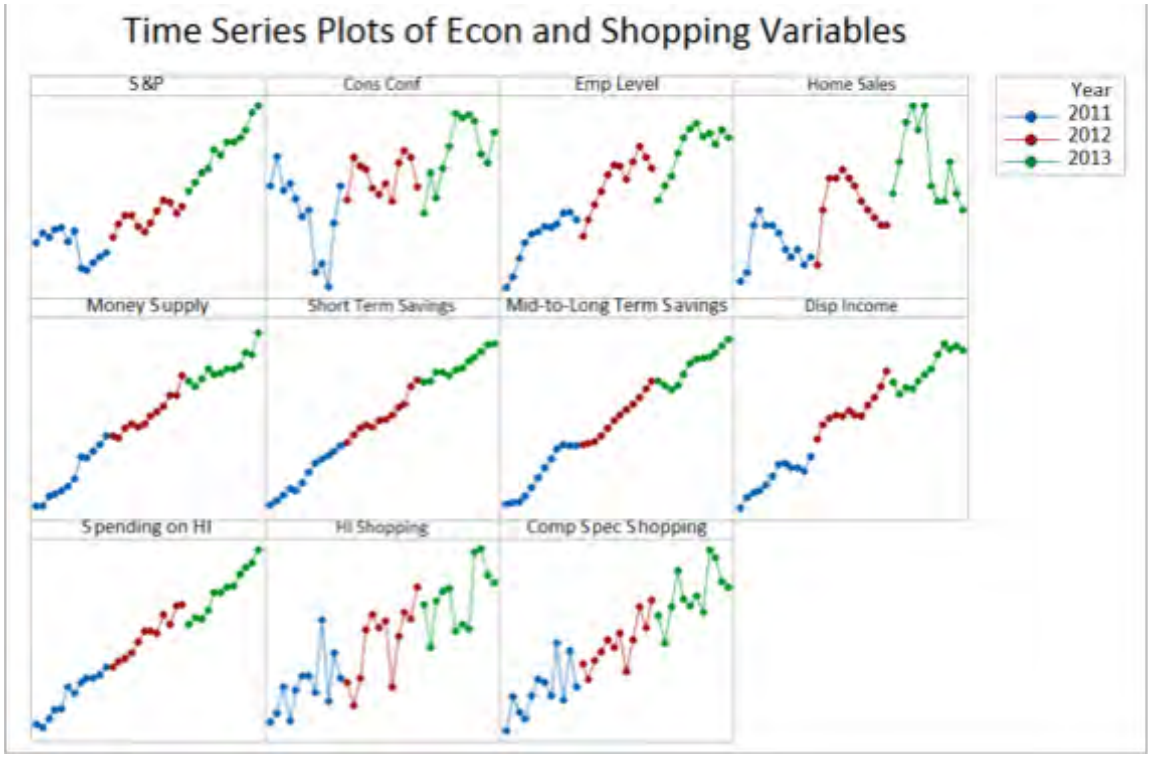
Steps to create a Time Series Graph In Minitab

1. Choose **Graph > Time Series Plot > With Groups**
2. Select all the variables from *S&P* through *Comp Spec Shopping* (C4-C14) for the Variables
3. Select the variable *Year* for the Categorical Variable
4. Click **Multiple Graphs**
5. Choose **In separate panels of the same graph** for Show Graph Variables
6. Click **OK** in each Dialog Box

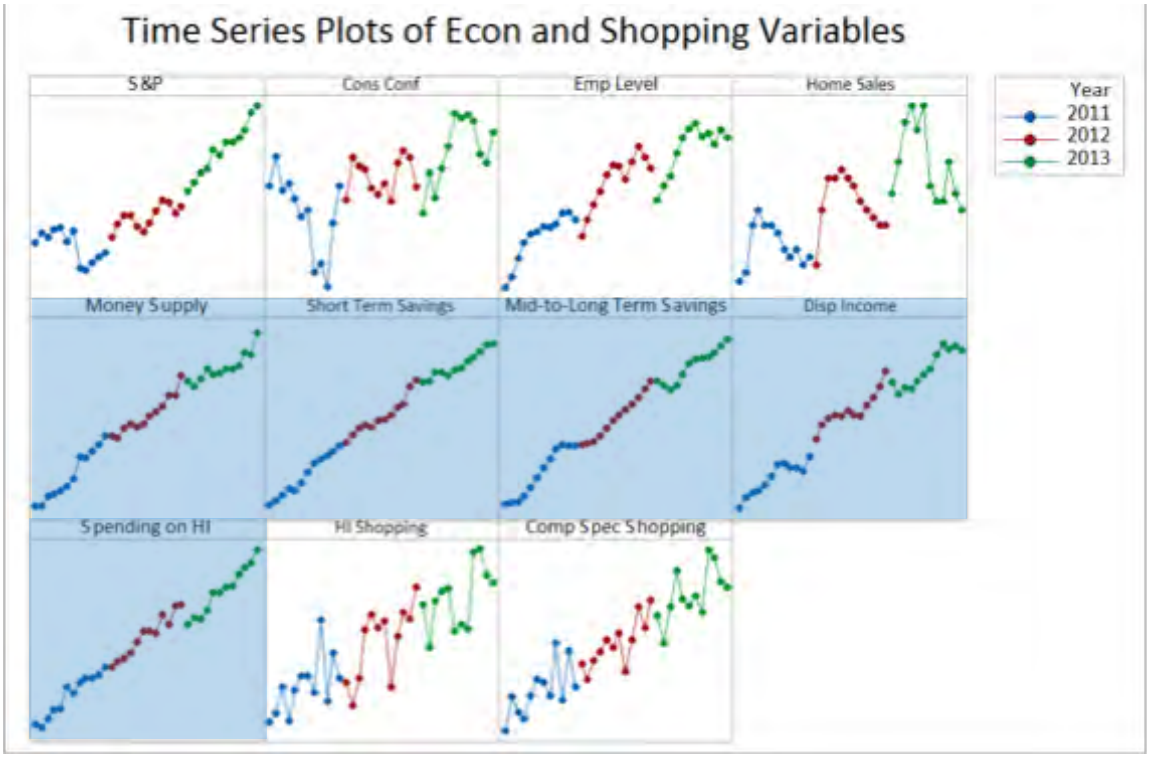
Steps to create a Matrix Plot in Minitab

1. Choose **Graph > Matrix Plot > With Groups**
2. Select all the variables from *S&P* through *Comp Spec Shopping* (C4-C14) for the Variables
3. Select the variable *Year* for the Categorical Variable
4. Click **Matrix Options**
5. Choose **Upper Right**
6. Click **OK** in each Dialog Box

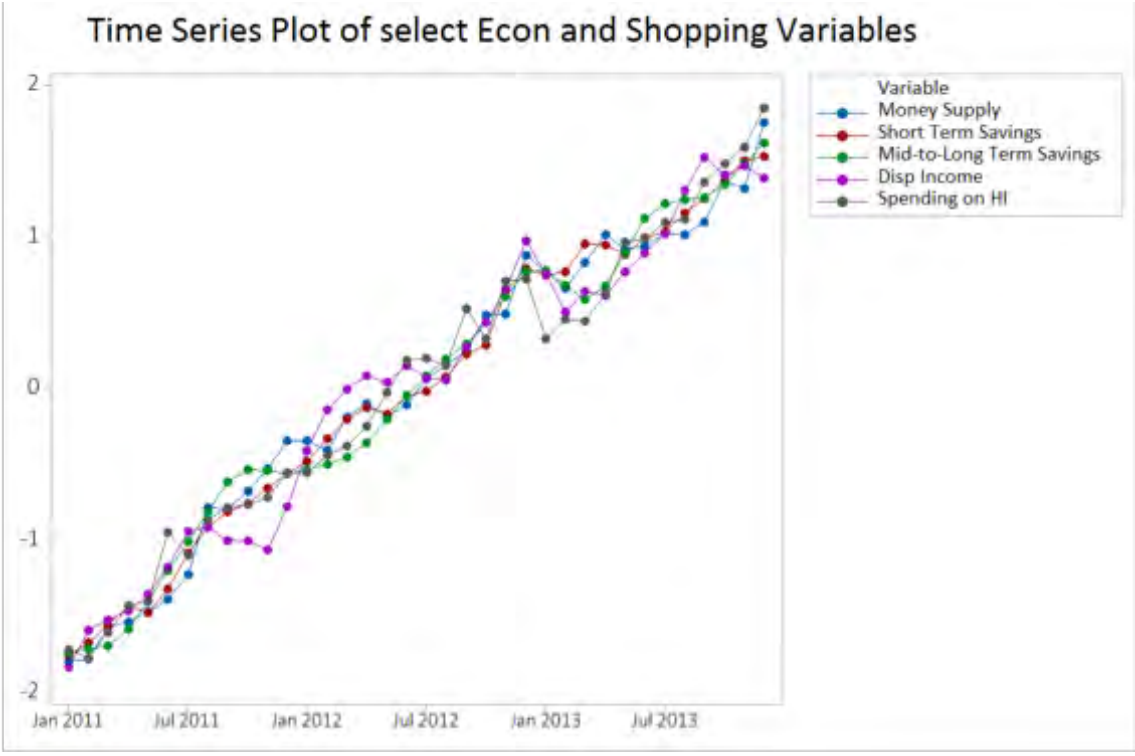
Executive Dashboard



Executive Dashboard



Executive Dashboard



Executive Dashboard

Executive Dashboard

Executive Dashboard

Steps to calculate correlation between Variables in Minitab

1. Choose **Stat > Basic Stat > Correlation**
2. Select all the variables from *S&P* through *Comp Spec Shopping* (C4-C14) for the Variables
3. Unselect **Display p-values**
4. Click **OK**

