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Editorial Review Board

Delta Nu Alpha Contact Information
Delta Nu Alpha Administrator
1720 Manistique Avenue
South Milwaukee, WI 53172
admin@deltanualpha.org

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Mike Ilitch School of Business

Global Supply Chain Management

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Editorial Policy

The primary purpose of the JTM is to publish managerial and policy articles that are relevant to academics, policymakers, and practitioners in the transportation, logistics and supply chain fields. Acceptable articles could include conceptual, theoretical, legal, case, and applied research that contributes to better understanding and management of transportation and logistics. Saying that, our policy requires that articles be of interest to both academics and practitioners, and that they specifically address the managerial or policy implications of the subject matter. Articles that are strictly theoretical in nature, with no direct application to transportation and logistics activities, or to related policy matters, would be inappropriate for the *JTM*. Articles related to any and all types of organizations, and of local to global scope, will be considered for publication.

Acceptable topics for submission include, but are not limited to, broad logistics topics, logistics and transportation related legal issues, carrier management, shipper management of transportation functions, modal and intermodal transportation, international transportation issues, transportation safety, marketing of transportation services, transportation operations, domestic and international transportation policy, transportation economics, customer service, and the changing technology of transportation. Articles from related areas, such as third party logistics, purchasing and materials management, and supply chain management, are acceptable as long as they are related to transportation and logistics activities.

Submissions from practitioners, attorneys or policymakers, co-authoring with academicians, are particularly encouraged in order to increase the interaction between groups. Authors considering the submission of an article to the *JTM* are encouraged to contact the editor for help in determining relevance of the topic and material.

The Editor information is: Dr. John C. Taylor, Associate Professor of Supply Chain Management and Department Chaiperson, Department of Marketing and Supply Chain Management, School of Business, Wayne State University, Detroit, MI 48202. Office Phone: 313 577-4525. Cell Phone: 517 719-075. Fax: 313 577-5486. Email: taylorjohn@wayne.edu

Publishing Data

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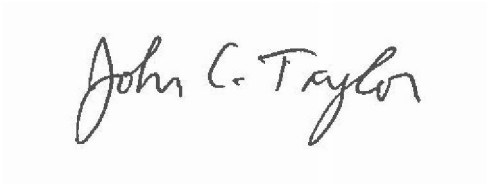
From the Editor...

Welcome to the Winter 2019 issue of the Journal of Transportation Management (JTM), being Vol. 29 No 2! The issue starts with an article on green carrier initiatives and its possible impact on shipper selection decisions. The second article examines global maritime transportation. The third article focuses on airport bond ratings. The issue concludes with a fourth article on social media and its potential use in risk detection.

Our first article examines carrier initiatives around green practices and how they might effect shipper selection of carriers. They conclude that by adopting green technologies, carriers can leverage their sustainable approach to supply chain functions and appeal to the sustainable sourcing preferences of shippers. The second article looks at global maritime issues and impacts on shippers. The paper offers conclusions intended to help managers develop successful supply chain strategies in today's uncertain post-Panamax world. The third article examines several important bond rating issues including the impact of prior context on how bond raters rate specific bonds. The fourth article investigates the potential use of social media as a technology to help with supply chain risk detection and supply chain resilience. The authors conclude that social media can play a major role in reducing risk and increasing supply chain resiliency.

At the *Journal*, we are continuing to make a number of changes that will improve the visibility of JTM, and improve its position in the supply chain publishing world. These include registering and updating journal information with several publishing guides, and placing the past and current content on services that provide visibility to Google Scholar. Authors will receive summaries of downloaded articles monthly, and can examine the Digital Commons web site for data on various aspects of the publication and their articles. One year old issues will be placed into the system.

I look forward to hearing from you our readers with questions, comments and article submissions. The submission guidelines are included at the end of this issue's articles and I encourage both academics and practitioners to consider submitting an article to the Journal. Also included in this issue is a subscription form and I hope you or your library will subscribe.



John C. Taylor, Ph.D.
Editor, Journal of Transportation Management
Chair, Department of Marketing and SCM, Ilitch School of Business
Wayne State University

AN EXPERIMENTAL TEST OF GREEN MANAGEMENT INFORMATION SYSTEM EFFECTS ON CARRIER SELECTION: WEIGH STATION AND TOLLBOOTH BYPASS TECHNOLOGY ADOPTION

Rodney W. Thomas
University of Arkansas

Jessica L. Robinson
California State University, Long Beach

Jessica L. Darby
University of Arkansas

Scott Cox
Western Kentucky University

Donnie F. Williams, Jr.
University of Arkansas

ASBSTRACT

In a highly competitive price-driven industry, carriers are continuously searching for opportunities to differentiate their offerings, minimize operational costs, and appeal to shippers. At the same time, environmental sustainability has evolved from being trendy jargon into a requirement for competitive supply chain management. It is at the intersection of these two modern topics that the current study identifies a new carrier selection attribute based on a specialized type of green management information system. We apply social exchange theory to hypothesize carrier price and green technology adoption effects on shipper purchase intent. The hypothesized direct and interaction effects are tested by way of a vignette-based experiment, with a sample of full-time working professionals. The supported hypotheses collectively suggest that the adoption of weigh station and tollbooth bypass technology, as a type of environmentally sustainable information system, positively affects transportation carrier selection and attenuates the negative effect of a carrier's price on shippers' purchase intentions. These research findings offer unique theoretical, practical, and policy implications surrounding the trucking carrier selection decision.

INTRODUCTION

Weigh station and tollbooth bypass technology is a type of environmentally sustainable information system available within the trucking industry. This green system places a transponder within each tractor-trailer to wirelessly communicate load information with tollbooth and weigh station operations (Hansen, 2010). By adopting and implementing this technology, carriers avoid waiting in queues to manually pay tolls and exchange paperwork (Marett et al., 2013). Carriers are automatically identified and compliance with state requirements is verified without stopping for inspections at weigh stations (Gelinas, 2009). Like most green management information systems, bypass technology reduces reliance on unnecessarily manual and time intensive tasks. Carrier idle times, fuel consumption, lead-times, and paper usage are

reduced with this approach resulting in both lower costs and a lower carbon footprint for carrier operations (Crainic et al., 2009).

Although many non-value added activities and carrier related costs are reduced using bypass transponders, little is known about how shippers view carriers who implement this environmentally sustainable technology. Systematic reviews of traditional carrier selection criteria do not identify green management information systems as an important attribute for consideration (Williams, et al, 2013; Meixell and Norbis, 2008). However, given the steadily increasing importance of environmentally sustainable supply chains and recent calls for carrier selection decisions to include green performance (Davis-Sramek et al, 2018; Thomas et al.,2016), this gap in understanding is noticeable and an important question to be answered. Insights from Social Exchange Theory (SET) suggest that carrier selection decisions may indeed be affected by green technology adoption. Specifically, shippers may view bypass technology as an additional type of relational benefit in exchanges with carriers and be more likely to select carriers who utilize this green technology (Thibaut and Kelley, 1959; Emerson, 1976).

To determine if carrier selection decisions are affected by the adoption of bypass technology, a vignette-based behavioral experiment was designed to test *a priori* hypotheses derived from social exchange theory (SET). A vignette experiment is one where various descriptive scenarios are presented to subjects. The vignette approach used various scenarios to describe a carrier selection decision involving high and low conditions for independent variables like price and green management information system adoption. The scenarios also controlled for other known criteria (i.e. service, capability, lead-time, power/ dependence, etc.) that affect carrier selection decisions, but were not a focal interest in this research. Purchase intention, an acceptable proxy for actual carrier selection decisions, was the dependent variable in the study (Davis-Sramek et al., 2018; Thomas et al., 2016). Participants in the experiment were full-time working professionals. A behavioral experiment was selected as an appropriate method to study the phenomena because it allows researchers to carefully isolate the effects of independent variables while simultaneously controlling for other known factors (Tokar, 2010; Thomas, 2011; Eckerd and Bendoly, 2011). By gaining a greater understanding of bypass technology adoption on trucking carrier selection decisions, results of this research offer theoretical, managerial, and policy implications. Each of these implications will be discussed later in the paper.

THEORY AND HYPOTHESES

Social Exchange Theory

Social Exchange Theory (SET) posits that actors evaluate exchange relationships by comparing alternatives in terms of relational costs and benefits (Thibaut and Kelley, 1978). The theory assumes actors are rational and maximize their own self-interests by seeking awards and avoiding punishments (Homans, 1961). The assessments of costs and benefits are not absolute; they may vary over time or from person to person. This type of subjective cost-benefit analysis may consider a variety of economic, psychological, and sociological factors (Blau, 1964). However, the relational process remains the same. Actors consider the net worth of an existing or potential exchange relationship (i.e. benefits - costs) as a baseline and then compare it to perceived alternatives (Thibaut and Kelley, 1959). This comparison of alternatives drives the formation, evolution, or deterioration of relational exchanges. Ultimately, the behaviors of actors are driven by the basic motivation to obtain profitable outcomes in exchange relationships (Emerson, 1976).

Although SET has been traditionally underrepresented within the supply chain management discipline (Krause and Ellram, 2014), it is gaining wider acceptance as a useful theoretical lens for the broad domain of buyer-supplier exchange phenomena that utilizes behavioral experiments (Defee et al., 2010). For example, Thomas et al. (2010) studied the effects of buyer induced time pressure on suppliers. Kaufmann et al. (2018) examined the resilience of buyer-supplier relationships when faced with a psychological contract breach. Thomas et al. (2013) tested the effects of negotiation strategies on knowledge sharing proclivity in buyer-supplier interactions. Narasimhan et al. (2009) gained better understanding of buyer-supplier relationship dynamics in lock-in situations. As these exemplars show, when supply chain members engage in exchange relationships, SET is an appropriate theoretical foundation to inform behavioral investigations into the complex subtleties surrounding specialized buyer–supplier (i.e. shipper-carrier) interactions.

Carrier Selection Effects

Carrier selection initiates a shipper-carrier exchange relationship. It is a specific type of sourcing decision that has significant cost and service effects on supply chains (Bardi, 1973; Thomas et al.,2016). An extensive body of research has explored determinants of carrier selection from the perspectives of both shippers and carriers (Bardi, 1973; Kent and Parker, 1999; McGinnis, 1990; Meixell and Norbis, 2008; Premeaux, 2002; Voss et al., 2006; Williams, Garver, and Taylor, 2013). Various studies have identified cost and service attributes like pricing, lead-times, reliable delivery, capability, and capacity as key determinants of carrier selection (Baumol and Vinod,, 1970; Milne and Laight, 1963; Heskett et al. 1964; Bardi 1973; Evans and Southard, 1974; Jerman, Anderson and Constatin, 1978; Stock and Lalonde, 1977). However, carrier selection has morphed from a routine purchase decision into a much more involved evaluation process with important implications for supply chains (Bardi, Bagchi, and Raghunathan, 1989; Murphy and Hall, 1995; Robinson et al., 2013; Garver, 2016; Saleh and Lalonde, 1972). Changing regulatory environments, evolving supply chain strategies, and increasing shipper expectations have influenced carrier selection criteria by expanding the potential attributes that shippers use when choosing a transportation service provider (Wang et al., 2015).

Although recent studies have demonstrated that shippers expect a broader range of carrier attributes and services, transporting goods in a better, cheaper, and faster manner remains a universal constant throughout all types of supply chains (Meixell and Norbis, 2008; Williams et al., 2013; Robinson et al., 2013; Garver, 2016; Joo et al., 2017). In particular, freight rates continue to be a primary selection determinant for transportation services (Dobie, 2005; McGinnis, 1990). As one of the most easily quantifiable and comparable types of relational costs, carrier pricing enables shippers to evaluate potential carrier exchange relationships in an unambiguous manner. If all other attributes are equal, then SET suggests a higher freight rate will reduce the net worth (i.e. relational benefits – relational costs) of a potential shipper-carrier relationship and incentivize a shipper to consider other alternatives. Shippers will be less likely to exchange with carriers that have higher prices. Therefore, based on applicable carrier selection literature and SET insights, we hypothesize the following negative main effect:

Hypothesis 1: As a carrier's price increases, a shipper's purchase intent decreases.

Green Management Information Systems Effects

The role of management information systems (MIS) in transforming supply chain practices to improve performance, enhance innovation, and generate new

economic opportunities has been well documented (Bharadwaj, 2000; Gunasekaran & Ngai, 2004; Rai et al., 2006). However, with growing organizational awareness of environmental concerns and the increasing importance of sustainability, the concept of green MIS is gaining momentum (Melville, 2010; Malhotra et al., 2013). Information systems can play a crucial role in supporting or transforming sustainable organizational practices through MIS-enabled organizational processes that improve environmental performance (Melville, 2010). Increasingly, green technology practices are deemed essential to sustainability movements that seek to meet the demands of the current generation without compromising the ability to meet the needs of future generations (Shrivastava, 1995; Malhotra et al., 2013; Hu et al., 2016).

The concept of "green" has become associated with computing technology in several ways. Green information technology can diminish the carbon footprint of equipment by designing and manufacturing energy efficient chips, reducing energy consumption, and reducing electronic waste generated by obsolete computers, servers or associated subsystems (Watson et al., 2008). Information systems can also enhance sustainability by using teleconferencing, groupware, environmental auditing, and automation to advance environmentally friendly operations through ongoing sustainable process development (Corbett, 2013; Sarkis et al., 2013; Watson et al.,2008). A growing body of research suggests that green MIS is more than simply a cost of doing business; it is an opportunity for firms to increase productivity, reduce costs, enhance profitability, and achieve competitive advantage while also helping organizations deliver environmentally friendly value to stakeholders throughout a supply chain (Nanath and Pillai, 2017; Dao et al., 2011).