Executive Dashboard

Correlation Matrix

	S&P	Cons Conf	Emp Level	Home Sales	Money Supply	Short Term Savin
Cons Conf	0.752					
Emp Level	0.785	0.573				
Home Sales	0.615	0.451	0.661			
Money Supply	0.833	0.536	0.918	0.623		
Short Term Savin	0.858	0.565	0.921	0.647	0.994	
Mid-to-Long Term	0.844	0.539	0.936	0.592	0.989	0.990
Disp Income	0.857	0.611	0.925	0.631	0.974	0.985
Spending on HI	0.859	0.581	0.950	0.600	0.979	0.982
HI Shopping	0.719	0.405	0.825	0.552	0.848	0.851
Comp Spec Shoppi	0.811	0.534	0.885	0.604	0.918	0.922

	Mid-to-Long Term	Disp Income	Spending on HI	HI Shopping
Disp Income	0.975			
Spending on HI	0.988	0.978		
HI Shopping	0.848	0.850	0.858	
Comp Spec Shoppi	0.918	0.916	0.916	0.951

Cell Contents: Pearson correlation

Executive Dashboard

Correlation Matrix

	S&P	Cons Conf	Emp Level	Home Sales	Money Supply	Short Term Savin
Cons Conf	0.752					
Emp Level	0.785	0.573				
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	Mid-to-Long Term	Disp Income	Spending on HI	HI Shopping
Disp Income	0.975			
Spending on HI	0.988	0.978		
HI Shopping	0.848	0.850	0.858	
Comp Spec Shoppi	0.918	0.916	0.916	0.951

Cell Contents: Pearson correlation

Executive Dashboard

Correlation Matrix

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	Mid-to-Long Term	Disp Income	Spending on HI	HI Shopping
Disp Income	0.975			
Spending on HI	0.988	0.978		
HI Shopping	0.848	0.850	0.858	
Comp Spec Shoppi	0.918	0.916	0.916	0.951

Cell Contents: Pearson correlation

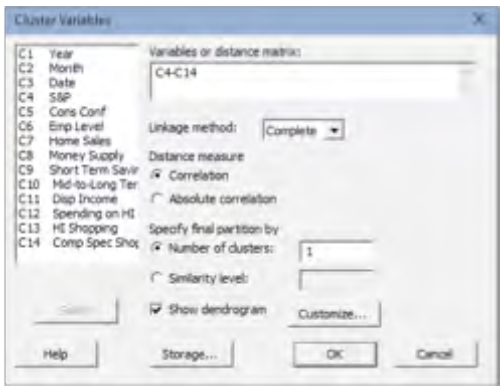
Executive Dashboard

Perform a Cluster Variables Analysis…

Executive Dashboard

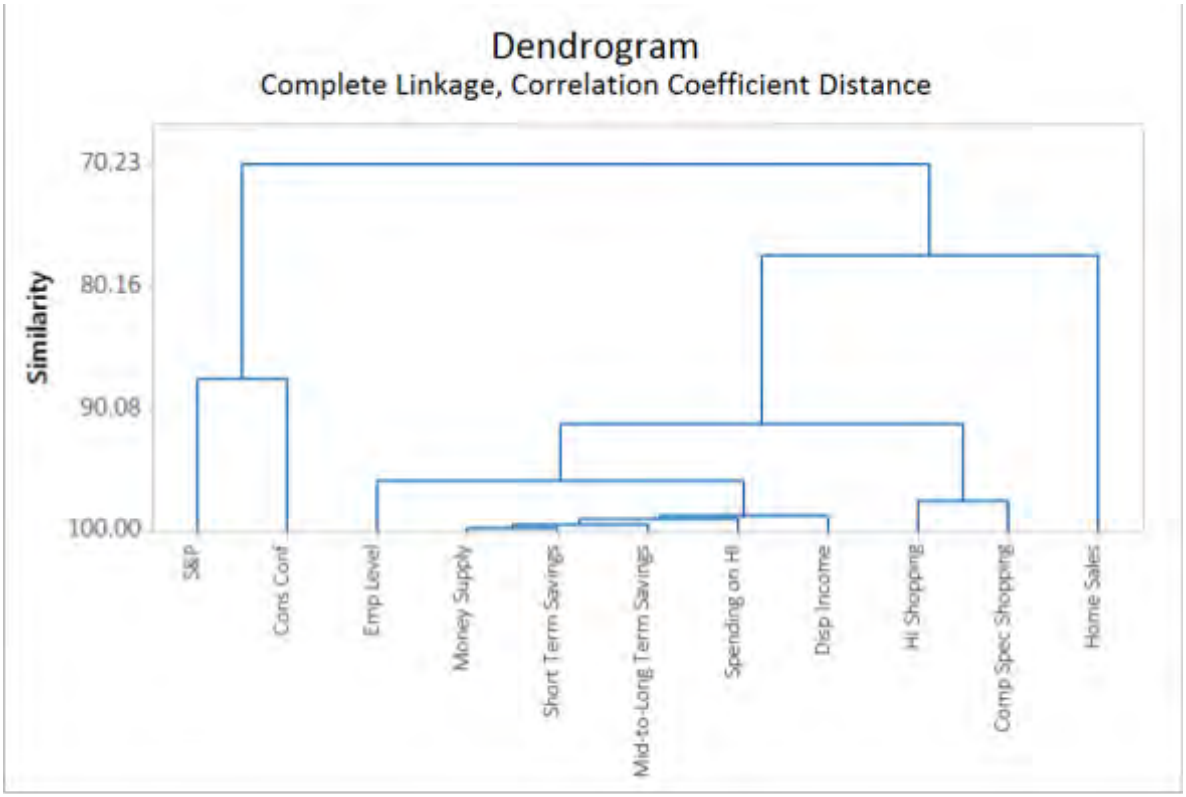
Steps to performing a Cluster Variables Analysis in Minitab

1. Choose **Stat > Multivariate > Cluster Variables**
2. Complete the dialog box as shown below



3. Click **OK**

Executive Dashboard



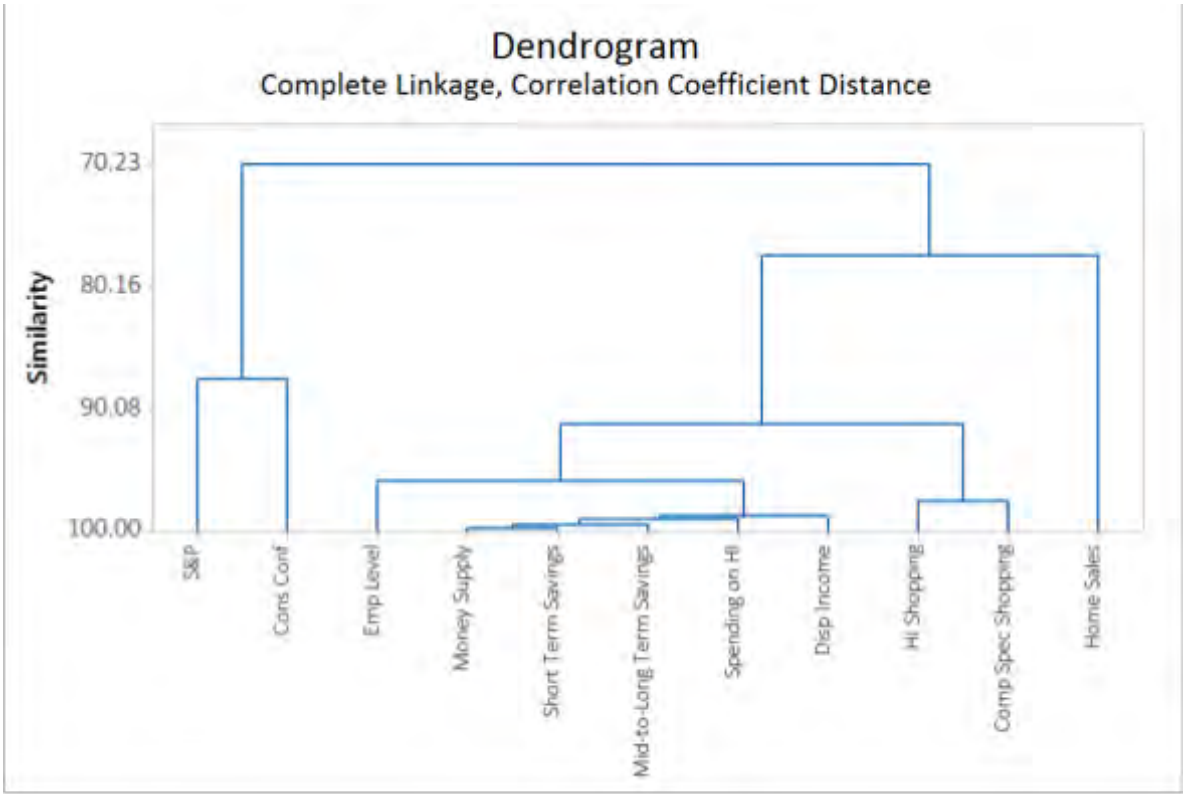
Executive Dashboard

Cluster Analysis of Variables: S&P, Cons Conf, ...

Correlation Coefficient Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	10	99.6965	0.006070	5	6	5	2
2	9	99.4263	0.011475	5	7	5	3
3	8	98.9613	0.020774	5	9	5	4
4	7	98.7071	0.025858	5	8	5	5
5	6	97.5440	0.049120	10	11	10	2
6	5	95.9241	0.081518	3	5	3	6
7	4	91.2291	0.175418	3	10	3	8
8	3	87.6055	0.247890	1	2	1	2
9	2	77.5814	0.448371	3	4	3	9
10	1	70.2325	0.595349	1	3	1	11

Executive Dashboard



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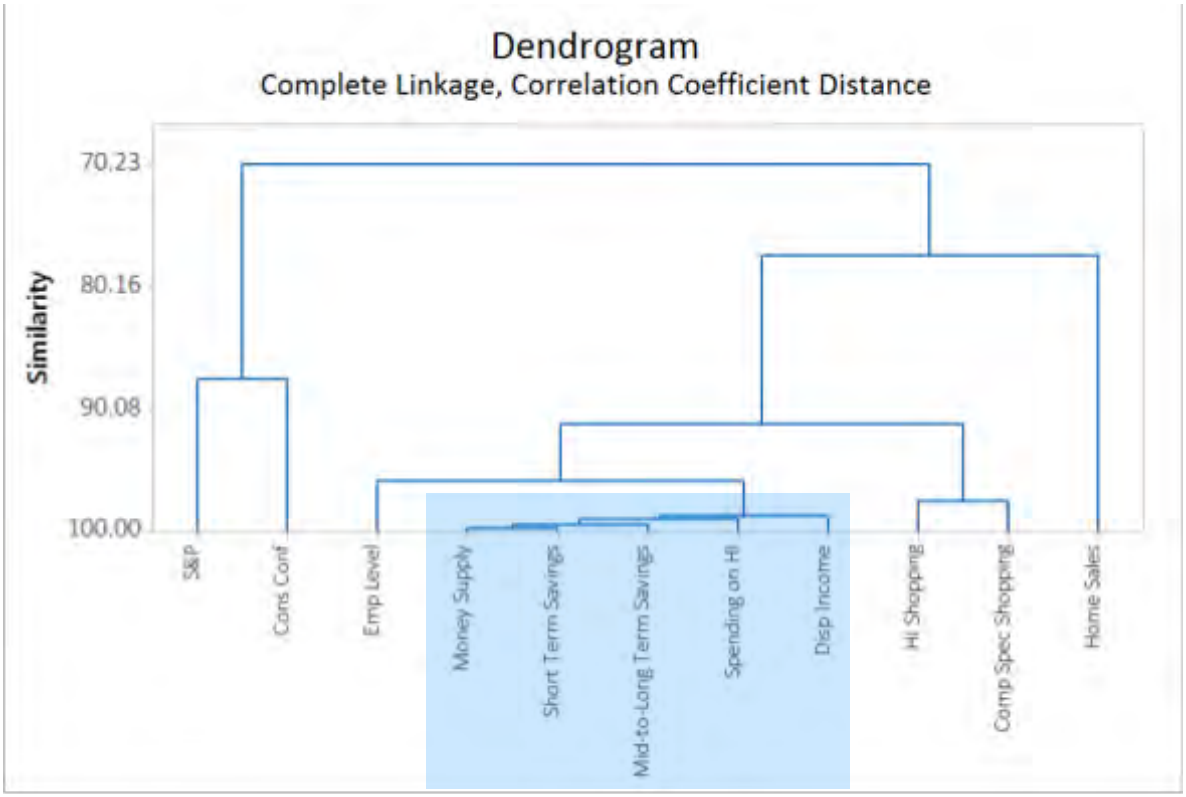

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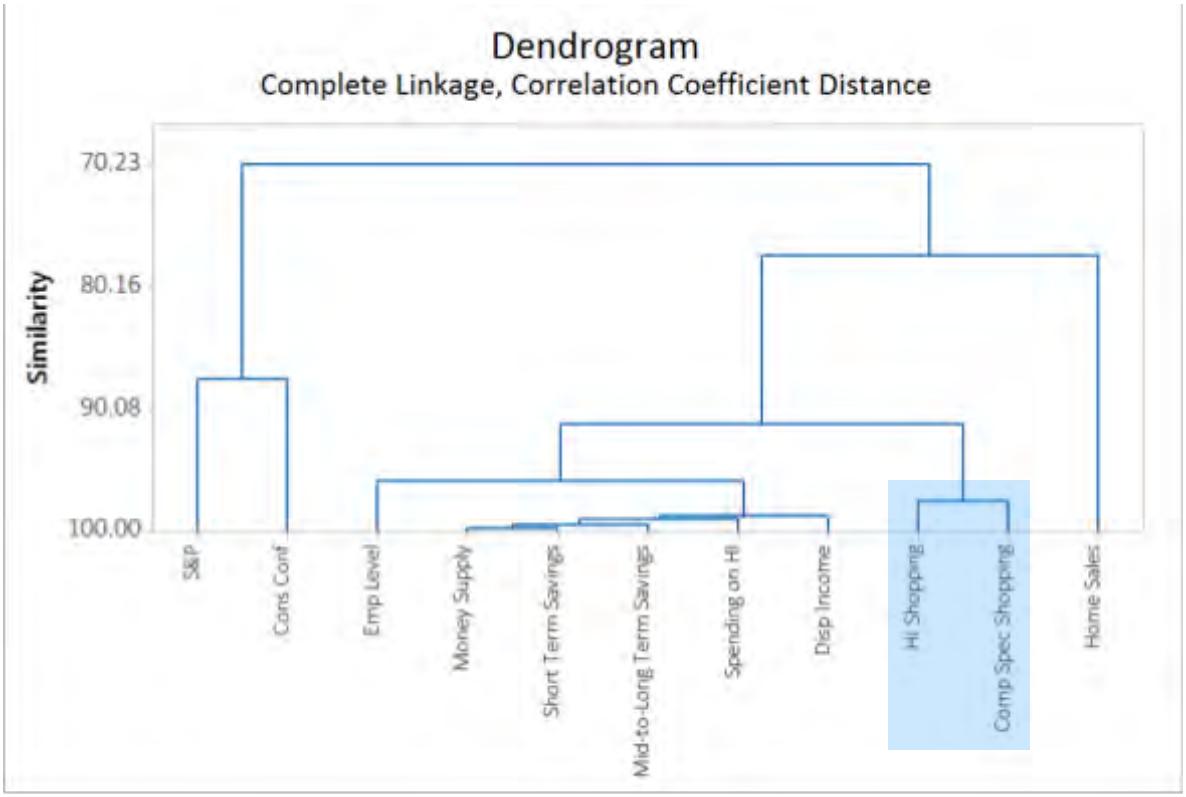

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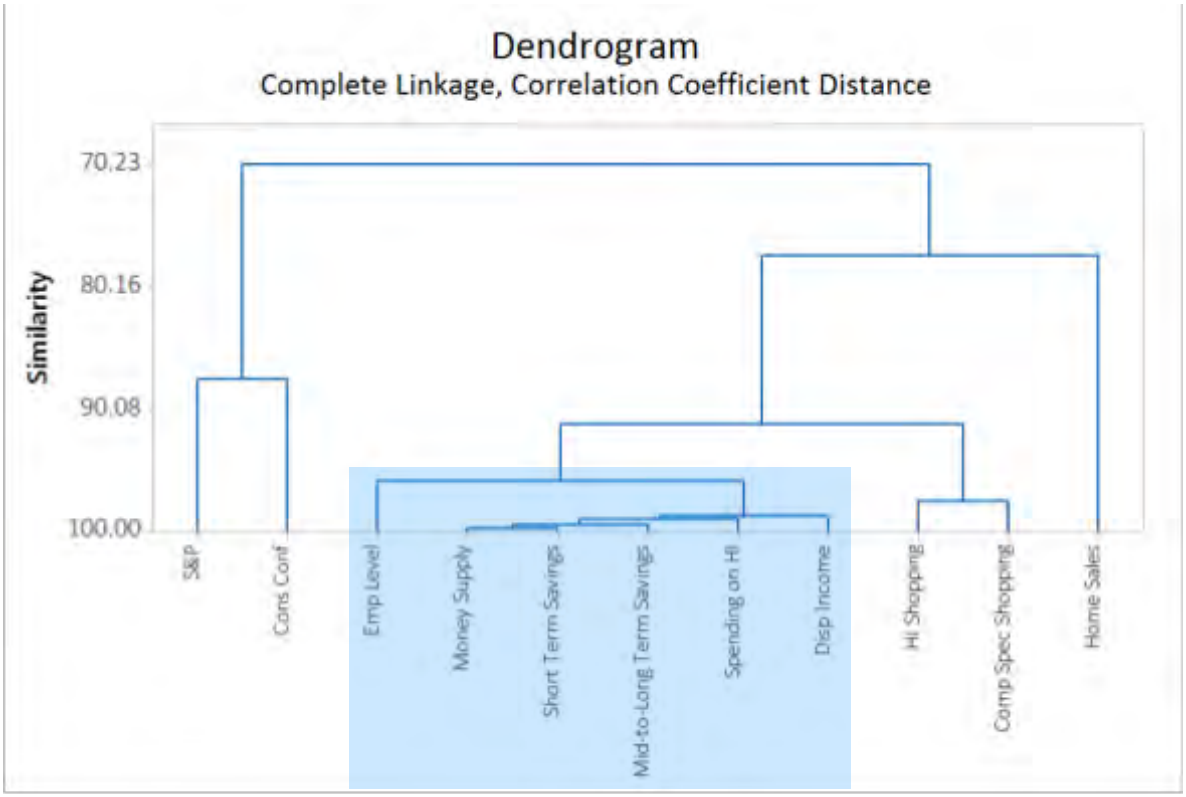