MIS can improve efficiency and provide greener solutions for major greenhouse gas emitting supply chain functions like transportation (Dedrick, 2010). For example, weigh station and tollbooth bypass technology enables carriers to deliver goods in a more efficient and greener manner (Marett et al., 2013). However, by adopting this type of green MIS, carriers may do more than simply reduce their internal costs and environmental footprint. Carrier bypass technology may also be perceived as a relational benefit to shippers as they consider potential exchange relationships with transportation providers. As consumers and governmental entities increasingly demand that processes, products, and services be environmentally friendly, shippers are held more accountable for the waste streams of upstream supply chain members (Green et al., 2012). Selecting carriers with bypass technology helps address these stakeholder concerns and likely makes an exchange relationship more attractive. Therefore, based on applicable green MIS literature and SET predictions, we hypothesize the following positive main effect:

Hypothesis 2: As a carrier's green MIS adoption increases, a shipper's purchase intent increases.

Carrier Selection and Green Management Information Systems Interactions

According to SET, a carrier's pricing and bypass technology adoption influence a shipper's purchase intent. However, beyond these simple main effects, SET logic also suggests a potential interaction may exist between these factors. When carrier prices are low, shipper purchase intentions naturally increase. In this situation, adding bypass technology to the exchange will increase the relational value for a shipper, but since purchase intentions are already high the effects of the green technology benefit will be constrained. However, when carrier prices are high and shipper purchase intentions are low, then the opportunity for green MIS to increase the net worth of the relationship is much greater. As a result, carrier bypass technology adoption has a larger positive effect on shipper purchase intent when carrier pricing is high rather than low.

Therefore, based on the application of SET, we hypothesize the following interaction effect.

Hypothesis 3: A carrier's green MIS adoption and pricing interact in such a way that green MIS has a greater effect on shipper purchase intent in higher price conditions than lower price conditions.

RESEARCH DESIGN AND METHODOLOGY

To test our hypotheses, a vignette-based experiment was conducted using a sample of managers. Vignette-based experiments deploy varying versions of descriptive scenarios to convey scripted information about specific levels of factors of interest that influence judgments, preferences, or decisions (Rungtusanatham et al., 2011). Extant research has illustrated that vignettes are useful for "evaluating the intended reasoning, decision making processes, and/or the intended behaviors of respondents" (Bendoly and Eckerd, 2013; Deck and Smith, 2013; Eckerd and Bendoly, 2011). Further, the use of vignettes works well when asking subjects what they "could" or "would" do in similar situations, rather than what they "did", "have done", or "should do" (Cantor et al., 2014; Thomas et al., 2010). Given the context of environmental sustainability, and the potential for social desirability effects (Fischer, 1993), the use of a vignette is crucial to mitigate the effects of associated norms and it permits explication of how managers actually think and react to the adoption of green MIS (Davis-Sramek et al., 2018; Matthews et al., 2016)

The vignette-based experiment was a 2 x 3 between-subjects factorial design. The independent variables were carrier adoption of green MIS (high, low) and carrier price (high, average, low). Carrier adoption of green MIS was manipulated within the vignettes by describing the extent to which the carrier "utilizes bypass system technologies" or "does not utilize bypass system technologies". Carrier price was manipulated within the vignettes by including the rate quote per mile - $2.04 (high), $2.00 (average), $1.96 (low) – and how it compared to other carriers under consideration. The dependent variable was the carrier selection decision proxy, which was measured using a three-item scale for purchase intent (Davis-Sramek et al., 2018; Thomas et al., 2016). The vignettes employed in the experiment meet the design guidelines suggested by Rungtusanatham et al. (2011). Additional information on the vignettes, manipulations, and measures can be found in Appendices A and B.

Sample

The sample consisted of 158 full-time working professionals affiliated with a supply chain management executive education program in the United States. The average age of participants was 37.8 years with applicable work experience of 11.3 years. The sample was 62% male. In order to guarantee complete anonymity, encourage authentic responses, and minimize potential social desirability bias effects, no other demographic information was collected from participants. Although individual identifying characteristics are not available for specific analysis, the composition of the executive education program included managers from both shipper and carrier companies.

Procedure

Participants were randomly assigned to one of six treatment conditions that resulted from a 2 x 3 between-subjects factorial design. Vignettes manipulated pricing (high vs. average vs. low) and green MIS adoption (high vs. low). The scenario descriptions (Appendix A) also controlled for other relevant transportation sourcing criteria that could potentially confound results. Data was collected via a paper and pencil format in a common classroom setting over several executive education sessions. All data collection was administered by the same researcher under the same conditions. Participants

were told to read their assigned scenario and simply answer questions openly and honestly. To limit potential social desirability bias effects (Fischer, 1993), participants were specifically instructed that there were no "right" or "wrong" answers.

Measures

All measures used in this study were adopted or adapted from existing scales and used a 7-point scale (Appendix B). All scales had been previously tested and were found to be valid and reliable. Item modifications were limited to small wording changes. The modifications were performed to ensure logical consistency between the vignette descriptions and the individual scale items. Items for the dependent variable of purchase intent were adapted from Grewal et al. (1998) and Hardesty et al. (2002). Manipulation check items for the independent variables of green MIS adoption and pricing were adapted from Choi and Ng (2011). Realism check items were adopted from (Dabholkar, 1994).

RESULTS

Manipulation Checks

Manipulation checks were performed to ensure the vignettes worked as intended (Bachrach and Bendoly, 2011). ANOVA results show a significant manipulation of pricing ($F = 114.878$; $M_{high} = 5.61 > M_{average} = 3.77 > M_{low} = 2.13$; all p's < 0.001) as well as a significant manipulation of green MIS adoption ($F = 486.98$; $M_{high} = 6.10 > M_{low} = 2.14$; $p < 0.001$). Therefore, the experimental treatments effectively manipulated the independent variables.

Attention Checks

Directed query items were imbedded into the post-treatment questionnaire (Abbey and Meloy,2017). These attention checks were used to determine if participants were sufficiently engaged and attentive to the experimental tasks. Participants effectively responded to these directed queries and thus demonstrated sufficient attention to detail in the research setting. Therefore, results of the experiment can be interpreted without concern for inattentive participant responses.

Confounding Checks

Two types of confounding checks were performed. First, consistent with Perdue and Summers (1986) the discriminant validity of the independent variable manipulations was evaluated. This check showed no significant interactions between the factors and their measures (all p's > 0.05). Therefore, the vignette based manipulations were clean and free from confounding. The second type of confounding check involved post hoc qualitative inquiry that asked participants to describe their decision making processes. These open-ended responses were reviewed to determine if any unknown confounding factors were inadvertently introduced into the experiment. The research team did not find any evidence of confounding conditions in the participant responses. Based on these two types of checks, results of the research can be evaluated without concern for confounding conditions.

Realism Checks

Consistent with Dabholkar (1994), realism checks were performed. Participants were asked if they could imagine themselves in the described situation and if they thought the situation was realistic. Participants responses indicated above average realism ($M_{realism} = 4.99$). Therefore, concerns about the potential adverse effects associated with an artificial or contrived laboratory setting are reduced.

Hypothesis Testing

Hypotheses were tested via ANOVA on the dependent variable of purchase intent with pricing and green MIS adoption as factors. Results show

that an increase in carrier pricing reduces a shipper's purchase intent ($F = 30.567$; $p < 0.001$; effect size = .287) thus supporting H1. Results also show that an increase in a carrier's green MIS adoption increases a shipper's purchase intent ($F = 177.682$; $p < 0.001$; effect size = .539) and offer support for H2. As predicted, the main effect hypotheses were qualified by the predicted interaction between pricing and green MIS ($F = 3.388$; $p < 0.05$; effect size = .043) indicating that green MIS affects the established relationship between pricing and purchase intent. This result supports H3. Table 1 summarizes the hypothesis testing results.

DISCUSSION

The purpose of this research was to test *a priori* hypotheses about the effects of pricing and green MIS in carrier selection decisions. The results of our vignette-based experiment illustrate that the adoption of green MIS positively affects carrier selection and attenuates the negative effect of price on shippers' purchase intentions. These experimental findings are consistent with theoretical predictions of SET and shed light on the subtle relational complexities involved in shipper-carrier exchange beyond the influence of traditional cost and service factors. Indeed, our study illustrates that the adoption of green MIS presents an opportunity for carriers to increase the relational value of the exchange for prospective shippers and mitigates the negative effect of higher prices. Overall, by providing new insights into the opportunities for differentiation presented by green technologies, our research offers important implications for theory, practice, and public policy.

Theoretical Implications

This research confirmed SET predictions regarding shipper-carrier relationship formation and showed that SET insights can extend beyond traditional psychological or sociological context boundaries into specialized supply chain applications. As anticipated, a price increase was viewed as a relational cost and lowered purchase intent. Although this finding was intuitive, it does support the notion that economic factors still matter in complex exchange relationships often conflated by social/psychological dimensions. However, green MIS was also found to be a statistically significant predictor of shipper purchase intent. This finding is important because it shows that green MIS is indeed viewed as a relational benefit in a shipper-

TABLE 1
SUMMARY OF EXPERIMENT ONE

ANOVA RESULTS Independent Variables	F-Value	Effect Size
Main Effects		
Pricing	30.567***	0.287
Green MIS	177.682***	0.539
Pricing x Green MIS	3.388*	0.043

*p<0.05 **p<0.01 ***p<0.001

carrier exchange relationship and thereby adds an additional dimension to the evolving carrier selection literature.

Perhaps the most theoretically significant finding of this research addresses the role of green MIS relative to pricing in carrier selection decisions. An effect size comparison shows that adoption of bypass technology has nearly twice the impact of a 4% change in freight rates (i.e. 2% below average to 2% above average). This result questions the decades old assumption that price is the ultimate determinant when selecting transportation providers (Dobie 2005; McGinnis 1990) and it supports the SET premise that relational costs and benefits may change over time. The significant interaction effect of the independent variables on shipper purchase intentions further supports the emerging role of sustainability criteria in carrier selection. Results of this research suggest that green MIS weakens the generally accepted relationship between price and selection. Rather than advocating that actors "should" source sustainably, researchers can now begin to provide evidence that suggests actors "do" consider green factors in carrier selection and propose empirically supported theoretical relationships.

Managerial Implications

Many benefits of bypass technology are well documented and widely accepted (Marett et al.,2013). No one seems to debate that transponders reduce congestion, idle time, or fuel consumption. Everyone seems to agree that instantaneously sharing important carrier information in a wireless digital format can reduce costs, improve service, and shorten lead-times. Multiple transportation stakeholders and the overall environment benefit from these efficiencies. However, results of this research also suggest that green MIS adoption has an additional benefit for carriers. It differentiates them in a way that increases their chances of being selected by shippers. Bypass technology not only reduces bottom line costs, but it has the potential to increase top line sales. There has always been a case that "going green helps you make more green", but that traditional perspective is cost focused. Our research builds on this foundational premise of environmental sustainability and then suggests that incremental demand can also be generated for carriers. This finding has clear managerial implications for carriers as well as advocates for green MIS adoption.

Policy Implications

Although some suggest that policy mandates may be the only avenue to affect meaningful sustainability progress (Markman and Krause, 2016), results of this research suggest that market mechanisms may be an effective alternative to legislation. In our experiment, the use of bypass technology had a statistically significant effect on carrier selection. Therefore, if the transportation market is permitted to function without intervention, it appears shippers will naturally select carriers with better sustainability performance. Over time, a Darwinian filter could shape the trucking industry by rewarding environmentally sustainable carriers. Carriers with high levels of green MIS adoption could prosper and those with low levels of sustainability would eventually disappear. This type of market driven evolution would take time, but it could avoid potential unintended consequences that may accompany government imposed regulations (Davis-Sramek et al., 2018 cite).

Green MIS also provides a standardized and consistent enforcement function for government agencies. Street-level bureaucrats, such as regulatory agents in weigh stations, exercise significant discretion in the distribution of sanctions and implementation of policies (Lipsky, 1980). However, with bypass technology, trucks are electronically pre-screened for compliance with federal and state regulations, which eliminates the "human" factor in policy implementation. Thus, carrier adoption of bypass technology can help to

decrease variations in the level of compliance and the distribution of sanctions across fleets.

Limitations and Future Research

In shipper-carrier interactions, our results suggest that social benefits of a relationship are beginning to take a more prominent role – perhaps even relative to the economic costs of an exchange. However, future research needs to explore this notion in more detail and determine which psychosocial or economic aspects of green MIS influence relational net worth. Our results show that green MIS has a statistically significant impact and large effect size on carrier selection. SET predicted this relationship based on cost/benefit logic, but our understanding of the perceived benefit of green MIS remains limited. Why do shippers select carriers with bypass technology and what specific rewards are associated with this type of exchange are questions that remain unanswered. Perhaps green carriers are selected because shippers like being associated with environmentally responsible providers or maybe they simply think it is the right thing to do. On the other hand, a more utilitarian decision calculus might be at play. Maybe shippers believe that green technology adoption will eventually drive down economic costs or consumers will purchase more goods from firms that associate with green suppliers. Future research is needed to fully explore the more specific motivations involved in complex shipper-carrier exchanges.

The experimental results of this study show that bypass technology adoption has a much larger effect on shipper purchase intent than a 4% price differential. Although we think this finding is meaningful and suggests that sustainability considerations are beginning to affect traditional price driven sourcing decisions, our vignettes were limited to three treatment conditions for price (i.e. 2% below average, average, and 2% above average). In transportation, many think a 2% to 4% price differential is quite meaningful, but others could suggest such a cost range is inconsequential and that drawing meaningful conclusions regarding the role of price and sustainability is problematic. Although sustainability appears to be gaining traction as an important selection attribute, there is likely a tipping point where a cost differential becomes large enough that green MIS no longer matters. Therefore, additional research is needed to further refine our understanding of this relationship.

CONCLUSION

While cost and service still have a fundamental influence on carrier selection decisions, the breadth of selection criteria has expanded to include environmentally sustainable technology solutions. For shippers and carriers alike, the adoption of bypass technology is a more efficient form of compliance monitoring and serves as a strong sustainability signal to customers and regulators. By adopting green technologies, carriers can leverage their sustainable approach to supply chain functions and appeal to the sustainable sourcing preferences of shippers. Our findings suggest that adoption of green technologies differentiates transportation service providers and moves carrier evaluation criteria beyond traditional cost focused approaches.