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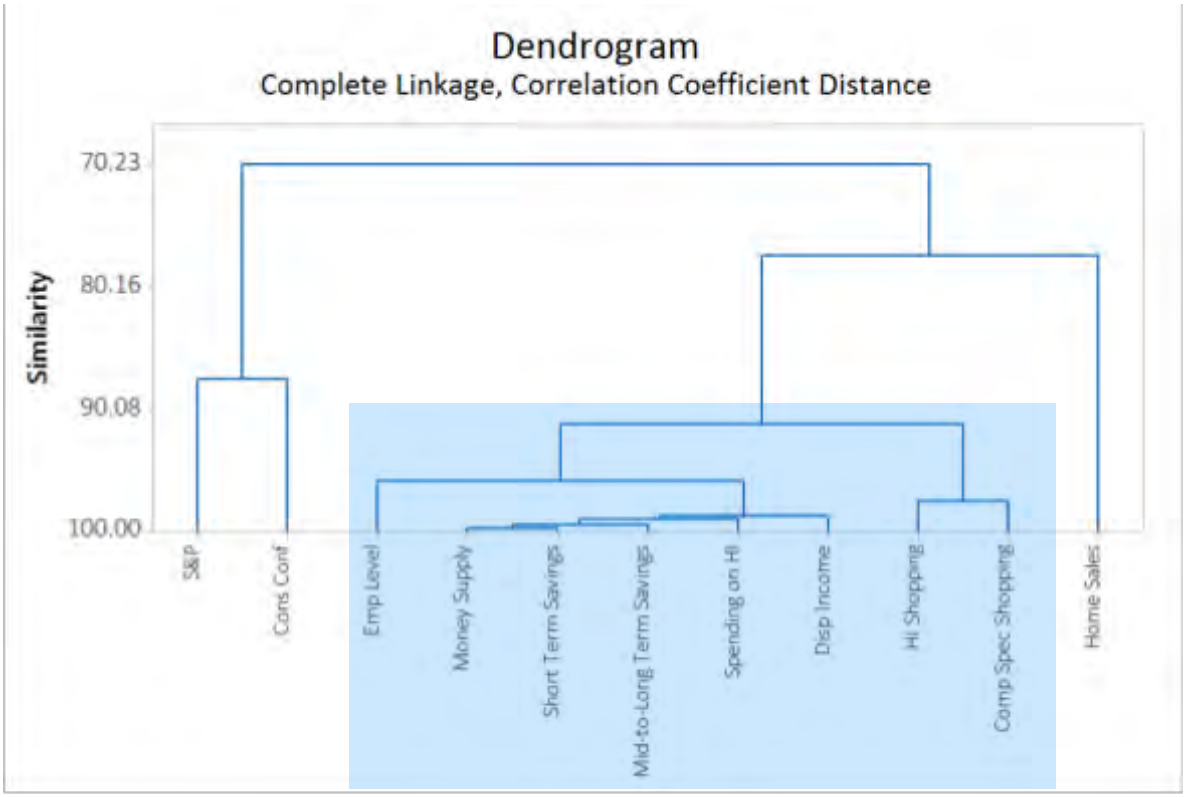

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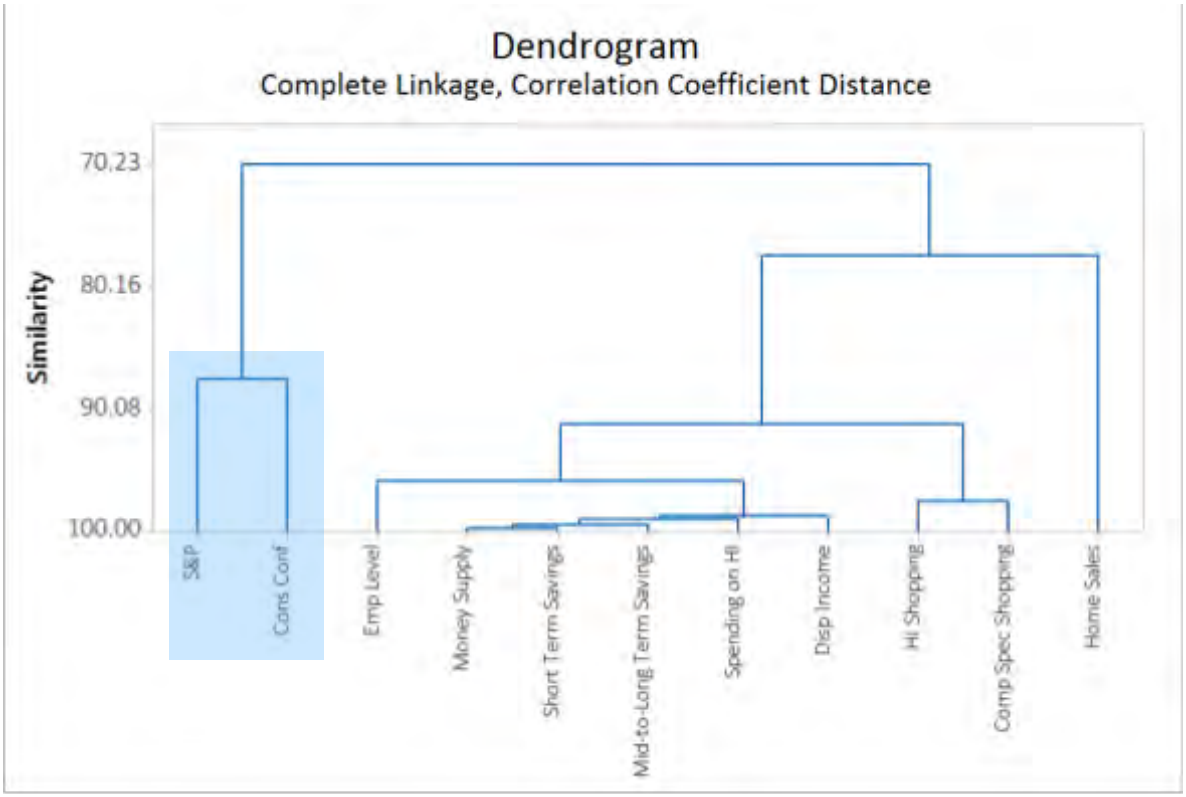

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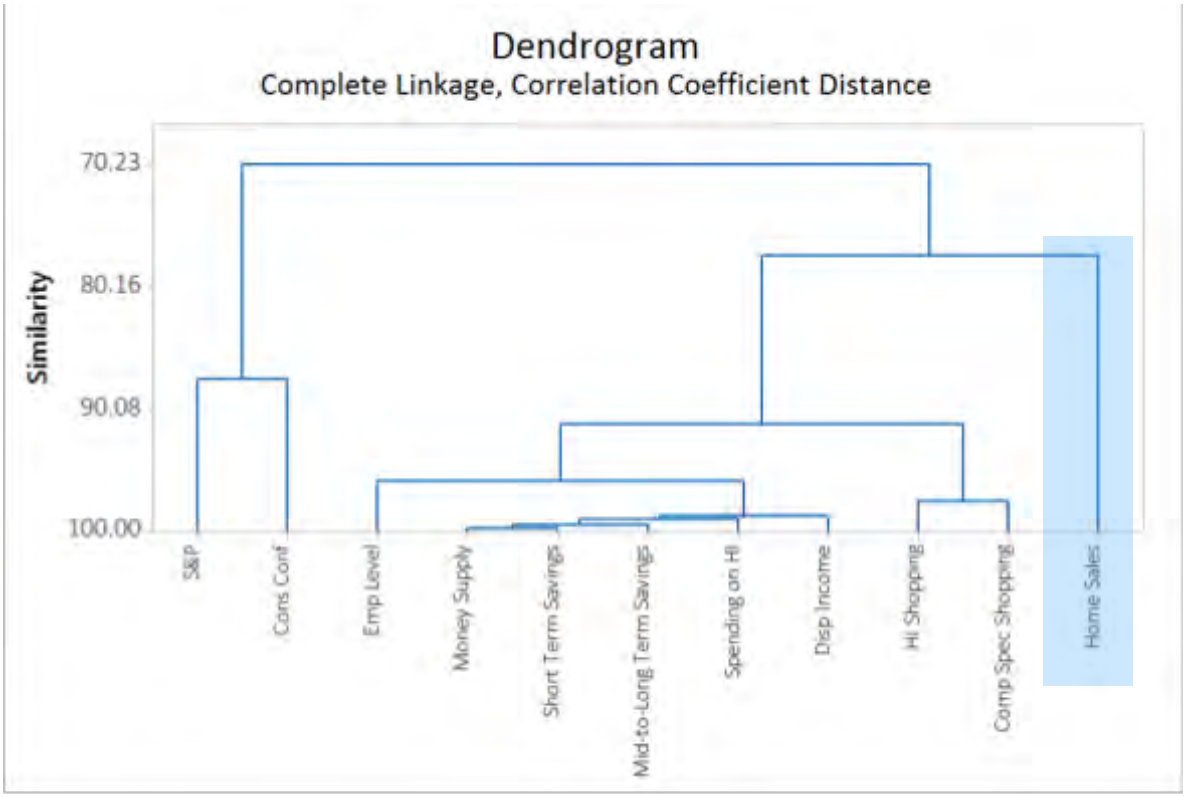

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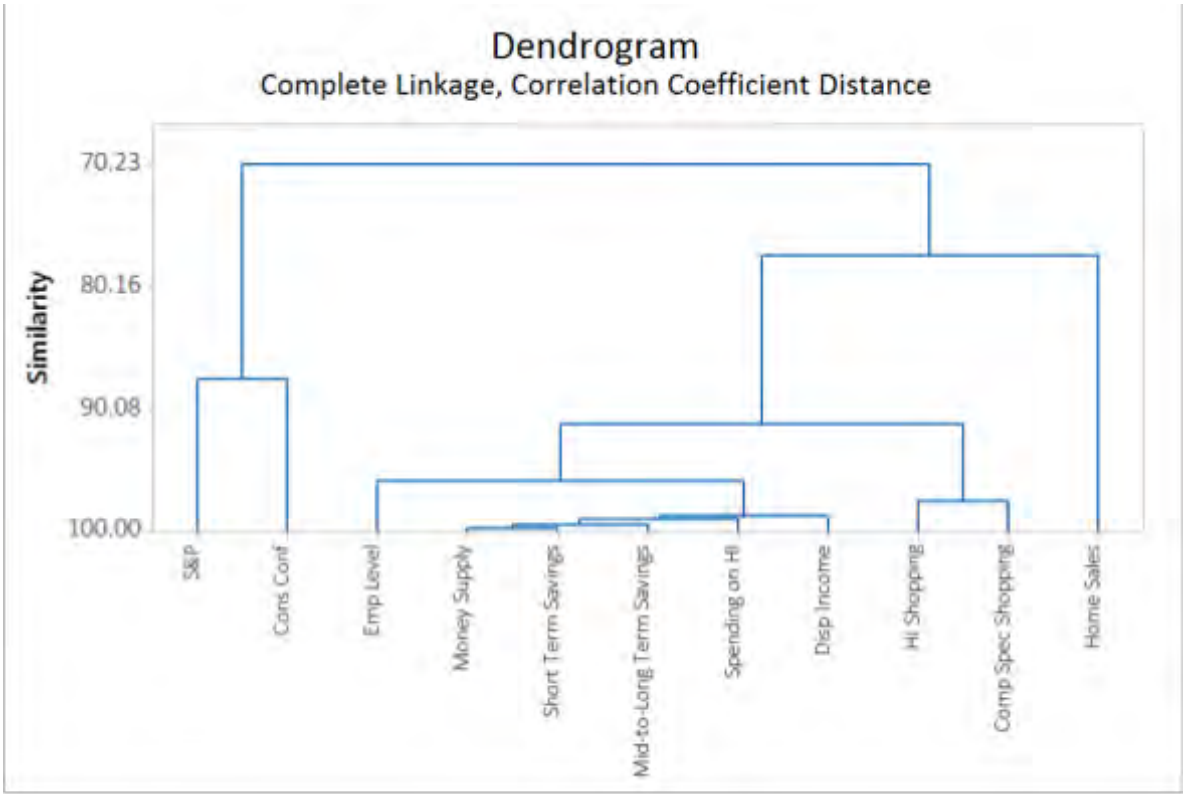

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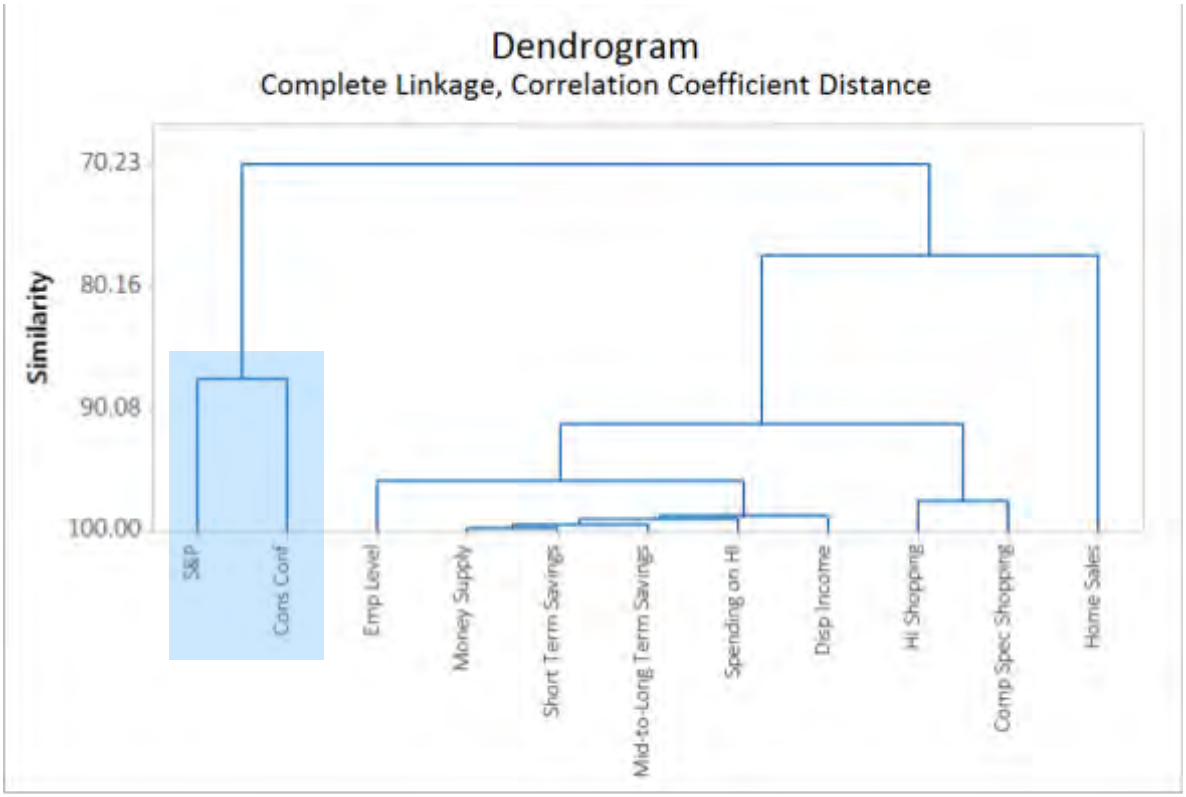

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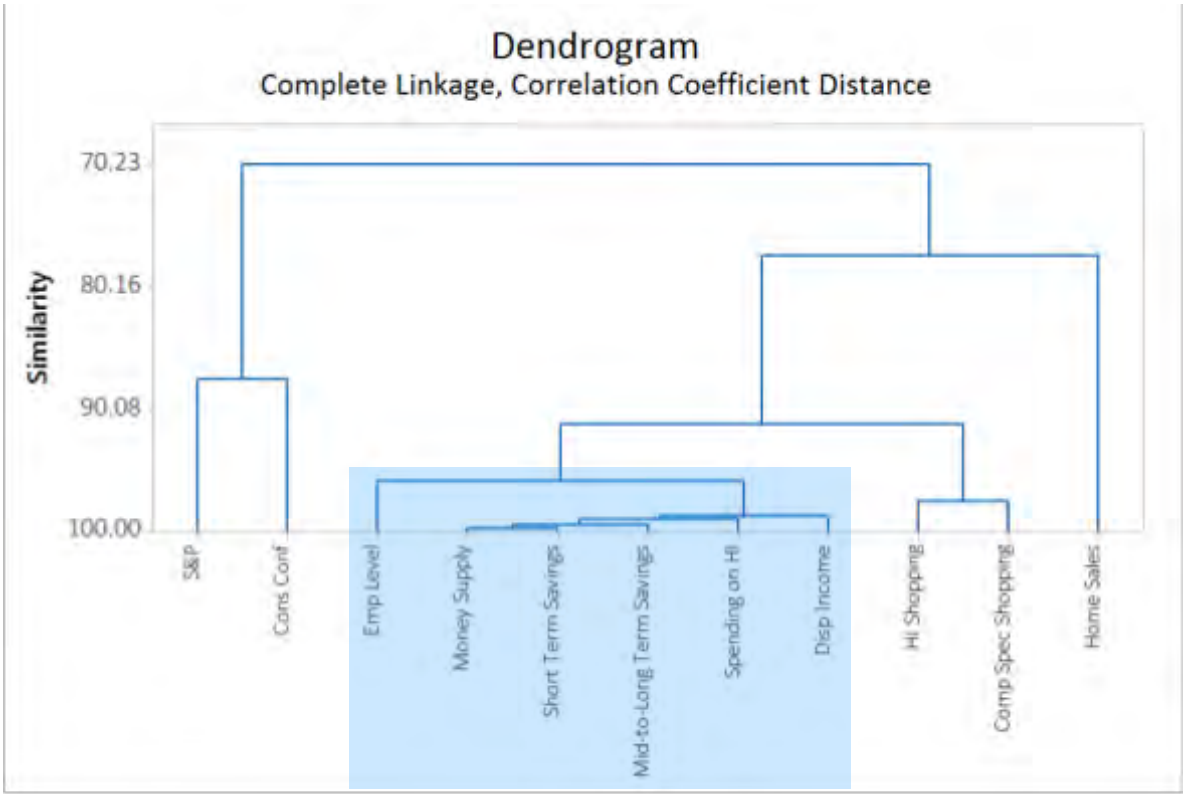

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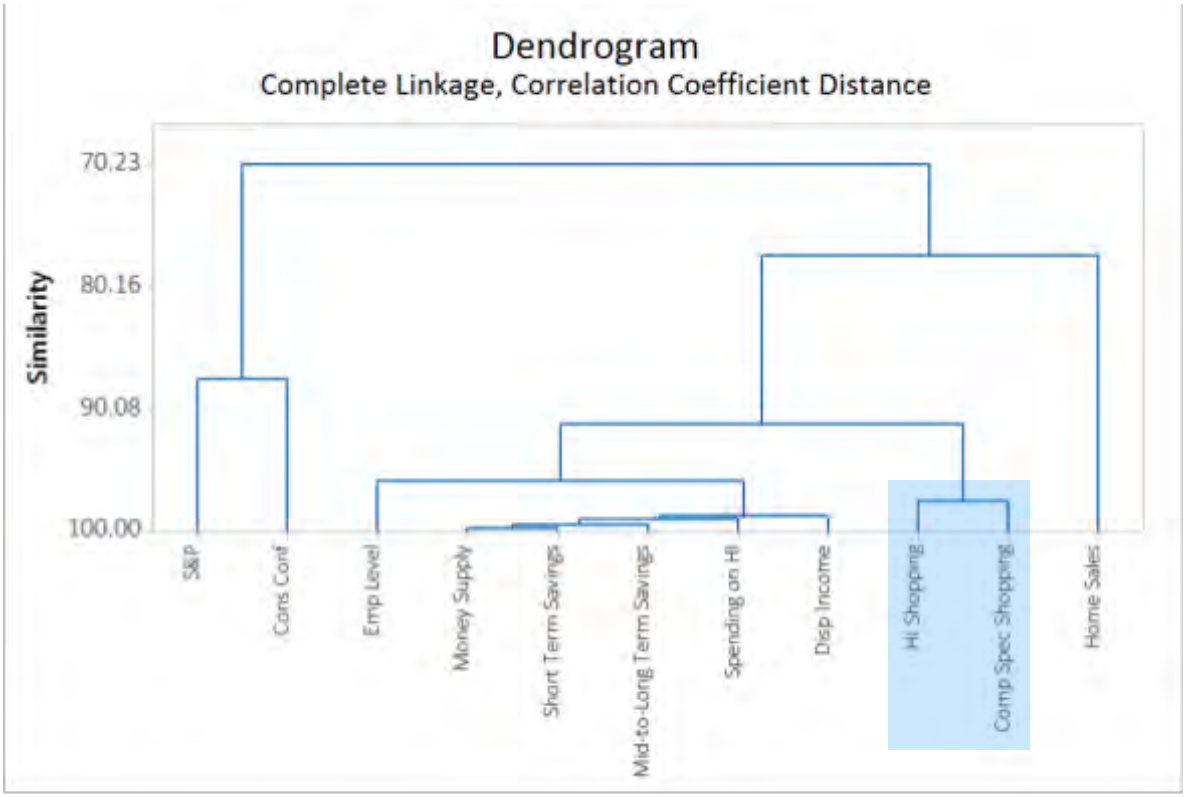