Our study also provides empirical evidence to support managerial and policy discussions focused on the relative efficacy of the private sector versus the public sector in the promulgation of environmental regulations and sustainability standards. Our findings suggest that the shipping market rewards carriers who adopt and implement environmentally sustainable practices, as shippers are more likely to select carriers who have adopted green technologies and weigh adoption more heavily than some price related factors. Accordingly, government interventions may no longer be necessary to motivate environmental friendliness in the trucking industry because the market now provides sufficient incentive for carriers to adopt green technologies. In contrast to government

policies that react to changes in constituent preferences, the self-regulating nature of the market mechanism allows for continual adjustment and fine-tuning over time as demand for environmental sustainability evolves and new green technologies are introduced.

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BIOGRAPHIES

Rodney W. Thomas is an Associate Professor of Supply Chain Management in the Sam M. Walton College of Business at the University of Arkansas. His research interests focus on behavioral aspects of supply chain management. Email: rthomas@walton.uark.edu

Jessica L. Robinson is an Assistant Professor of Supply Chain Management at California State University, Long Beach. Her research interests focus on the integration and behavioral aspects of supply chain management. Email: Jessica.Robinson@CSULB.edu

Jessica L. Darby is a Ph.D. Candidate in Supply Chain Management at the University of Arkansas. Her research focuses on the effect of public institutions supply chain operations and performance. Email: jdarby@walton.uark.edu

Scott Cox is an Assistant Professor of Management at Western Kentucky University. His research interests include supply chain management technology, change management, and the behavioral dimensions of supply chain management. Email: scott.cox@wku.edu

Donnie F. Williams, Jr. is a Clinical Assistant Professor of Supply Chain Management and the Executive Director of the Supply Chain Management Research Center at the University of Arkansas. Email: dwilliams3@walton.uark.edu

APPENDIX A
COMMON TRANSPORTATION SOURCING SITUATION

Directions

In the following scenario, a common transportation sourcing situation is described for a major retailer. Assume all scenario descriptions are accurate and trustworthy. After you read the scenario, please answer each question. As you answer each question, predict how the retailer would act in this type of situation. Please do not base your answers on how you think the retailer should approach the situation, but rather on how they actually would approach the situation.

Basic Scenario

Imagine that a major retailer is conducting its annual review of truckload carriers. Based on this review process, the retailer has decided to add another transportation service provider to its preferred group of core carriers. After evaluating numerous carrier proposals, the retailer has narrowed down their potential options to six remaining truckload carriers. With the exception of rates and bypass technology discussed in the following paragraphs, all six carriers are identical on any relevant selection criteria. For example, all six carriers provide the same level of acceptable coverage, legal compliance, service, safety, and lead-times. All six carriers also have the same basic transportation management information systems capabilities for keeping track of orders, dispatching, shipments, routing, and payments.

Pricing Manipulations:

(HIGH) Superior Transportation Services (STS) is one of the six remaining carriers. STS quoted an average rate of $2.04 per mile. The other carriers under consideration all quoted a rate of $2.00 per mile. Therefore, the STS rate quote is 2% higher than the other carriers.

(AVERAGE) Superior Transportation Services (STS) is one of the six remaining carriers. STS quoted an average rate of $2.00 per mile. The other carriers under consideration also all quoted a rate of $2.00 per mile. Therefore, the STS rate quote is the same as the other carriers.

(LOW) Superior Transportation Services (STS) is one of the six remaining carriers. STS quoted an average rate of $1.96 per mile. The other carriers under consideration all quoted a rate of $2.00 per mile. Therefore, the STS rate quote is 2% lower than the other carriers.

Green MIS Manipulations:

(HIGH) Unlike the other carriers under consideration, STS has also invested in intelligent transportation system capabilities. In addition to basic transportation management systems, STS utilizes bypass system technologies that allow truck drivers to bypass tollbooths and highway weigh stations. STS trucks are equipped with transponders that transmit information about each shipment (i.e. weight, cargo, and driver's hours of service) to receivers located at highway weigh stations along the vehicle's route. This bypass system technology reduces idle time at weigh stations, reduces highway congestion, reduces fuel consumption, reduces greenhouse gas emissions, and reduces paper usage. Therefore, STS has the smallest carbon footprint among the final six carriers.

(LOW) Like the other carriers under consideration, STS has not invested in intelligent transportation system capabilities. STS does not utilize bypass system technologies that allow truck drivers to bypass tollbooths and highway weigh stations. STS trucks are not equipped with transponders that transmit information about each shipment (i.e. weight, cargo, and driver's hours of service) to receivers located at highway weigh stations along the vehicle's route. STS does not have the bypass system technology that reduces idle time at weigh stations, reduces highway congestion, reduces fuel consumption, reduces greenhouse gas emissions,

and reduces paper usage. Therefore, STS has the same carbon footprint as the final six carriers.

APPENDIX B
MEASURES FOR DEPENDENT AND INDEPENDENT VARIABLES

Purchase Intent (Grewal et al., 1998; Hardesty et al., 2002):

- The retailer's willingness to select STS as their new carrier is very high.
- The retailer is very likely to purchase transportation services from STS.
- The probability that the retailer would consider selecting STS is very high.

Pricing (Choi and Ng, 2011):

- Compared to the other carriers, STS prices are…(lower, average, higher).

Green MIS (Choi and Ng, 2011):

- STS has "green" management information systems.

Realism (Dabholkar 1994):

- The situation described in the scenario was realistic.
- I can imagine myself in the described situation.

THE TUMULTUOUS WORLD OF GLOBAL MARITIME TRANSPORTATION: A CAUTIONARY TALE FOR SUPPLY CHAIN MANAGERS

Kent N. Gourdin
College of Charleston

ABSTRACT

The past five years have seen unprecedented changes transform the way goods are moved around the world. The expanded Panama Canal now permits larger vessels as well as simultaneous transits in each direction. Coincidently, steamship lines began purchasing a new generation of bigger ships, forcing ports in the United States to make very large investments in new infrastructure. When examined within the context of other environmental events impacting global trade, the total effect has been to put the maritime industry into a state of flux. This paper will examine these and other important issues before offering conclusions intended to help managers develop successful supply chain strategies in today's uncertain post-Panamax world.

INTRODUCTION

The past five years have seen unprecedented changes transform the way goods are moved around the world. The expanded Panama Canal opened for business on June 27, 2016. Widely hailed as a game changer on the scale of the original, the increased capacity of the new locks now permits larger vessels as well as simultaneous transits in each direction, both serious limitations of the pre-existing canal. Coincidently, steamship lines began purchasing a new generation of ships that are too big even for the larger locks. In order to handle these large vessels, ports in the United States have been forced to make significant investments in new infrastructure. When examined within the context of other environmental events impacting global trade, the total effect has been to put the maritime industry into a state of disarray that has made managing the transportation element of the firm's global supply chain especially challenging. This paper will examine these and other important issues before offering conclusions intended to help managers develop successful supply chain strategies in today's uncertain post-Panamax world.

THE EXPANSION OF THE PANAMA CANAL

The Panama Canal expansion officially began on October 22, 2006 with the passage of a national referendum in Panama approving the project. Work actually commenced on September 7 the following year with an estimated completion date of October 2014. From the outset, the Panama Canal Authority (ACP) stated that the purpose of the expansion was to double the Canal's capacity in order to accommodate much larger container vessels, an issue discussed in more detail in a subsequent section (Panama Canal Authority, 2018). However, most U.S. ports were ill prepared to handle such large ships on a regular basis, either because of water depth issues, landside shortcomings, or both, and immediately initiated steps to remedy deficiencies so as to take advantage of the anticipated boon. On the Atlantic Coast, the major ports of New York, New Jersey, Baltimore, and Virginia have all recently completed or nearly completed post-Panamax expansions.

Charleston is poised to begin a dredging project that will deepen its harbor to 52 feet at mean low water (MLW) by 2020 (South Carolina State Ports Authority, 2016), while the Port of Savannah is

planning to increase its depth to 47 feet at roughly the same time (Georgia State Ports Authority, 2018a). PortMiami recently completed $1.3 billion in infrastructure upgrades that will improve vessel, truck, and rail access to its container facility (Klulisch E., 2017). The Gulf Coast's major ports, despite facing much shallower water because of the coastal profile, are planning similar upgrades. At Bayport, the Gulf's largest and newest container facility, port authorities are dredging deeper channels, expanding berthing space, adding container yard acreage, and installing post-Panamax cranes (Port of Houston, 2018). The major West Coast ports of Oakland and LA/Long Beach already enjoy sufficient water depth and are focusing their improvement efforts on systems to speed ship loading/unloading and expedite the movement of cargo into and out of the respective terminals.

Clearly, U.S. ports, regardless of size, expect to benefit from the expansion and are, at great cost, proceeding accordingly. Whether or not they should be, remains to be seen. No port wants to be left out, because the risk of "missing the boat" by doing nothing is simply too high. That said, these projects are expensive and complex, leading to costs which are often underestimated at the outset. Once begun, the work must be completed regardless of the extra funds required. Because long-term benefits are very difficult to know and quantify, they tend to be overstated at the beginning to justify the work. Sometimes the port/bridge/waterway is built only to discover twenty years later that it probably shouldn't have been.

THE CURRENT SITUATION

Unfortunately, as is often the case, the world has changed in unexpected ways since expansion work began. First, the present state of the global container shipping industry will be scrutinized with respect to the growth in ship size and the reduction in the number of carriers. Then, containerized cargo flows into and out of U.S. ports will be discussed, followed by a closer look at critical problems affecting some domestic ports. Finally, something that cannot be ignored is the ongoing uncertainty surrounding the Trump administration's handling of foreign trade issues and in what ways their policies might affect global maritime transportation.

Global Maritime Industry

Two of the most significant and recent changes to the container shipping industry have been the rapid growth in vessel sizes and the unprecedented consolidation of carriers.

Vessel Sizes

Containerized shipping actually began in the mid-1950s with the movement of truck-trailers. The inefficiencies associated with transporting what are essentially boxes with wheels quickly became apparent, and the modern container was created and standardized in either twenty-foot or forty-foot lengths. In fact, the twenty-foot equivalent unit, or TEU, is the global standard unit of measure for containerized freight transportation. One TEU represents a single twenty-foot long container while two TEUs could refer to two twenty-foot containers or one forty-foot container. Thus, while ship capacity is commonly quoted in TEUs, the number of actual containers on the vessel represents a mix of twenty-foot and forty-foot boxes that, theoretically, will always be lower than its quoted capacity. By the mid-1960s, ships specifically designed and built to transport nothing but containers began to appear, and the rest is history. As shown in Figure 1, growth in ship size and carrying capacity has continued ever since. Given the dimensions of the original Panama Canal locks, vessels were broadly categorized at that time as being either Panamax (roughly 5,000 TEU, the largest size able to use the canal) or Post-Panamax (too big to use the canal). Those classifications remain, but are different for the expanded locks

where Panamax now refers to vessels of approximately 13,000 TEU capacity or higher.

As shown in Figure 2, beginning in 2010, the average size of the global container fleet surged as lines began buying megaships, a term loosely referring to vessels capable of moving 18,000 TEU or higher. In fact, orders for 50 such vessels of between 18,000 and 22,000 TEU were placed in 2015. Mediterranean Shipping Company (MSC) deploys the largest number (90) of what are sometimes referred to as Ultra Large Container

FIGURE 1
FIFTY YEARS OF CONTAINER SHIP GROWTH

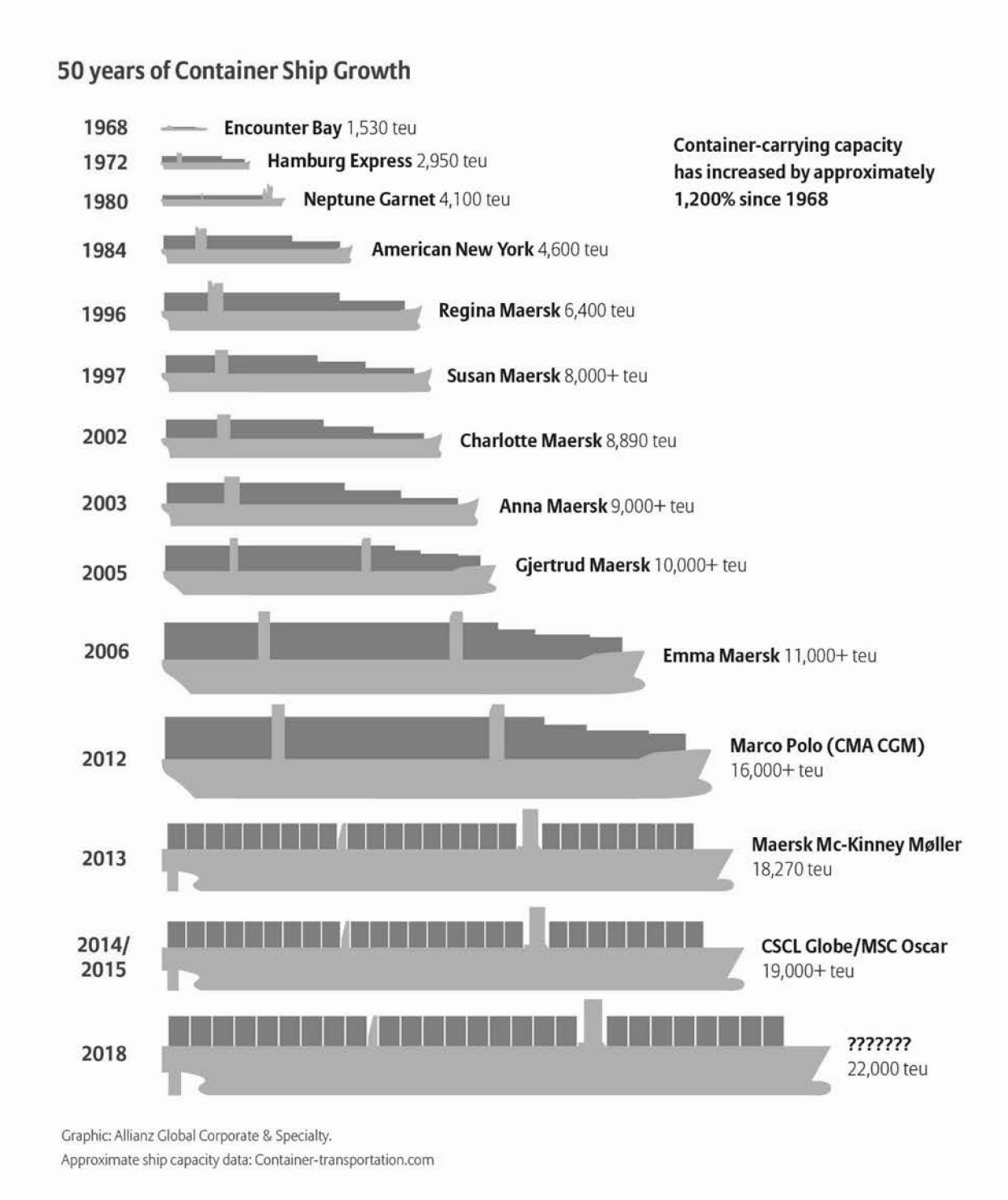
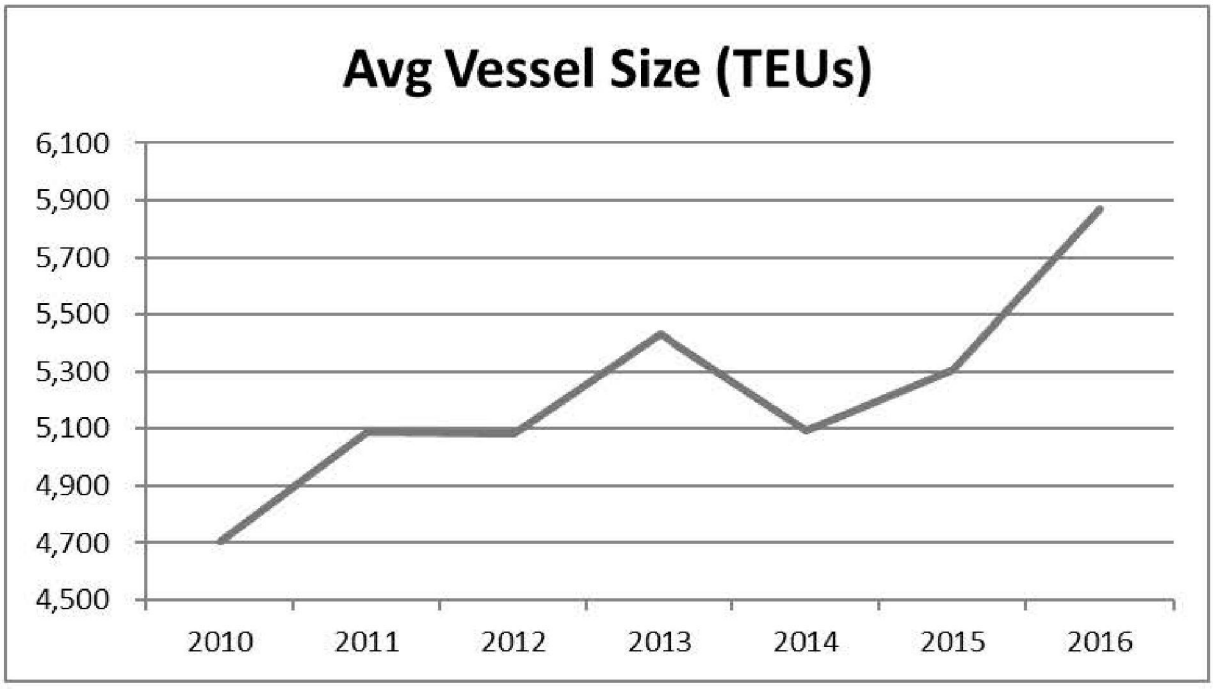


FIGURE 2
AVERAGE VESSEL SIZE IN TEUS



Source: South Carolina State Ports Authority

Ships (ULCS) and has 11 on order that can each accommodate 23,350 TEU (Visser, 2018).

Unfortunately, the arrival of these new ships coincided with a flattening of global trade, resulting in a glut of capacity chasing smaller amounts of cargo. Beginning May 1, 2016, contract rates fell to historic lows, some as low as $700 per 40-foot container moving eastbound across the Pacific where they remain to this day. Unless these rates cover break-even costs of approximately $1500, the carrier will lose money (Paris and Walker, 2018). While an in-depth examination of slot costs (i.e. costs incurred to move one container) is beyond the scope of this paper, suffice to say that empirical data do not support the hypothesis that unit costs necessarily decrease with increments of vessel size, especially beyond 8,000 TEU, nor that TEU-mile cost decreases as ship size increases. Because fuel makes up roughly 40% of these costs, the savings are greater when the price of oil is high. A 2015 comparison of slot cost savings per round trip voyage on a typical Asia-North Europe service of an 18,000 TEU ship versus one with 14,000 TEUs showed that savings had reduced from $76 per slot to $38 per slot based a reduction in fuel costs (Knowler G., 2015). Instead, the economies of container ship voyages appear to depend on many factors unrelated to size. For example, larger vessels are also faster and can, therefore, provide better service and utilization of assets. On the other hand, they are often harder to handle necessitating more demanding requests, in terms of both money and time, related to navigating channels along rivers/ canals, port berthing, port access channels, and cargo handling facilities. In other words, because there is a tradeoff between the positive returns earned at sea and the negative returns while in port, the overall efficiency of a ship may depend ultimately on the total time taken to complete a voyage dock to dock (Gkonis and Harilaos, 2009).

Even before the August 31, 2016 Hanjin collapse (more about that later), spot rates were trending higher. In November of that year, the spot rate for a forty-foot container was $1843 versus $623 the previous April. In response, carrier managers began to reduce capacity by selling or scrapping smaller, relatively new vessels that are able to move through both the old and new sets of locks on the Panama Canal (Tirschwell, 2016). In April of 2018, the spot rate for a forty-foot container from Shanghai to the West Coast was $1127, up 19.3% over the previous week. Negotiations for transpacific trade lane contract rates normally begin with the largest customers signing contracts in late March or early April. These accounts, in turn, set the floor for service contract rates that run from May 1 through April 30 the next year. Contract negotiations are then concluded with small and mid-size beneficial cargo owners who generally pay several hundred dollars more per forty-foot equivalent unit (FEU) than do the largest shippers (Mongelluzzo, 2018). However, if the market remains firm after the Chinese New Year holiday, then there can be a pressure from shippers to tie down their yearly rate agreements earlier (Wackett, 2017). However, the level of uncertainty is illustrated by the fact that some industry experts feel the overhaul of the market could help prevent excess capacity and problems on freight rates, while others fear that shipping lines might cut their rates to pursue market share for their new alliances or order ships to beef up services. Finally, idle ships could be put back into service relatively quickly, further driving rates down (Wright, 2017).

Industry Consolidation

For most of the carriers, the damage resulting from falling rates has already been done. Of the largest 12 shipping companies that published financial results in 2016, 11 announced huge losses. A.P. Moller-Maersk, the industry leader, lost $1.9 billion, their largest negative result ever (A.P. Møller-Maersk A/S Annual Report, 2016) while CMA CGM went from a $567 million profit in 2015 to a $325 million net lost in 2016 (Barnard, 2017). Perhaps the most shocking event was the sudden collapse of Hanjin Shipping that stranded ships, crews, and cargo around the world for months. In addition, other mergers were announced in 2016. CMA CGM acquired Singapore's NOL and its APL brand; Hapag-Lloyd bought United Arab Shipping Company (USAC); China Ocean Shipping Company (COSCO) combined with China Shipping Container Line (CSCL); and Maersk purchased Hamburg Süd (Hand, 2016).

Clearly, 2016 was a disastrous year for container shipping and did not bode well for the ability of smaller lines to compete with the behemoths. In fact, consolidation activities continued through 2017 and into the follow year. COSCO hopes to complete their acquisition of OOCL in June 2018 (Goh, 2018), while Japan's big three shipping groups ("K" Line, Mitsui O.S.K. Lines (MOL), and NYK) are spinning off their respective container shipping businesses into a new joint-venture company called Ocean Network Express (ONE). The new entity will have a total capacity of 1.4 million TEU, which would rank as the sixth largest in the world and have a global market share of approximately 7% (Paris and Tsuneoka, 2018). There have also been unconfirmed rumors the Taiwanese lines Evergreen and Yang Ming will combine (https://fairplay.ihs.com, 2018). The result of all this activity is that 90% of total container capacity on major trades routes will be controlled by three carrier alliances made up of the following companies (Paris, 2017): 2M (Maersk, MSC), Ocean Alliance (CMA CGM, COSCO, Evergreen, OOCL); THE Alliance (Hapag Lloyd, ONE, Yang Ming).

Containerized Cargo Flows through U.S. Ports

As shown in Table 1, while the ports on the U.S. West Coast are perceived to occupy a very high profile position in U.S. container trades, the U.S. East and Gulf Coasts actually handle more freight.

TABLE 1
U.S. CONTAINERIZED CARGO FLOWS BY COAST IN MILLION TEUs

Year	West Coast	Atlantic and Gulf Coasts	Total
2015	14.3	**17.3**	31.6
2014	14.9	**16.7**	31.6
2013	14.8	**15.9**	30.7
2012	14.5	**15.4**	29.9
2011	14.5	**15.0**	29.5
2010	14.1	**14.3**	28.4
2009	12.4	**12.9**	25.3
2008	14.3	**14.7**	29.0
2007	**15.0**	**14.7**	29.7
2006	**14.6**	13.7	28.3
2005	**13.5**	13.1	26.6
2004	**12.3**	12.2	24.5
2003	**11.1**	10.9	22.0
2002	**10.1**	10.1	20.2
2001	**9.3**	9.3	18.6
2000	**9.4**	9.2	18.6

Source: South Carolina State Ports Authority

There are several reasons for this change. First, the gradual shift of off-shore manufacturing from China to Southeast and Southern Asia has made the choice of reaching U.S. markets via the Suez Canal more competitive (Prozzi and Overmyer, 2018). Second, congestion on and off the West Coast terminals can seriously impede the flow of goods into and out of the ports even on the best of days. Third, contentious labor relations keep the specter of slowdowns and strikes there on the West Coast an ever-present threat, especially at peak shipping times. Fourth, many of the eastern ports are extremely efficient, making them an attractive option for shippers and carriers alike. The long term effect of these West Coast limitations has been to pull the center of gravity for U.S. distribution activities farther east. In sum, these obstacles to efficient cargo handling on the West Coast, combined with problematic intermodal services for the remainder of the eastbound journey, and emerging global production centers, make using Eastern and Gulf Ports an appealing alternative even if the ocean portion of the total move is longer and/or costlier (Conway, 2017).

In the short term, the demand for global transportation will remain flat as growth in global trade volumes have slowed in recent years, thanks to a tepid economic recovery from the financial crisis of 2008 and the changing structure of the Chinese economy. Also, the Trans-Pacific Partnership (TPP), aa trade agreement between twelve Pacific Rim countries originally including the United States, was intended to jump start global trade among the signatories, however it has not been implemented further harming global trade. Among other things, the TPP contained measures to

lower trade barriers and establish an investor-state dispute settlement mechanism. Though signed in February of 2016, President Trump promptly cancelled the agreement shortly after taking office, opening the door for China to assume the leadership position abrogated by the U.S (Mui, 2017). However the Agreement was not signed as noted, and trade has not increased as much as one would have expected while the Agreement was being negotiated. Longer term, there is little doubt that global trade will increase, although by how much and when remains in question.

THE IMPACT OF BIGGER CONTAINER SHIPS ON U.S. PORTS

Congestion

Congestion can occur on both the shipside and the landside. In LA/Long Beach, for example, mega-ships generate between 5,000 to more than 10,000 extra container moves per call. Assume one crane can average 40 lifts per hour and 10,000 TEU are coming off. If four cranes are utilized, the off load will require almost 3 days, with the same amount of time needed to load outbound containers. Obviously using more cranes will speed the process but may require that other vessels wait. Once the containers are landed, they have to go somewhere. As mentioned earlier, most carriers operate in vessel-sharing alliances, which distribute containers from as many as six individual lines each using a different terminal with its own policies and procedures. The model of carrier-owned chassis has also changed and added complexity, with three large chassis-leasing companies now providing them. The interface between the port and the intermodal transportation system also contributes to the problem. Drayage industry issues such as a shortage of drivers or long waits at terminal gates can slow the flow of containers into and out of the port. In fact, the simultaneous arrival of multiple large ships can simply overwhelm the port and swamp the long-distance rail system essential for moving the containers to their final destination (Mongelluzzo, 2016). Similar problems have bedeviled the Port of New York and New Jersey in recent years as well (Morley, 2016).

Labor Strife

Larger ships with many more containers exacerbate the impact of work stoppages because the sheer volumes that build up during a slowdown or strike can overwhelm the system. Work stoppages affected port operations on both sides of the country in 2016, with the expected impacts from larger ships making it difficult for ports to recover. Though none were as disruptive as the West Coast strike in 2002 (which lasted for 11days) or the 8-day action there in 2012, just the thought of a similar shutdown is enough to send ship operators scurrying for alternative ports, a disruption in its own right. However, the aftermath is arguably more disruptive to supply chains than the strike itself. Port operations alone can take weeks and even months to return to normal. The big railroads suffer as well because the flow of containers on their way to affected ports must be stopped as soon as possible, either at origin or some intermediate spot. Once the dispute is resolved, the floodgates are opened and transporting cargo out of the port becomes the problem. During the strike, the companies lose a massive amount of revenue because nothing is moving; once the port reopens, the sheer volume of outgoing containers overwhelms the rail system leading to additional delays, lost cargo, and poor service.