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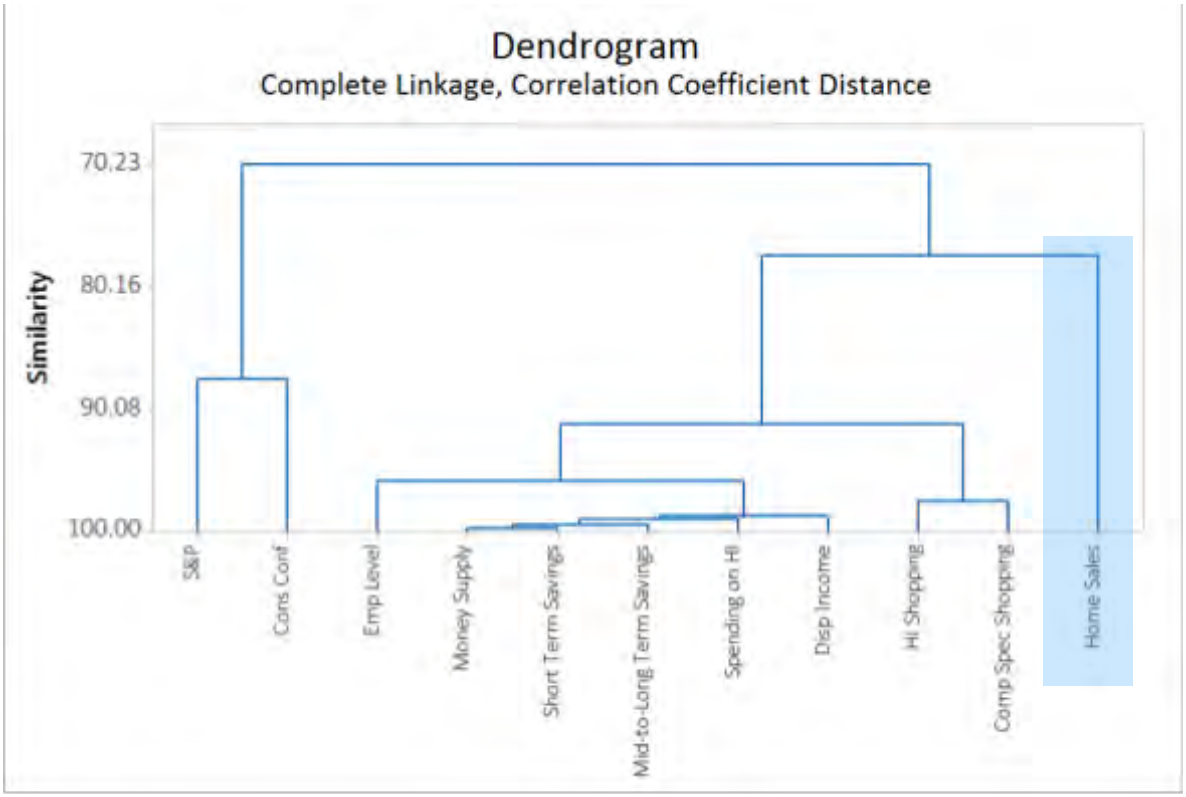

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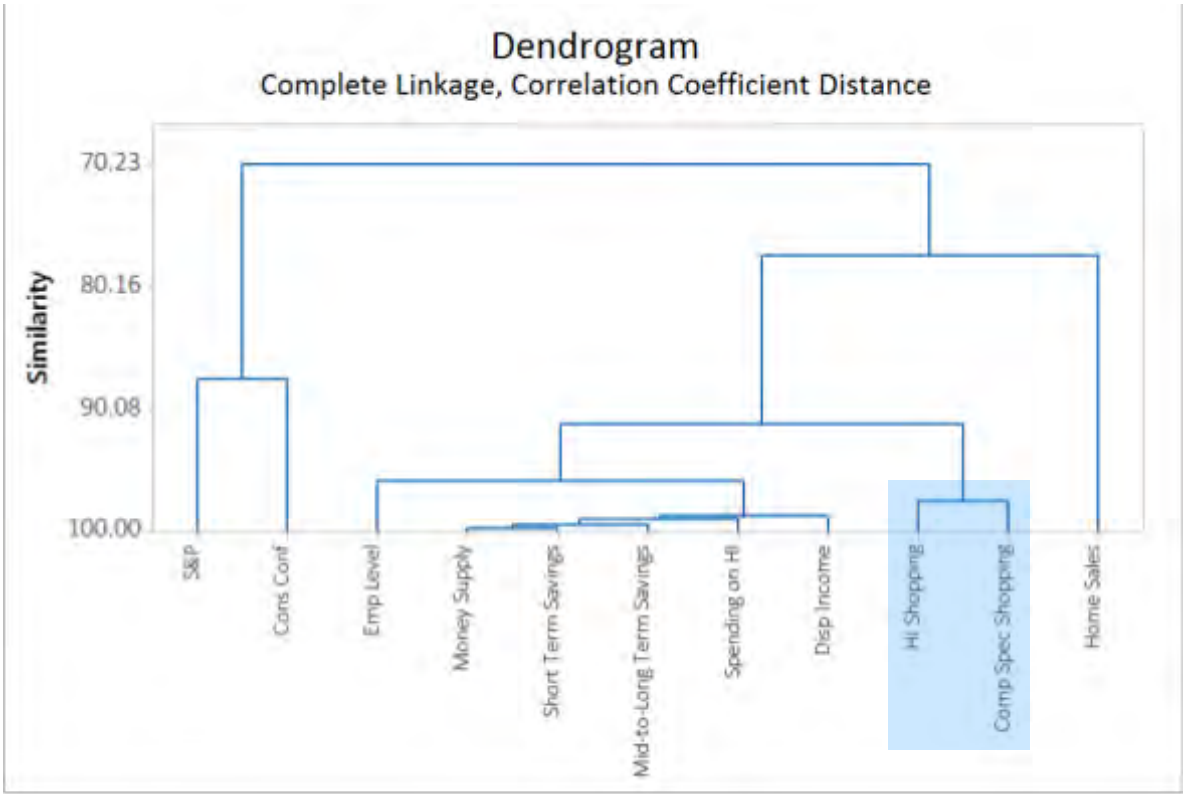


Executive Dashboard

C	M	N
Date	HI Shopping	Comp Spec Shopping
Jan-11	-1.66	-1.87
Feb-11	-1.49	-1.15
Mar-11	-0.93	-1.47
Apr-11	-1.64	-1.61
May-11	-1.01	-1.13
Jun-11	-0.71	-0.78
Jul-11	-0.71	-0.84
Aug-11	-1.06	-1.12

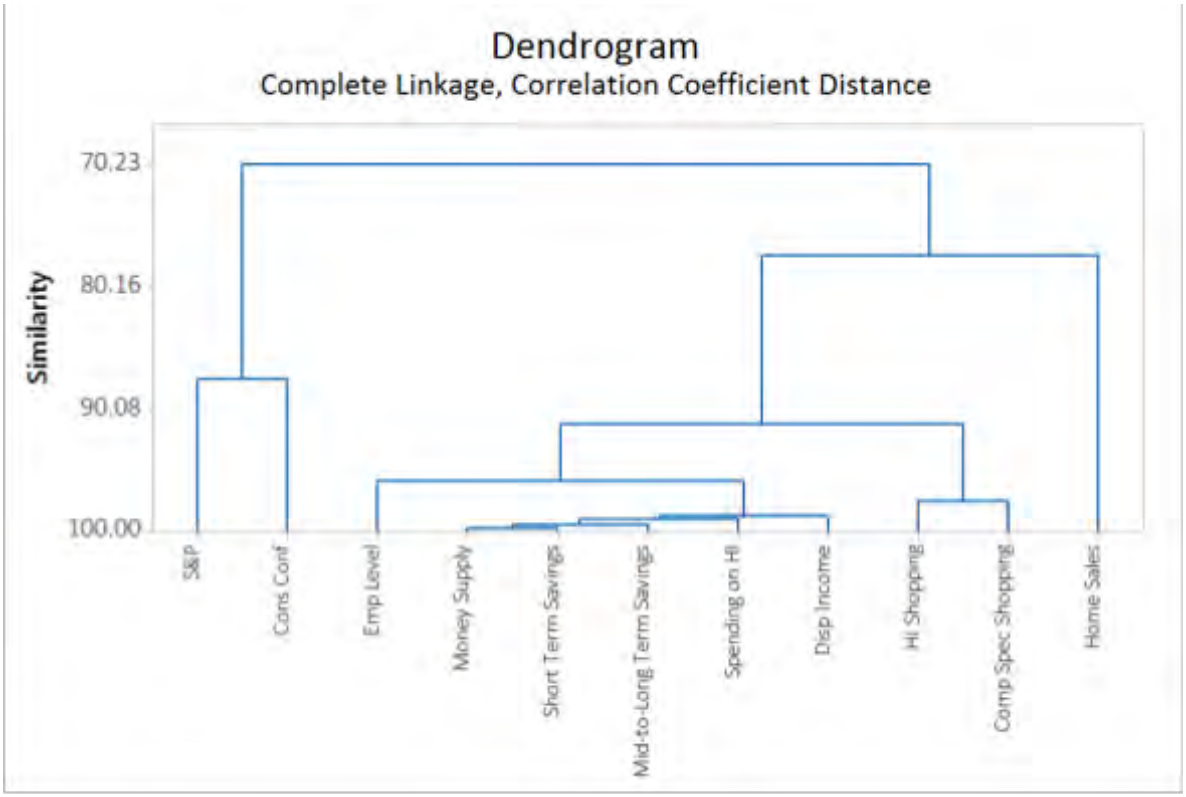
Executive Dashboard

C	M	N	O
Date	HI Shopping	Comp Spec Shopping	Shopping_Company vs Industry
Jan-11	-1.66	-1.87	-0.21
Feb-11	-1.49	-1.15	0.33
Mar-11	-0.93	-1.47	-0.54
Apr-11	-1.64	-1.61	0.04
May-11	-1.01	-1.13	-0.12
Jun-11	-0.71	-0.78	-0.07
Jul-11	-0.71	-0.84	-0.13
Aug-11	-1.06	-1.12	-0.06