Because the upheaval in supply chains is so severe and the potential for strikes on the West Coast is ever present, retailers and direct shippers have indicated in surveys that they are increasingly likely to shift some of their cargo volume to East Coast ports. Southeast ports like Charleston and Savannah, which typically experience little to no labor disruption, saw significant increases in volumes in the second half of 2014 due to diversions. A

permanent loss of some cargo for the West Coast may be inevitable as shippers increasingly look at the potential labor actions as a serious threat to the security of their supply chains (http://actlogisticsinc.com, 2015). Two-thirds of the U.S. population lives east of the Mississippi River. Many of the large retailers that dominate U.S. containerized imports are based there as well and have extensive retail store networkers in the eastern half of the country, resulting in the "distribution pull" discussed earlier.

PORT INFRASTRUCTURE PROJECTS

Ports are businesses like any other and must remain competitive if they are to remain attractive to both shippers and steamship lines. To that end, ports in the United States have started on, or recently completed, vary large infrastructure projects intended to keep them viable in today's environment with these much larger ships. A few of these are discussed below.

Dredging

The West Coast ports enjoy sufficient harbor depth to handle the large ships, so much of their investment has been in procuring larger cranes and other equipment to service those vessels. While the ports on the East Coast are making similar purchases, they face other challenges as well due to larger ships. As mentioned earlier, both Charleston and Savannah are actively dredging their ports. The Savannah project is especially daunting because it requires deepening the entire 40-mile-long shipping channel: the 18.5-mile outer harbor to 49 feet and the Savannah River channel to 47 feet MLW (2018). In each location, work only started after completing planning and approval processes that stretched across two decades. Miami has already deepened its channel to 50 feet, while the Port of Jacksonville and Port Everglades are pushing to do the same thing (Kitchen, 2016).

Development of Inland Ports

Again, in order to disperse the large numbers of containers flowing as a result of larger ships, ports have sought to spread the volume around to more locations. For instance, in October 2013, the South Carolina State Ports Authority (SCSPA) opened an inland port in Greer, South Carolina, 212 miles inland. This facility connects with port facilities in Charleston via a dedicated daily rail service that facilitates the rapid movement of containers out of and into the port itself, effectively extending the Port's reach well beyond the borders of South Carolina. The facility was so successful that the SCSPA opened a similar facility in Dillon, South Carolina in 2018 (SCSPA, 2018). The Georgia Ports Authority is also planning to open their second site, the Appalachian Regional Port in Chatsworth, Georgia in October 2018 (Georgia Ports Authority, 2018b).

Raising the Bayonne Bridge in NY/NJ

Another reaction to larger ships involves the need to provide higher vertical bridge clearances. The project to raise the navigational height of the 151-foot-tall bridge to 215 feet was completed in mid-2017 (McDonald, 2017). Prior to that time, the largest ships that could dock at the terminals in Newark and Elizabeth, N.J., carried between 8,500 and 9,000 TEUs. However, the largest vessel ever to call the port, the CMA-CGM Theodore Roosevelt with a capacity of 14,400 TEU, made its way to New Jersey in September after transiting the Panama Canal (Villanova 2017).

Jasper Ocean Terminal

Perhaps the most ambitious project, in order to deal with the larger ships, is the on-again/off-again effort by the states of Georgia and South Carolina in the southeastern part of the United States to develop a new terminal on the South Carolina side of the Savannah River that would be jointly-operated by

the port authorities in each state. The $4.5 billion, bi-state project, is on again after more than two decades of discussions and a series of lawsuits. Once complete, it will handle seven million units of shipping cargo that the ports in Savannah and Charleston wouldn't be able to process when they reach capacity within the next 15 years. By 2040, with the complete build out of the terminal, the Port has the potential to create one million jobs and $9 billion in tax revenue between Georgia and South Carolina, according to a 2010 study by the University of Georgia and Wilbur Smith & Associates. If/when the project is completed; it would be the largest single land port in the United States (Murdock, 2015).

OTHER TRADE AND CONTAINER SHIPPING ISSUES

Political Instability in the United States

Political uncertainty will continue to characterize the near term for managers of global logistics and supply chain systems. The U.S. withdrawal from the TPP was mentioned earlier. In April, President Trump announced plans to impose a 25% tariff on $50 billion worth of Chinese-made products and followed up in late May with a decision to impose tariffs on steel and aluminum imported from the European Union (EU) (Zumbrun and Salama, 2018). Until a clear direction has been established for U.S. international trade policies by the present administration, strategic business decisions will need to be made with care and include the ability to quickly pivot in response to the winds of change. However, the reality is that global trade will continue growing in response to the booming e-commerce demand, the shift of the Chinese market from a focus on production to one of consumption, and, for the time being, lower fuel prices.

Volatility in the Price of Oil

As alluded to earlier, petroleum prices rose steadily during early 2018, but quickly fell late in May as Saudi Arabia announced plans to increase production (Petrov, 2018). The drop in oil prices is welcome news for drivers, as well as transportation companies and oil-importing countries like India that buy a lot of energy. Unfortunately, the nation's producing the oil prefer higher prices which generate the revenue upon which those governments depend to fund their political agendas (Ibid). This dichotomy virtually guarantees continued instability in the world's oil markets.

CONCLUSIONS AND IMPLICATIONS FOR SUPPLY CHAIN MANAGERS

While the completion of the Panama Canal expansion was touted as a "game changer," the term could be applied to many other issues discussed in this paper. In essence, the game itself has changed which in no way should minimize the accomplishment of the construction of the Panama Canal or its potential impact on the supply chain. Given the immediate sense of unease, however, supply chain managers must deal with simultaneous, unprecedented, and perhaps more pressing changes to their environment.

The introduction of mega-ships at a time of stagnant global trade led to a consolidation of maritime carriers into alliances that will undoubtedly leverage their size and market power to negotiate higher rates from shippers which will, in turn, make port efficiencies a bigger factor in distribution decision making. To expedite door-to-door delivery times and mitigate the risk of shipment disruptions, managers will opt for using ports where the chances of congestion and labor issues are small, most of which are on the Southeast or Gulf Coasts of the U.S. In fact, a 2016 National Real Estate Investor study confirmed that the East and Gulf Coasts are currently experiencing the highest traffic growth, and listed Savannah, Charleston, and Houston among the five top performing non-West Coast Ports (Carr, 2016). With the demand for prime warehouse and distribution space expected to

remain elevated for the next few years (Thompson, 2016), development will target those ports and the customers/market areas they serve. Supply chain managers would be wise to do the same thing.

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BIOGRAPHY

Kent N. Gourdin is a Professor and Director of the Global Logistics and Transportation Program in the School of Business at the College of Charleston. Dr. Gourdin also served on the faculty at the University of North Carolina at Charlotte and completed a 20-year career in the USAF. Dr. Gourdin earned his doctorate at the University of Tennessee and has published extensively on various aspects of international transportation and logistics management. In addition, he has the authored two books: *Global Logistics Management* and *A Profile of the Global Airline Industry*. E-Mail: gourdink@cofc.edu

YOUR COMMUNITY GETS A B-: ANALYSIS OF THE SPECIFIC AND CURIOUS REALM OF AIRPORT BOND RATINGS

by
Richard R. Hawkins
University of West Florida

Stephen A. LeMay
University of West Florida

Peter M. Ralston
Iowa State University

ABSTRACT

Commercial airports are publicly-owned transportation infrastructure, usually funded with bonds. The bond rating decision for these entities thus has important ramifications for bond investors, issuers, airport managers, and even the communities the airports serve, but the rating decision process is not well understood. This paper discusses a simulation of the rating process in two decision environments, including a downgrade. The effect of information framing in an environment of incomplete data is examined using amateur evaluators. Amateur evaluators were utilized to understand how people with limited financial analysis skills would respond when presented with incomplete information and a primed scenario. The results indicate that amateur evaluators were more likely to downgrade a bond grade than a ratings agency, but this effect was moderated for amateur evaluators with more work experience. Implications for airport and supply chain infrastructure are discussed.

INTRODUCTION

Access to financial capital for U.S. airports is a requirement for sustained performance. Funding can come in many forms, including airport revenue and federal, state, and local grants (Zou et al., 2015). Another primary source of capital for U.S. airports continues to be the municipal bond market.

For background, bonds – like stock issues or loans – help entities raise money. Bond issuers receive financial capital in return for a promise to pay back the principal plus a premium (i.e. interest) to the capital provider. The size of this premium is usually tied to a bond's grade and the perceived riskiness of the bond, essentially an assessment of the likelihood that the issuer will default on it. A bond's grade, determined after a review by a credit rating agency, can severely impact the borrowing costs of bond issuers (Grammenos, Alizadeh, and Papapostolou, 2007). A lower grade indicates a higher level of riskiness, and therefore a higher premium on top of the principal must be offered to potential capital providers. Thus, it serves a bond issuer well to earn the most advantageous grade possible to lower the interest payments associated with bond outlays.

The intent of the current research is to better understand the grading process of municipal bonds specifically utilizing airport bonds as the primary example. Because of a lack of information deemed important by credit ratings agencies to fully assess

bond grades, an experiment was designed and implemented to examine if amateur bond graders evaluated an existing airport bond in the same manner as professionals of a credit rating agency. The experiment also analyzed the possible influence of framing on decisions. This understanding is critical because the bond grading process is opaque and capital seekers need to fully appreciate if differences exist between professionals and other people in an environment where information is incomplete.

This work responds to calls for additional research in understanding the present state of capital inputs for the aviation industry (Fu, Homsombat, and Oum, 2011; Zou et al., 2015). It has important implications for airports, airport managers, municipal budgets, and the future level of community supply chain infrastructure. A lower bond grade limits the ability of a municipality to borrow to maintain or improve the condition of an airport. Thus, bond grades can affect the size of bond outlays, the number of bond outlays, and future behavior (i.e. a negative experience may prevent municipal leaders from undertaking needed improvements).

At a macro level of analysis, infrastructure (for example: airports) plays a major role in supply chain logistics. Yet infrastructure receives little attention in the logistics and supply chain literature. We see few articles on the nature and structure of ports, airports, and other primarily publicly owned facilities, despite their importance to the operation of both domestic and international logistics operations and supply chain design. Even the literature on supply chain finance focuses on money flows and financial arrangements related to inventory (Hoffman, 2005; Kouvelis and Zhou, 2011; Gelsomino et al., 2016). Further, there seems to be little understanding of how infrastructure is funded, where it exists, or its strategic importance not only in developing sound supply chains and transportation systems, but also in the global political arena (Li,, Cui, and Lu, 2014). We also find that infrastructure and infrastructure finance has been neglected in business curricula. It appears that building roads is left to engineers, despite the crucial nature of infrastructure to the business community and consequently to the business student.

This paper contributes to the literature in three ways: first, it addresses the importance of infrastructure finance and financial ratings firms; second, it demonstrates a method for teaching the infrastructure concepts; and third, it adds to the body of literature in supply chain behavioral research (Knemeyer and Naylor, 2011; Siemsen, 2011).

LITERATURE REVIEW

Agency Theory and Airport Managers

The classic agency problem arises when cooperating parties have different goals to be achieved through the same means (Jensen and Meckling, 1976; Eisenhardt, 1989). A prime example of the principal agent problem is an employee-employer relationship. The employer may seek abnormal profits or growth of a company, while an employee may simply want a paycheck and a good quality of life. While differing goals are not automatically a negative, the further goals are misaligned between principals and agents, the greater the chance for conflict and increased costs of monitoring (Fama and Jensen, 1983). Potential agency issues can be exacerbated in airport bond markets.

Accessing financial capital is a factor of production which can create an array of complex relationships among owners, managers, and creditors (Armstrong, Guay, and Weber, 2010). U.S. airports finance large investment projects with revenue bonds (Fuhr and Beckers, 2009). In effect, airport managers serve multiple principals when capital funds are raised through bond markets. Airport managers report directly to city, county, or regional commissions but act as indirect agents for creditors for specific airport bonds. This can form a

relationship where government acts as a steward for the private investors (Oum, Adler, and Yu. 2006), ensuring airports work towards achieving their own goals while also maintaining the fiduciary responsibility of paying back borrowed funds.

The trend of financing airport projects with private investment including bonds has actually been driven by the "cash-in" principle of municipal governments (Cruz and Marques, 2011). The "cash-in" strategy refers to governments taking a relatively safe and stable public asset, such as an airport, and capitalizing on that asset for financial continuity (Cruz and Sarmento, 2017). For example, municipalities and private investors alike know that commercial airports have a high probability of continued operations. Both parties seek to capitalize on this, with one accepting an investment for the continued or improved operation of that asset, while the other party seeks a guaranteed return on investment. Essentially, this is the source of the agency problem for airport managers when dealing with multiple principals.

While their direct superiors can give airport managers direct feedback or actionable goals, bond investors must give feedback indirectly. Rather bond investors either have to assume their investment is being handled in their best interest or rely on an outside party for judgment. These outside parties include credit rating agencies.

Rating Agencies

Credit rating agencies operate in an oligopolistic market with little competition (LeMay, Burns, and Hawkins, 2016). Moody's, Fitch, and Standard and Poor's rate 95% of the general obligation bonds globally (Evans, 2015). While this market structure suggests the potential for a mixture of collusion and forbearance, competition seems to be fairly intense (Becker and Milbourn, 2011). This competition is further exacerbated by a unique setup in bond markets where the issuers themselves pay for the credit analysis and resultant rating (Livingston and Zhou, 2016). An obvious conflict of interest exists because the bond issuer has long-term fiscal incentives to select the credit rating agency which will provide the best rating. As a result, investors should use caution if they rely solely on credit rating agencies' analyses when making investment decisions. In fact, each of the big three credit rating agencies were found to have distorted markets and provided an overly positive view of bonds and securities that failed in the global financial crisis in 2007 and 2008, and again in the European sovereign debt crisis in 2010 (Long, 2013).

Bonds are usually rated in two phases: at the initial outlay and then through an annual "watch" phase that can confirm or alter the original bond grade. While competition can drive bond ratings slightly positive at outlay, it is also the period in which the bond grade is most fully analyzed (Bae, Kang, and Wang, 2015). Credit rating agencies derive most of their revenue from bond outlays, not monitoring. The credit rating agencies also know that the most eyes are on them at the time of bond issue, so reputational effects may be present (Hau, Langfield, and Marques-Ibanez, 2013). Recertifying bonds, or altering their initial grade, accounts for a small percentage of the earnings for credit rating agencies (Driss, Massoud, and Roberts, Forthcoming). Since the surveillance mechanisms are costly, recertification usually comes after a quick review of objective data specific to the issuer, a review combined with subjective judgement (Raiter, 2009; LeMay et al., 2016). This can result in multiple problems. Of obvious concern would be bonds that should have been downgraded, but weren't due to oversight. Another concern is the impact of downgrade on an entity when the reasons for a downgrade seem arbitrary and opaque. This is further impacted by the potential subjective nature of analysis. A template of criteria from all analyses may aid rating agencies and raters when recertifying bonds. While a standardized template can be an obvious place to start for (re)analysis, credit rating

agencies must judge each bond, or specific supply chain expenditure, on that issue's own merits (Moon and LeBlanc, 2008).

Municipal Bond Grading – Airports

Using municipal bonds for airports as a specific example, Fitch applies five criteria broadly to grade airport bonds: 1) Revenue risk – volume, 2) Revenue risk – price, 3) Infrastructure development/ renewal, 4) Debt structure, and 5) Debt service (Fitch 2012a). These criteria, termed "Key Rating Drivers" or "Key Rating Factors" interchangeably, help Fitch determine an airport's resilience of demand as well as an airport's flexibility to offset the volatility associated with the airline industry (LeMay et al., 2016). These concepts, paired with an airport's actual market size, help contribute to the grade of bonds associated with that particular airport (Fitch, 2012a).

However, a prime contention of the current research is that bond grades may be assigned unfairly. This primarily stems from the fact that airport bonds have an artificial ceiling imposed on them by Fitch (Fitch 2012a). All markets, regardless of size, have a ceiling, with smaller markets having a progressively lower "top" grade. This imposed anchor, along with the knowledge that key rating factors are subjectively interpreted, makes one assume that a rating for a particular airport is provided based on the judgement of the analysts assigned those markets (LeMay et al., 2016). These judgments can have a large impact financially, operationally, and strategically for communities as a link has been shown between credit ratings and borrowing costs (Calcagno and Benefield, 2013). While a relationship between a lower bond rating and higher borrowing costs is probably intuitive, other factors such as the ability to take on multiple capital improvement projects at one time have to be considered. Also, receiving a poor bond grade on one project may influence the pursuit of another project if a bond grade is required.

Pairing these thoughts is critical when one also considers that municipal bonds are notoriously sound investments. The default risk for municipalities is very low (Kincaid, 2016).

Additionally, over half of the States in the U.S. prevent municipalities from declaring bankruptcy (Swedroe, 2013). On a per issuance basis, municipal bonds fail .086% of the time where corporate bonds fail 35.63% of the time (Appleson, Parsons, and Haughwout, 2012). Those percentages are based on 54,486 municipal bond outlays for the period between 1986 and 2011 versus 5,656 corporate bonds for the same period. Arguably, if ceilings are being imposed on bond grades for municipalities, then perhaps floors should be imposed as well. If municipal bonds' failure rates are so low, it would be assumed that changes to bond grades during the "watch" phase would be the result of obvious factors. A downgrade would be triggered by known negative influences. However, it appears that is not always the case.

Decision-Making: Framing, Anchoring and Halo Effects

Psychological effects can influence the decisions of those assigned to assess bonds on behalf of credit rating agencies. Information utilized to grade bonds is reported annually in a context that possibly influences, at least in part, the way in which the information is considered. Shafir, Simonson, and Tversky (1993) identify two broad approaches to decision-making under conditions of uncertainty and conflict: formal models and reason-based analysis. Formal models include normative models like expected utility theory (von Neumann and Morgenstern, 2007) and descriptive models like prospect theory (Kahneman and Tversky, 1979). Formal models usually associate numerical values with alternatives; such models usually either maximize gains or minimize losses (Shafir et al., 1993). Reason-based analyses typify business and political discourse, notably in the interpretation of

case studies in law schools and business schools (Shafir et al., 1993).

Unless they are quantified and consciously included in formal models, contextual openers like priming, anchoring, and framing have little influence on decision-making that employs formal models. However, such openers can clearly influence decisions in reason-based choice. This is because context can be a piece of information considered when it is unclear what information is needed to make a necessary decision. In a way, context sets the stage and places potential boundaries around a decision event. Context can anchor a decision maker to a specific comparison value, or prime or frame a decision maker's mindset when considering information to make a decision (Kahneman, 2011). More complex decision environments may make the effects of specific primes, frames, and anchors more difficult to discern, in part because the choices become multi-layered (Caussade et al., 2005). This means that the influence of the opener may become more difficult to discern if prior or later layers of choice cover up or distort the influence of the opener. When outcomes can vary greatly, so can the ability of decision-makers to discriminate, especially as the items become more difficult to categorize (Schneider, 1995).

The grading of a bond would appear to be a layered, complex choice. In the case of the raters at an agency like Fitch, the watch phase may offer the employees issuing the ratings reports little or no risk. The employees can simply follow procedures and incorporate information that changes the valence of the bond from positive to negative, using the most recent rating as an anchor point for the decision. This leaves open the possibility that a bond that should have been rated AAA, but was rated BBB+ by rule, would be downgraded to BBB because of new information with minor negative effect on the riskiness of the bond. This phenomenon may be rooted in the behavioral economics paradigm of anchoring. Arguably, a bond grade serves as an anchor during a reassessment phase. Bonds are being compared more so to their previous assessment, rather than their actual risk of default.

In classic anchoring studies, the anchors were based in numbers that were irrelevant to the choice at hand. For example, Tversky and Kahneman (Kahneman, 2011), rigged a 'Wheel of Fortune' to give students one of two numbers, 10 and 65. Then the students were asked to estimate the percentage of African nations in the UN. Those who saw 10, guessed that 25% of UN nations were African. Those who saw 65, guessed that 45% were African nations (Kahneman, 2011). Obviously, the wheel of fortune numbers were irrelevant to the percent estimates, but they influenced the choices anyway. In the case of airport bond grades, we believe existing grades to be influencing the reassessment grade of the bond. This is problematic for many reasons. First, as mentioned, airport bond grades have a ceiling. Certain domestic airports may not receive a higher grade due to broad categorization factors that may or may not actually apply to a specific airport. Second, we believe that not all analysts understand that municipal bonds cannot default, directly influencing the inherent riskiness of a bond. If a previous bond grade can influence a decision, so perhaps can the knowledge that default is unlikely. Third, an airport bond grade can directly and indirectly affect a municipality's finances for an extended time.

Armed with this information, the current research sought amateur bond graders to assess a specific instance where a bond outlay was downgraded. Amateur graders were utilized to assess the decision point because of the belief that the contextual anchor of a previously issued bond grade was playing a greater role in the bond assessment than financial performance factors. This is because financial information in the bond grading process can be incomplete or subjectively interpreted. As such examining behavioral factors like anchors become appropriate to assess with amateur graders.

HYPOTHESES DEVELOPMENT

In 2008, the city of Pensacola, FL issued nearly $36 million dollars of airport bonds for capital improvements to the existing airport infrastructure including airport terminal expansion and parking lot construction. Fitch Ratings Agency was contracted to provide a ranking on the bond issue and provided a BBB+, the highest bond grade awarded to an airport of Pensacola's size (Fitch, 2012a).

Bonds are watched with an annual regrading. In this manner, bond grades can be raised, reaffirmed, or lowered. In 2012, the airport bonds from Pensacola were downgraded to BBB. The primary reasons offered for the bond downgrade were stagnant traffic levels, a debt burden higher than allowed for debt coverage service levels, and a lack of cash flow from a structured airline agreement (Fitch, 2012b). However, objective quantifiable data on the downgrade was limited (Fitch, 2012b; LeMay et al., 2016).

With financial data being incomplete and the financial analysis being a subjective process, the bond process may be impacted by different factors. Arguably, anchors may be a reference point for bond grades when financial information is limited. In this case, one or two of five key ratings drivers may be perceived as negative; but information on the other ratings factors are incomplete. Because of incomplete information, undue weight may be given to where a bond is currently assessed instead of judging how likely a bond default actually is. The process becomes one of justifying the limited amount of information present versus an established metric (i.e. a bond's current grade), instead of fully considering the information against how likely an entity is to declare bankruptcy. This issue may indicate that anchoring is driving a bond's grade instead of the financial metrics grading agencies say are important.

Given our understanding of the imperfect bond grading process and the susceptibility of evaluators to forces identified in the behavioral science literature, the authors developed two hypotheses on the role that framing and anchoring information will play on decisions by amateur bond graders:

> H1: Provided the information that few municipal bonds default, amateur graders will not downgrade municipal bonds as much as professional analysts across similar metrics.

> H2: Provided the information that few municipal bonds default, amateur graders with more experience in the business world will not downgrade municipal bond ratings as much as amateur graders with less experience.

METHODOLOGY AND FINDINGS

To test these hypotheses, we conducted a behavioral experiment. Behavioral experiments provide an opportunity to understand the nuances of decision making (Knemeyer and Naylor, 2011). We chose experimentation for this investigation for three specific reasons. First, behavioral experiments provide a high level of control to help adequately judge causality (McGrath, 1981; Thomas et al., 2013). Second, behavioral experiments allow us to analyze specific cause-and-effect relationships between variables because they grant a higher level of control over those variables (Thomas, Esper, and Stank, 2010). Third, we wanted to assess the relationship between specific independent variables and the dependent variable of bond grade. In this instance, the research team was particularly interested in the effect of the knowledge actual municipal bond defaults would have on a bond grade. We are providing a different anchor or frame to our amateur graders and seeing if this impacts the reason-based choice they are making in any way.

We asked a convenience sample of college enrollees from a Florida university to analyze the

same data that Fitch Ratings published in its annual report on a continuing airport bond. The sample included both graduate students and undergraduate students. The use of student samples in behavioral supply chain research is an established methodology (Cantor and Macdonald, 2009; Thomas et al., 2010; Thomas et al., 2013; Mir, Aloysius, and Eckerd, 2016; Tokar et al,. 2016). College students are appropriate for the current research for two primary reasons. First, we seek internal validity by randomly assigning participants to our treatment control (Stevens, 2011). Second, we have specifically sought amateurs, or individuals with minimal experience, to analyze information as it relates to generating a bond grade (Thomas, 2011). Thus, specific interest is focused on the decision making of individuals who are unfamiliar with bond grading. We examine anchoring and not quantifiable financial analysis.

We gave the ratings exercise to 75 college students, 28 of whom were graduate students. We distinguish between graduate and undergraduate students expected between the two groups. This work experience and understanding of business environments may help graduate students distinguish between the effects of anchors. Collectively, the college students were given the five key rating criteria that Fitch Ratings published as airport bond rating criteria for the years covered by the data—2010, 2011, and 2012. The 2012 review was pertinent because that was the year that the Pensacola Airport bond was downgraded.

The forms used for the exercise created two different conditions. In the first condition, participants were given the information that only 47 municipal bond issues defaulted between the years of 1986 and 2011. In the second condition, this information was withheld. Otherwise, the forms used in the exercise were identical.

The forms included information on the five key ratings criteria for the years 2010, 2011, and 2012. The forms are shown in the Appendix to this paper. As can be seen from the forms, the data are

TABLE 1
SUMMARY OF FITCH AIRPORT RATING CRITERIA INFORMATION SUMMARY FOR RATING PENSACOLA AIRPORT BONDS

Fitch Criteria	Number of Drivers (within the Criteria)	Number of Complete Drivers for Pensacola (2010 to 2012)
1 – Revenue Risk Volume	3	3
2 – Revenue Risk Price	2	1
3 – Infrastructure Development and/or Renewal	2	1
4 – Debt Structure	5	3
5 – Debt Service	4	1

complete for all three years for some measures of the criteria, but not for others (Fitch 2010, 2011, and 2012b). That is because these forms contain only the information used in Fitch press releases for these years. The gaps in this information are shown in Table 1. All of the published data fit into the measures of the five ratings criteria as described by Fitch (Fitch 2010, 2011, and 2012b).

Forty students, including 13 graduate students were given the form that included the information about municipal bond defaults. Thirty five students, including 15 graduate students, were given forms that excluded this information. Both groups were asked to examine year-over-year changes in the measures used to rate each criterion and then mark it with a "+", "-", or "=" sign. This was intended to summarize their judgement of the impact that changes in the measure should have on the bond grade. For example, for key ratings factor – revenue risk volume – participants were given information on enplanement base, enplanement growth, and carrier risk for the years 2010, 2011, and 2012 as this is what appeared in the related Fitch releases. Each participant marked the blank space next to the measure in accordance with his or her judgement. This process was repeated for all five ratings criteria. At the end of the exercise, participants were asked to add up their plus and minus signs. Then they were asked to grade the bond on a scale in which they were all fluent: A, A-, B+, B, B-, C+, C, C-, D, and F. They were informed that Fitch's rating for the bond in 2010 was B+.

The participants were guided through this process with a PowerPoint presentation that included definitions of the key criteria and their measures. The participants were allowed to ask questions to clarify these definitions and criteria. Then they assessed the criteria one-by-one. The process took between 35 and 45 minutes. All presentations were given by the same member of the research team, assisted by the other members to assure that all of the procedures were carried out in a consistent fashion.