⋮

Shopping_Company vs. Industry = *Company Spec Shopping - HI Shopping*

Executive Dashboard



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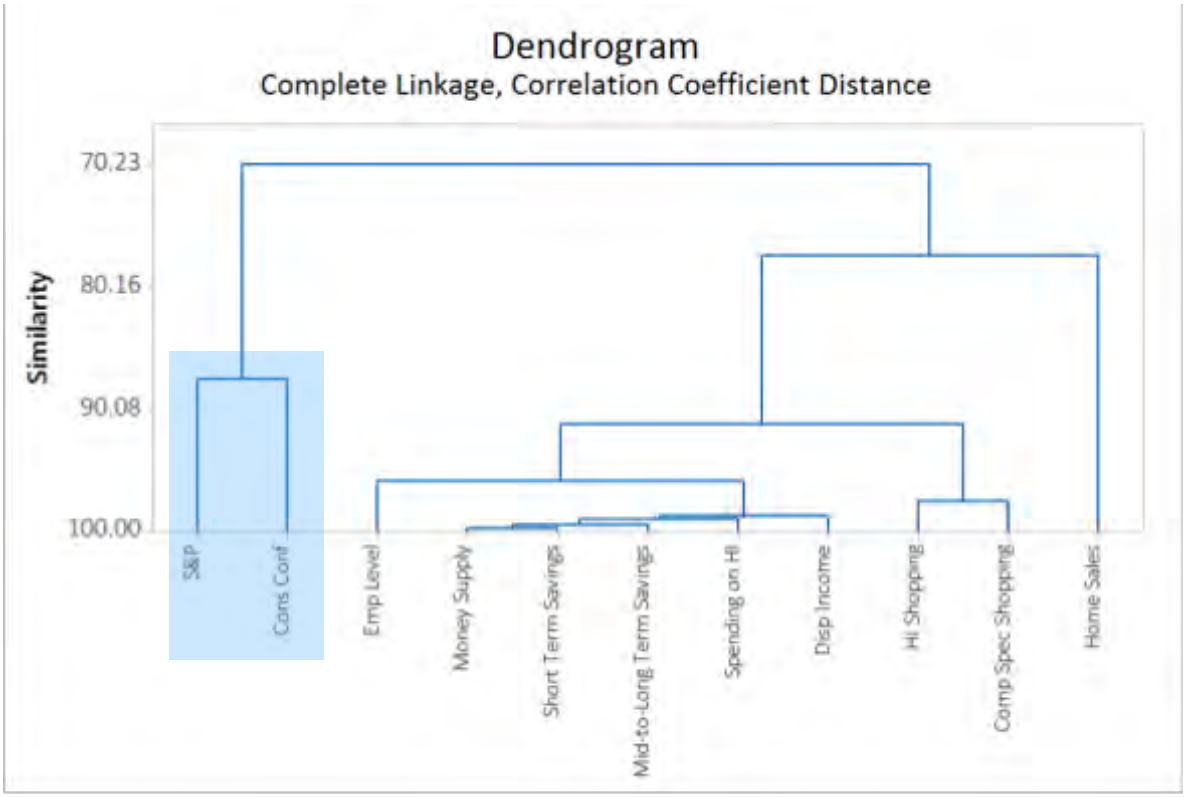

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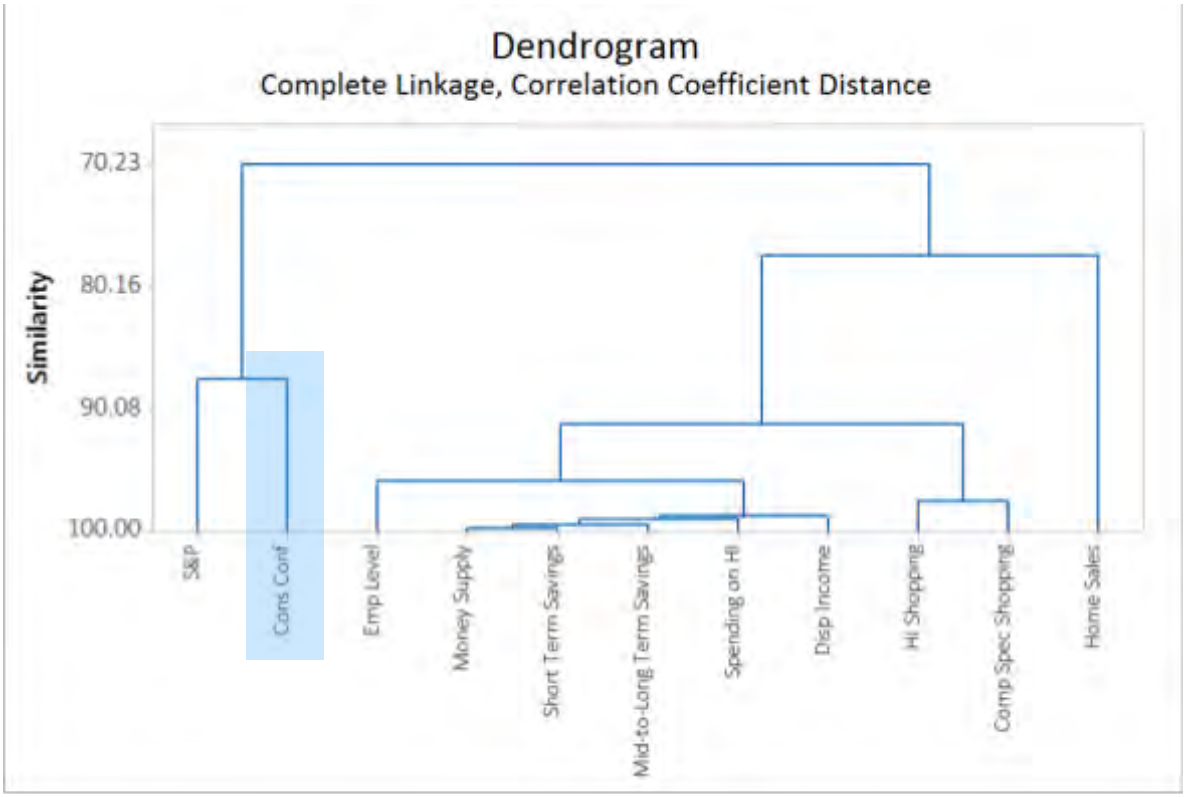

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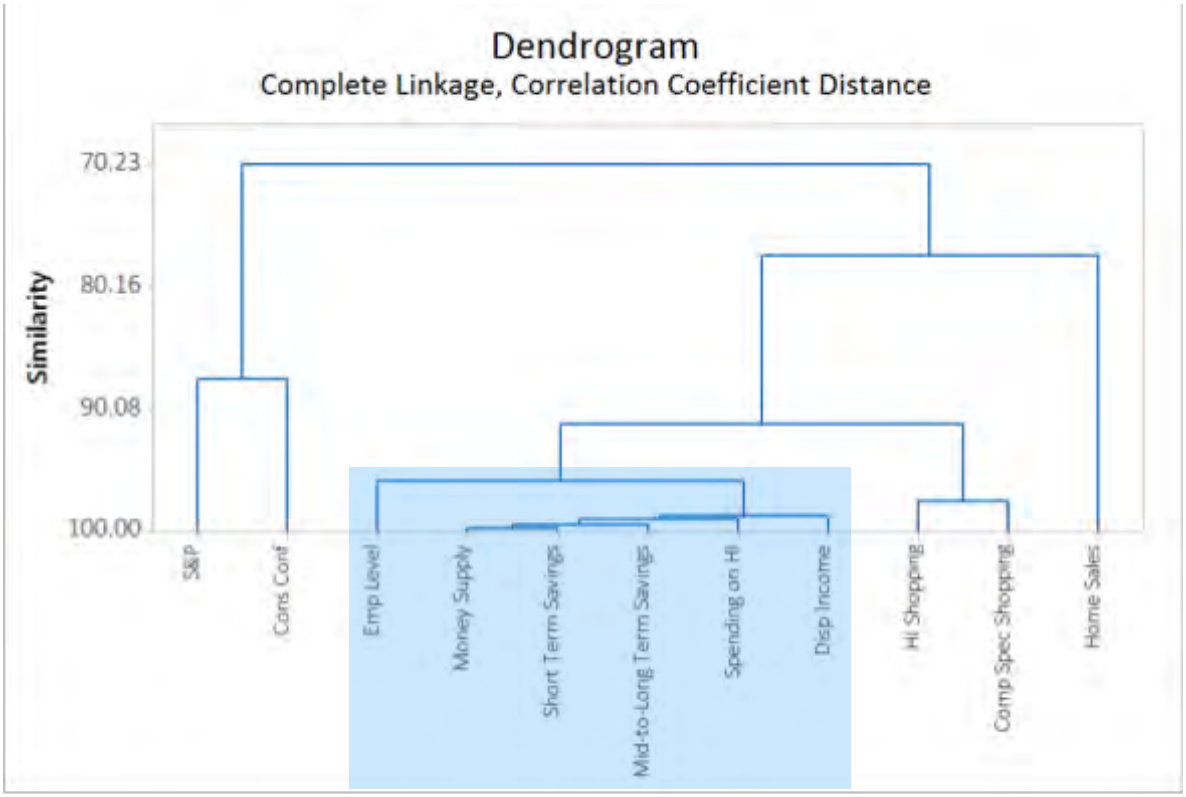