From the experiment worksheets, we have created a dependent variable for the participant's rating change in 2011 and one for 2012. For example, if a student downgraded the bond one increment in 2011 – B+ to B in their vocabulary – this appears as a negative one. We model the participant decision with:

$$y\_2011= \alpha+\beta\_(1\text{-}2011)\ x\_1+\beta\_(2\text{-}2011)\ x\_2+\beta\_(3\text{-}2011)\ x\_3+\beta\_(4\text{-}2011)\ x\_4+\beta\_(5\text{-}2011)\ x\_5+u\_2011$$

$$y\_2012= \alpha+\beta\_(1\text{-}2012)\ x\_1+\beta\_(2\text{-}2012)\ x\_2+\beta\_(3\text{-}2012)\ x\_3+\beta\_(4\text{-}2012)\ x\_4+\beta\_(5\text{-}2012)\ x\_5+\beta\_6\ y\_2011+ u\_2012$$

where all of the right hand side variables denoted with an *x* are discreet (e.g., MBA student status) and each equation ends with an error term. Details for the variables, including mean and standard deviation, can be found in Table 2. The only variation across the equations occurs in the right hand side variable y_{2011} for the change in grade for the next year, y_{2012}.

Parameter estimates from the model appear in Table 3. One variation of the model included a dummy variable for participant gender (right side), but the results are not sensitive to this choice in specification. The first finding confirms the dependent variable averages from Table 2 as the participants downgraded the bonds (significant, negative values for the intercept).

The results show limited support for hypothesis one in decisions for 2011, at the $p < .10$ level. In other words, students who received the low-default frame – that 47 municipal bonds failed over the past 25 years – were somewhat less likely to downgrade. The treatment is not significant for the 2012 decisions; the knowledge of municipal bond defaults over the past 25 years played no role in the grade of the Pensacola Airport bonds in 2012, a year where Fitch Ratings actually did downgrade the bonds. In summary, we find mixed results for hypothesis one; it was only somewhat supported in a year where Fitch did not downgrade.

Results indicate that amateur bond graders with more professional experience (i.e. graduate students) would adjust bond grades differently than their counterparts in 2011 at the $p < .10$ level. The result for 2012 is a larger and highly statistically significant coefficient where amateur graders with more professional experience were less likely to downgrade. For example, the model with the gender effect (right side of Table 3) has an intercept of negative 1.3365 but an MBA student adjustment of positive 1.4633. Therefore, hypothesis two is supported.

Examining the results of the study compared to hypothesis one indicate that anchoring respondents to the fact that few municipal bond defaults have occurred over the past 25 years does not influence the decision of respondents to downgrade bonds. Essentially, we looked to reframe a respondent's decision by providing amateur graders the same incomplete financial information analysts received, Pensacola's current bond grade, and indicating that municipal bonds default at an extremely low rate. This contextual factor, the low rate of municipal bond default, was a variable that had limited impact on students as a whole. Perhaps respondents

TABLE 2
SUMMARY STATISTICS (N = 75)

Variable	Model Name	Mean	Standard Deviation
Bond grade change for 2011	Y_{2011}	-0.640	1.835
Bond grade change for 2012	Y_{2012}	-0.613	2.046
Treatment (Information that few municipal bonds default)	x_1	0.533	0.502
MBA student	x_2	0.373	0.487
Pre-MBA student	x_3	0.187	0.393
Female	x_4	0.187	0.392

discounted this fact because they perceived that the statement was only broadly related to their specific bond regrade. While understandable, careful financial analysis occurs at time of bond outlay; not necessarily during the annual watch phase (Hau et al. 2013). Regardless, the current bond grade played more of a role in respondents decision to change a bond grade than information on municipal bond default rates.

When the student groups were separated between undergraduate and graduate respondents, there was a significant difference between the two respondent bases. Graduate students were statistically significantly less likely to downgrade a bond in the presence of municipal bond default rate information than their undergraduate counterparts. One possible reason for this explanation is the professional experience graduate students typically bring to their studies. Graduate students have oftentimes been business professionals and as such may cognitively process information differently than people with less experience. Perhaps graduate students realize that low municipal bond default rates indicate the financial safety of these investments. Alternatively, negative information would have to be perceived as very negative if a bond downgrade was to occur. In essence, graduate students may more fully understand how the business operates.

DISCUSSION AND IMPLICATIONS

Suggesting that amateur bond graders and credit rating agency employees are the same is not

TABLE 3
DETERMINANTS OF BOND GRADE CHANGES
(+1 is an upgrade and -1 is a downgrade, standard errors in parenthesis)

	Coefficient for Grade Change			
Variable	2011	2012	2011	2012
Intercept	-1.4075***	-1.4048**	-1.3780***	-1.3365***
	(0.3944)	(0.4961)	(0.4099)	(0.4827)
Treatment Frame (Information that few municipal bonds default)	0.7604*	-0.1190	0.7758*	-0.0790
	(0.4179)	(0.4683)	(0.4239)	(0.4743)
MBA student	0.8759*	1.4176***	0.8935*	1.4633***
	(0.4636)	(0.5204)	(0.4705)	(0.5273)
Pre-MBA student	0.1873	0.9286	0.20324	0.9683
	(0.5725)	(0.6276)	(0.5789)	(0.6332)
2011 Bond Grade	--	-0.2381*	--	-0.2411*
		(0.1300)		(0.1306)
Female	--	--	-0.1267	-0.3108
			(0.4384)	(0.4794)
Adjusted R^2	0.04	0.08	0.03	0.07

* Significant ($p<0.1$)
** Significant ($p<0.05$)
*** Significant ($p<0.01$)
Note: Treatment frame individuals received information that only 47 municipal bond issues defaulted between the years of 1986 and 2011.

something we take lightly. The entire grading process of municipal bonds should be analyzed, however, because of the obvious impact bond grades (and potential downgrades) can have on municipalities, including both the resident population and the firms who use the funded infrastructure. Our amateur graders often matched the changes by Fitch experts, even when armed with the experimental frame of the municipal bond default information. The graders with more professional experience differed from our traditional undergraduate students in that they were not as willing to downgrade bonds in 2012. In reality, Pensacola bonds were downgraded in 2012. While one would hope Fitch employees would have some experience-based knowledge that would help grade bonds, investors truly do not know the specifics behind why bonds are downgraded or upgraded. In other words, positive or negative changes for a particular metric do not convey any sense of weight.

It is understandable why researchers lack full clarity on the bond grading process since Fitch competes with other credit rating agencies. However, this lack of clarity can sometimes surprise a bond-issuer. Alternatively, the bond grade ceiling seems arbitrary. Fitch press releases note the size of the airport as a potential cap to the liquidity of an airport, with larger airports eligible for higher grades. Regardless of fairness, it is important to question if this standard accurately reflects the risk of a bond grade. Finally, one must wonder if agencies should even grade municipal bonds after issue. As mentioned, the failure rate is miniscule.

Bond grades clearly affect the perception of airport management. Steady or rising bond grades may have a positive effect on the perception of airport managers and the job they are doing, but a downgrade is likely to be seen as a loss, so downgrades can have serious repercussions for airport managers including loss of employment (known outcome from the Pensacola Airport Bond downgrade). This negative outcome is especially disturbing if the exact reasons for a bond downgrade are unknown.

Another impact of bond grades is on a municipality seeking to raise capital for infrastructure funding, which remains a critical global issue (Spychalski, 2011; Love, Ahiaga-Dagbui, and Irani 2016). Bond grades directly affect interest rate charges for a municipality and impact the amount of funding sought. A higher grade signals less risk for a bond issue and usually lowers the interest rate, and therefore interest rate payments, associated with bonds. A lower grade signifies that bonds may be riskier and typically raises the interest rate, and interest rate payments, associated with bonds. The obvious losers in this situation are constituents who reside in the locale where a bond issue is being considered. A lower grade may signify that municipal taxes will have to be raised to pay for the higher interest rates. Alternatively, and as a result of a potential lower credit rating, the amount of the bond issue may have to be lowered, thus affecting the actual capital project deemed important to the municipality.

Such bond grades also affect other users of facilities funded by these bonds, not just the local managers and residents. For example, UPS and FedEx build sort facilities across the country. These facilities tie the companies to a certain location. A lower bond grade increases the price of new transportation infrastructure. It may have an immediate impact on already planned future projects and potentially alter future proposals. This can be a dire situation for a civic area that could fund infrastructure projects that were appropriately rated, but has to wait to pay off higher than necessary financial obligations. Time is at a premium in municipalities where capital projects can take many years from planning to completion (Xiao, Fu, and Zhang, 2016). That is why eliminating bias in bond-rating decisions is so important.

Please note, we are not suggesting artificially high grades for risky bonds. Rather, we are imploring

credit rating agencies to adequately assess the rating process, including considering new key rating factors with or without a contractual obligation to do so. Eliminating the surprise from a downgrade is, in our view, an absolute necessity. Thus, the agencies should provide clarity to municipalities and investors as to why a downgrade is happening. As downgrades occur now, language seems obtuse as to why downgrades actually happen. There is an unfortunate social exclusion process at work (i.e. lower current, and lower future access to, supply chain infrastructure) with limited objectifiable support (Schwanen et al., 2015). Therefore credit rating agencies must be explicit as jobs, new charges to taxpayers, and other supply chain infrastructure funding can be at stake.

In addition, in this complex process, there is little doubt that behavioral biases and effects play a major role, one that varies from context to context. We have two areas of concern here. First, the presentation of information – such as the frame used in this study – should have no impact on future air travel for a community. The reader should recall from Table 1 that information for several of the Fitch criteria were not complete in the press releases for 2010 through 2012, meaning the presentation of information was not complete and can be viewed as a frame (perhaps unintentional, perhaps not).

Second, Fitch limits an airport like PNS to a BBB+ rating, despite the absence of defaults among bonds issued by such airports. This limit itself may be a function of a bias that relies on a simple concept: bigger is better, so smaller is worse. With this as an underlying given, the data that has accumulated over time does not matter, even if it supports the idea that such airports offer no more risk than larger airports. Thus, grading behavior can become imprinted over time which may impact bond grades to a greater extent than objective historical data, so the taxpayers in the area covered by the airport still end up paying more for their bond issue than the taxpayers in an area covered by a larger airport (Davis-Sramek et al., 2017).

The possibility of imprint means another framing effect could influence the process, the halo effect. Halo effects differ from anchors in the sense that the former are more general than anchoring and adjustment effects (Cialdini and Goldstein, 2004). In the current case, the presence of the city name, Pensacola, may bias the subject's grade of the bonds because they already have an opinion of the city or an opinion of the airport. For example, could someone's knowledge of Pensacola being on the Gulf Coast be paired with BPs oil spill, negatively impacting bond grades even if objective material states the two are unrelated? Offering the same objective operational information about an unidentified airport might produce a different set of results and the role of halo effects is a potential subject for future research.

CONCLUSION

The purpose of the current research was to explore bond grading procedures and investigate the impact they may have on airports and municipal bond outlays. Behavioral information was presented to show how biasing effects can occur during subjective analysis. While subjective analysis may not be prevented, an example is offered to show how one decision can have a severe impact on the financial needs of communities when using municipal bonds to finance key transportation infrastructure. In the current study providing a new anchor to amateur graders , that of the low rates of municipal bond defaults, did not impact graders' decisions to lower a bond assessment. However, when amateur graders were separated between perceived experience levels more experienced graders were less likely to downgrade municipal bonds as compared to their less experienced counterparts. Truly the results indicate that professional with more experience ignore contextual anchors, or process them differently.

The current study uses undergraduate and graduate students as respondents. While the students can certainly respond to behavioral stimuli, assessing financial analysts under the same experimental conditions would lend further credence to the current results. Additionally, examining a different bond downgrade would also be helpful. Future research should look to address these issues. Future research could also examine how bond downgrades influence capital projects within communities. Another suggestion is to examine the cost of initial capital for municipalities after a well-publicized, unrelated municipal default. Regardless, further examination of behavioral science factors and supply chain capital is needed.

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BIOGRAPHIES

Richard R. Hawkins (Ph.D. Georgia State University) is a full professor at the University of West Florida. Currently serving as Departmental Chairperson of the Marketing, Supply Chain Logistics, and Economics Department; Dr. Hawkins has extensive experience in researching the implications of tax policy. He is currently interested in behavioral actions of actors in consumer purchase and grading decisions. Hawkins's peer-refereed research has been published in *Applied Economics*, *Journal of Internet Commerce, National Tax Journa*l, and *Public Finance Review*. E-Mail: rhawkins@uwf.edu

Stephen A. LeMay (Ph.D. University of Tennessee) is an associate professor at the University of West Florida after a long career at Mississippi State University. Dr. LeMay is interested in many research areas including assessing factor markets and the development of supply chains in emerging markets. His research has appeared in various outlets including *Transportation Research Part E: Logistics and Transportation Review, Journal of Business Logistics, International Journal of Commerce and Management, Journal of Supply Chain Management*, and the *Journal of Transportation Management*. E-Mail: slemay@uwf.edu

Peter M. Ralston (Ph.D. Iowa State University) is an assistant professor at Iowa State University. He is interested in researching areas related to supply chain collaboration and supply chain infrastructure funding. Dr. Ralston has published his research in the *International Journal of Logistics Management, Journal of Business Logistics, the Journal of Supply Chain Management,* and *the Transportation Journal*. Dr. Ralston spent nearly 6 years in the cosmetics and office products industries as a customer specialist and distribution center manager before pursuing his Ph.D. E-Mail: pralston@iastate.edu

SOCIAL MEDIA AND SUPPLY CHAIN RISK MANAGEMENT: IMPROVING RISK DETECTION AND SUPPLY CHAIN RESILIENCE

Scott R. Cox
J. Kirk Atkinson
Western Kentucky University

ABSTRACT

The introduction of social media has changed the methods by which many individuals, communities, and organizations communicate and interact. The increasing popularity of social media within a business context has forced executives to rethink how they operate their businesses. Chae (2015) observed that the field of supply chain management (SCM) has been lagging in identifying the potential role and use of social media in both research and practice. Recently, greater attention is being given to social media and its potential uses within the supply chain. This paper investigates the potential use for social media as a technology to help with supply chain risk detection and supply chain resilience.

INTRODUCTION

Ever increasing competitive pressures including escalating customer demand expectations, requirements and greater competition from international markets have forced organizations to operate on a global basis (Manuj and Mentzer, 2008).