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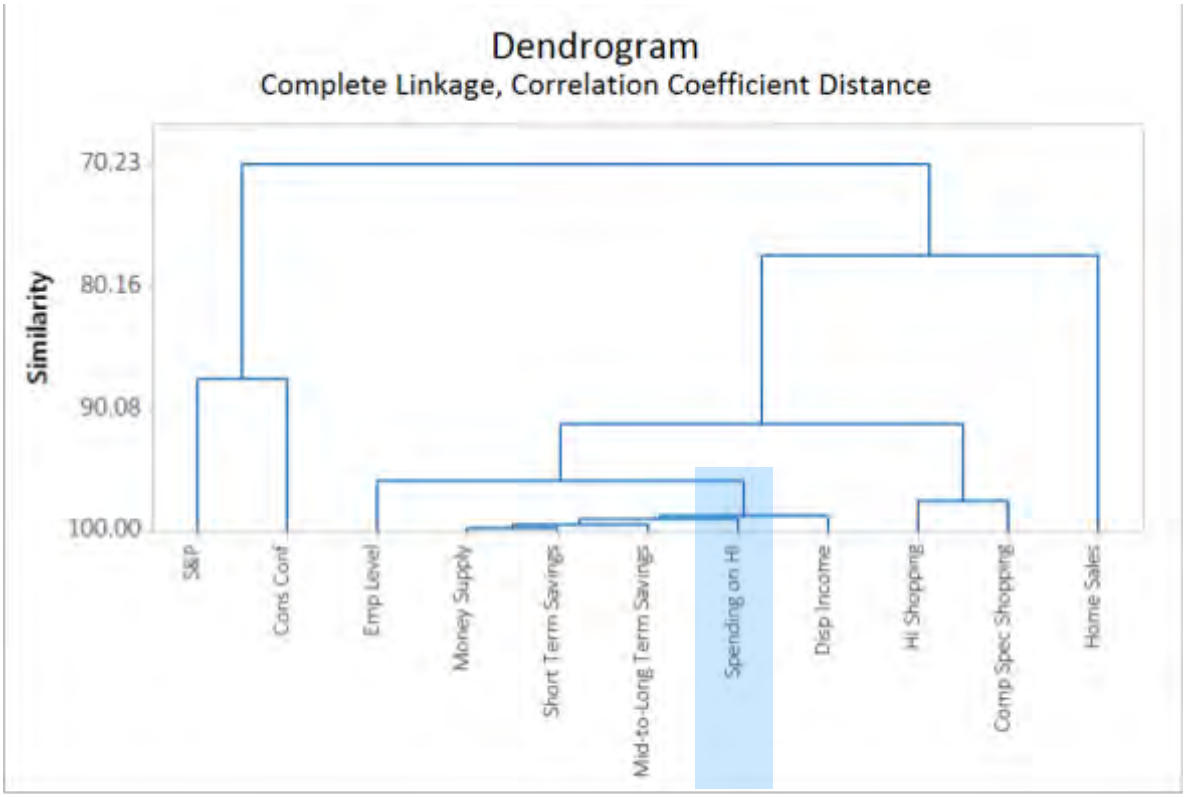

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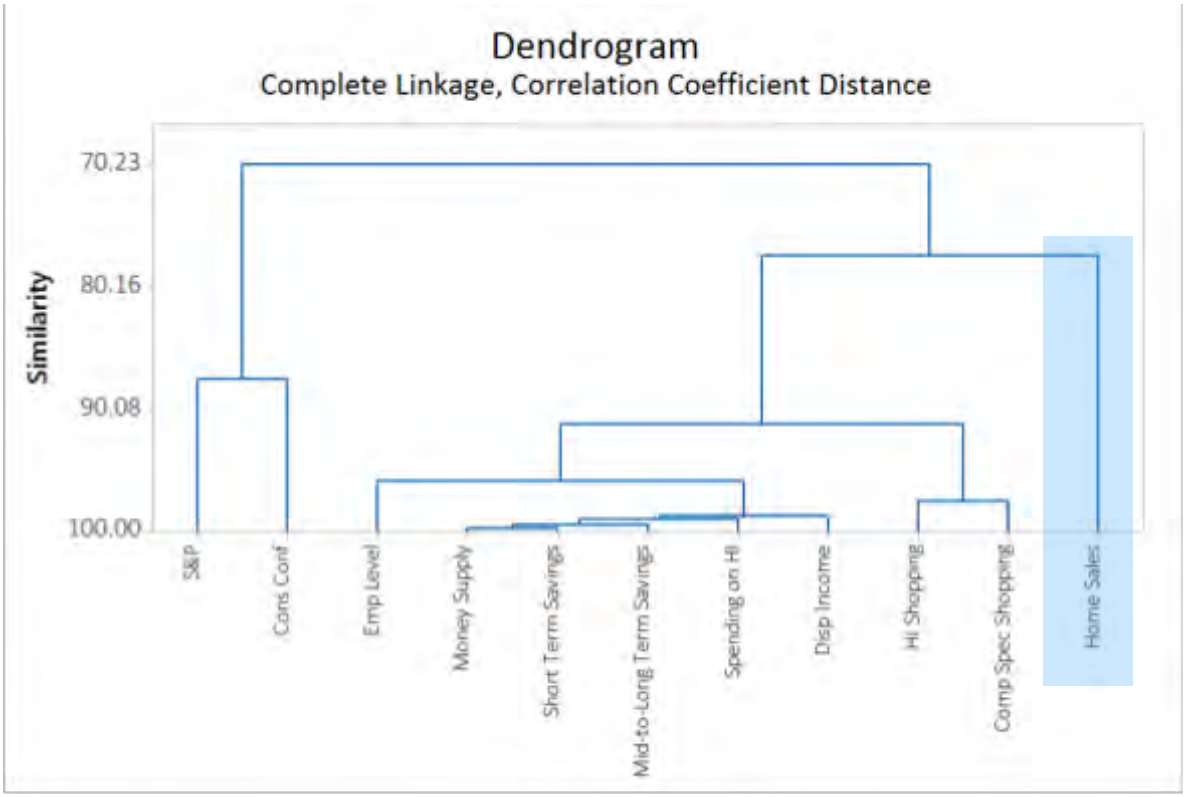

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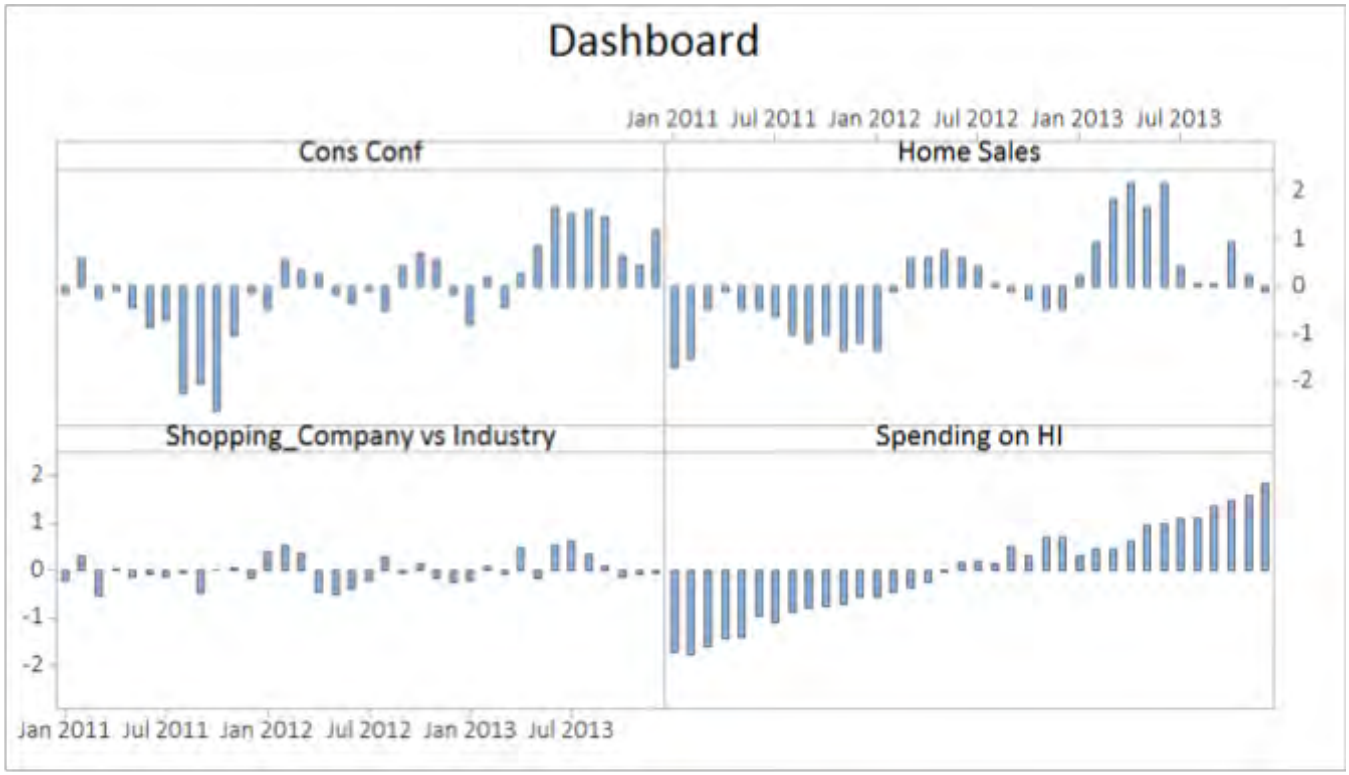

Variable Reduction & Selection

Methods

- Select the most important or representative variables based on subject matter expertise and/or prior knowledge of the system/process under study
- Select variables aligned with the preference and needs of the consumers of the analysis work
- Remove variables that are correlated with others variables
- Create composite variables
  - Subject matter expertise and interpretation
  - Needs and objectives of the analysis
  - Through a statistical procedure (e.g., Principal Component Analysis)

Authors Index