The increasing complexity of global supply chains necessitates the flow of goods, services, information, and cash, both within and across national boundaries, which must be highly coordinated. With increasing complexity, supply chains have become much more susceptible to disruption (Craighead et al., 2007). The more globalized the firm, the greater the risk exposure due to the increased length of the supply chain network. Numerous recent incidents, including natural disasters, various industrial and societal disputes, and other supply chain "glitches" have revealed the vulnerability of modern global supply chains. Modern supply chains increase the likelihood for potential delay points, providing for greater uncertainty and creating the need for improved coordination and communication. As a result, the modern supply chain must be continuously monitored and managed (Mentzer, 2001) and innovation is critical. Now more than ever, the supply chain and the innovations within are closely linked to some of the newest technologies. Blockchain is the latest technology that in various use cases has the potential to revolutionize supply chains by creating opportunities for improved processes. Innovative supply chain performance improvements demand technology. An additional emerging area of technology which holds much promise for innovative improvement in supply chain management is social media.

Social media is defined as collaborative online applications and technologies that enable participation, connectivity, user-generated content, the sharing of information, and collaboration amongst a community of users (Henderson and Bowley, 2010). The introduction of social media has changed the means by which many individuals, communities, and/or organizations interact and communicate (Kaplan and Haenlein, 2010). In a business context, social media is used in a business-to-consumer (B2C) environment to allow companies to promote their brands and market products to consumers (Howells, 2011). The field of supply chain management has been slow in identifying the potential role and use of social media for research and practice (Chae 2015). However, social media could provide many benefits for supply chain management such as greater visibility, improve communication, increase control, and potentially

reduce operational and labor costs. Social media could allow supply chain participants to monitor supply chain events and transactions to keep everyone up-to-date with current situations, such as a delay in shipping or a carrier failing to pick-up a shipment. Social media may provide companies with more timely and insightful information about risks and events, enabling organizations to take corrective action sooner and thus minimizing the impact of any supply chain disruption and increasing supply chain resilience (Rusch, 2014). It's this potential use for social media that leads to the following research questions:

(1) Can the use of social media improve an organizations ability to sense and recover from potential disruptions?

(2) How can supply chain managers use social media to adjust to changes in the upply chain environment?

This paper discusses the use of information technology to achieve supply chain innovation. A discussion of supply chain risk management and supply chain resilience follows. We then we provide background on Dynamic Capabilities (Teece et al., 1997) and describe the connection to the use of social media for improved supply chain resilience. Principles related to disaster recovery and social media are then applied in a supply chain context and propositions are offered. Finally, managerial implications along with conclusions from this examination are discussed.

INFORMATION TECHNOLOGY AND THE SUPPLY CHAIN

Value is created within the supply chain in matching supply and demand through both reliability and responsiveness. Reliability is defined as delivering the right product in the right quantity at the right time to the right place at the lowest cost. Responsiveness is defined as the ability to quickly respond to changing market conditions (Hendricks and Singhal, 2003). To be both reliable and responsive, organizations have formed sophisticated supply networks and management structures that allow materials to be sourced from around the world, while still delivering on reliability and responsiveness (Autry and Moon, 2016). The task of managing those supply networks necessitates coordination both within and across organizational boundaries, including the integration of business processes and functions across the supply chain (Cooper, Lambert, and Pagh, 1997). Some scholars maintain that it is impossible to achieve both reliability and responsiveness, and create an efficient, collaborative supply chain without information technology, noting that; "IT is like a nerve center in supply chain" (Gunasekaran and Ngai, 2004). The business processes associated with supply chain management are deemed mission critical for many organizations (Bala, 2013) and the reliance on IT to help achieve mission critical processes is generally accepted. Some scholars have referred to supply chain management as "a digitally enabled inter-firm process capability" (Rai et al., 2006).

The sharing of information is at the heart of the modern supply chain concept (Thomas, Esper, and Stank, 2010) and the advantages of increased information sharing through greater technology linkages has been discussed in much of the prior supply chain research (Lee and Whang, 2000). Cachon and Fisher (2000) detailed a reduction in supply chain costs with the sharing of both demand and inventory information among supply chain partners. Fawcett et al. (2007), reviewed two facets of information sharing; connectivity and willingness to share, and determined both are not only critical to an information sharing capability but both are found to positively impact operational performance. Zhou and Benton Jr. (2007) explored the effect of information sharing and supply chain practice on supply chain performance. Their conclusions indicated that both are crucial to attaining greater supply chain performance. Klein et al. (2007) found that firms realized better performance when information is shared among supply chain partners. Information sharing improves the coordination of supply chain processes enabling the flow of material and reducing inventory costs, leading to greater collaboration and increased levels of supply chain integration (Li and Lin, 2006).

Supply chains comprise vast numbers of products or commodities that are sourced, manufactured, or stored in multiple locations throughout the world, increasing complexity (Chopra and Sodhi, 2014). Events often occur that threaten to disrupt supply chain operations and jeopardize the ability to perform effectively and efficiently (Melnyk et al., 2015). Natural disasters, political instability, terrorist attacks, equipment failure and human error have all contributed to various supply chain disruptions. Irrespective of the type of disruption, the sharing of information is an essential component within any supply chain to quickly respond to a disruption (Datta, 2017). Supply chain disruptions can be costly and if not properly managed, can result in significant delays and an inability to meet customer demand (Blackhurst et al., 2005). Supply chain managers and practitioners understand the necessity to protect their supply chains from disruptions, unfortunately few take necessary action (Chopra and Sodhi, 2014). The most obvious solutions; increasing capacity, boosting inventory levels and having multiple suppliers, can undermine efforts to improve supply chain cost efficiency and responsiveness to demand changes. Consequently, supply chain risk management has emerged as a top priority for companies (Chopra and Sodhi, 2014).

SUPPLY CHAIN RISK MANAGEMENT AND RESILIENCE

Supply chain risk is defined as the likelihood and impact of unexpected events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities (Ho et al., 2015). Supply chain risk management (SCRM), defined as an inter-organizational collaborative endeavour utilizing quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain (Ho et al., 2015), is rapidly evolving into a preferred area of research for both academicians and practitioners (Rao and Goldsby, 2009). Although scholars understand that SCRM is a necessary part of a holistic supply chain management philosophy, researchers have also argued that managing risks in the current environment continues to be an increasingly challenging task (Christopher and Lee, 2004). The essence of SCRM is to make decisions to concurrently take advantage of opportunities and minimize risk (Narasimhan, 2009). Scholars have noted that a firm should have a cost-effective risk management strategy for monitoring and detecting supply chain disruptions (Autry and Moon, 2016) and managers can reduce risk by designing supply chains to contain risk rather than allow it to proliferate throughout the entire supply chain (Chopra and Sodhi, 2014). An organization can substantially increase its resilience; that is the ability to resist disruptions and recover operations capability after disruptions occur, by improving its ability to detect and respond quickly to such events (Sheffi, 2105). Despite this, executives have been hesitant to address supply chain risk. There is a perception among executives that providing for risk reduction will lessen any cost efficiencies and other benefits of their existing global supply chains (Chopra and Sodhi, 2014). Trade-off decisions between managing risk and delivering value are important factors for building resilience into the supply chain (Juttner et al., 2003). SCRM is considered to be the principle method for enhancing supply chain resilience (Datta, 2017).

Supply chain resilience is a concept which has received increased attention within the supply chain domain. It is a complex construct, regarded as a dynamic process of directing actions so that organizations always stay out of trouble should a disruptive event occur. The system then initiates a very swift and efficient response to minimize the consequences and maintain or regain a dynamically stable state, which then allows the firm to adapt operations to the new requirements of the changed environment (Datta, 2017). For this research, resilience is defined simply as the ability of the supply chain to both resist disruptions and recover operational capability after disruptions occur (Melnyk et al., 2015). Melnyk et al. (2015) note; "The resilient supply chain requires two critical capacities: the capacity for resistance and the capacity for recovery" (p. 35). Organizations throughout the world have reported incidents of

increased significance regarding supply chain resilience. Datta (2017) detailed the well-known example of Nokia's ability to adapt quickly to disruption by using alternate suppliers following a fire at a key component manufacturer in 2000. The same disruption also affected Ericsson. However, their lack of resilience resulted in a loss of $400 million in revenue. In another example, Melnyk et al. (2015) discussed the ability of General Motors to quickly recover from the Thailand floods of 2011 despite having suppliers in the area affected.

A great deal of the literature concerning supply chain resilience has examined recommendations for structuring a resilient supply chain (Datta, 2017). In his seminal work *The Resilient Enterprise,* Sheffi (2005) illustrates how organizations can decrease the likelihood of a supply disruption by building both redundancy and flexibility into their supply chain. The author notes that using practices such as standardization, modular design, developing collaborative relationships and creating a culture of flexibility can help build a more resilient enterprise. Detailing the importance of managing the efficiency of resilience enhancement interventions, Collicchia et al. (2010) proposed a simulation model specifying the impact of different risk management procedures. Christopher and Peck (2004) specified what they termed the five broad enablers of supply chain resilience. These were supply chain understanding; implying knowledge about supply chain structures, a supply base strategy; selecting the right number of suppliers; supply chain collaboration, agility, and creating a risk management culture. The fundamental principle of supply chain collaboration is that the sharing of information can reduce uncertainty (Martha and Subbakrishna, 2002). The construction of a supply chain that will facilitate the exchange of information between supply chain partners is a key priority for SCRM and improving supply chain resilience (Christopher and Peck, 2004). Autry and Moon (2016) note that a strategy for detection is needed to allocate limited management resources to monitor the supply network to more quickly detect and disseminate information about any disruption. Social media has emerged as a technology and a business tool that can capture and share information, enable collaboration, and improve supply chain resilience through better SRCM. Thus, social media has the potential to help improve resiliency.

SUPPLY CHAIN RESILIENCE AND DYNAMIC CAPABILITIES

Dynamic capabilities (Teece et al.,1997) was selected to explicate the necessity for the use of social media platforms like Twitter to improve effectiveness and efficiency in supply chain risk management. Dynamic capabilities are defined as 'the ability to integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments' (Teece et al., 1997, p. 516). Dynamic capabilities are considered a response to the need for change, and those changes may take many different forms, including the transformation of organizational processes and the allocation of resources. The changing allocation and utilization of resources is an essential part of dynamic capabilities. These resources can include human capital, including managers and employees, technological capital, knowledge-based capital, and tangible-asset-based capital, among others (Easterby-Smith and Prieto, 2008).

Organizations find themselves resource constrained and are forced to take steps to manage key resources more effectively. In this model, the organization's need to innovate and integrate is critical, even when there is no guarantee of a sustained, competitive advantage (Wade and Hulland, 2004). Technologies, like e-business proved to have a dramatic impact on operational efficiencies. Zhu et al., (2006) examined this area from the technology diffusion perspective. Social media, likewise, is proving to provide both opportunities and challenges in a dynamically changing business environment.

Traditionally, new technologies are introduced into the workplace and accepted and integrated at varying rates, depending upon numerous factors like need and competition (Winter 2003). Social media platforms like Twitter are already pervasive allowing for little to no transition in organizations. In addition, even late adopters and laggards can appear in the marketplace with no apparent long-term effects.

Dynamic Capabilities, originally proposed for information system resources (Wade and Hulland, 2004), is process based and assumes adaptation between an organization's resources and a dynamic business environment. Social media seems to be a natural fit into this sphere due to the almost instantaneous response capabilities and mobile nature of the mobile devices that are common.

SOCIAL MEDIA AND SUPPLY CHAIN RESILIENCE

Social media has gradually become an increasing part of the fabric of society and human social interaction. According to Statista, a provider of market and consumer data, in the first quarter of 2018, Twitter and Facebook, two of the most popular social media platforms, were reported to have 336 million users and over 2.19 billion users respectively (Statista, 2018). With access to such an enormous number of prospective customers, business disciplines such as marketing have made widespread use of social media. The field of supply chain management has been lagging in identifying the potential role and use of social media in both research and practice (Chae, 2015; O'Leary, 2011). However social media has the potential to impact the supply chain in several different ways. This includes increasing productivity, reduced operating costs, gaining marketplace intelligence, better risk detection, improved risk management, and increased resilience.

Fronetics (2014) conducted a survey on the use of social media within logistics and supply chain management. The results indicated Twitter as the first preference social media tool for supply chain improvement. Social media can serve as a tool to facilitate intra- and inter-organizational activities and provide for greater information sharing within the supply chain (Ngai et al., 2015; O'Leary, 2011). According to O'Leary (2011) Twitter messages can be used to provide information about a broad range of supply chain events. Twitter messages can indicate the arrival or departure of a shipment from a specific warehouse, to communicate the need for shipments of a certain type, or to alert drivers to accidents and road closures. According to Rusch (2014), a few additional examples of the use of social media related to supply chain risk are:

- Information about accidents and road closures can be issued that affect delivery times and can be used to re-route deliveries
- Report weather conditions that might affect shipments
- Facilitate responses to supply chain disruptions via social media
- Share supply chain risk identification to uncover vulnerabilities to mitigate supply chain risks

The case may be made that these examples fall within three general categories as defined by Hines (2016); Customer Engagement, Market Intelligence, and Business Intelligence. Involving customers, almost instantaneously, in the supply chain process mitigates risks of disruption. This might include something as simple as notifications related to local road closures that would delay truck deliveries to communications related to potential weather issues. Mining information across Twitter feeds, capturing that information, and applying analytic software tools increases market intelligence and, when aggregating results with other strategic information sources strengthens overall business intelligence. Used for risk management, an early warning detection system is crucial if risks are to be identified fast enough to do something about them (Burnette et al., 2016).

Examples of some current uses of social media within the supply chain, specifically logistics and transportation, are varied and novel. Smaller trucking companies like Liberty Linehaul Inc. are very involved. Running 75 trucks out of two terminals Ayr, Ontario and the other in Los Angeles, CA Liberty Linehaul operates as a less-than-truckload (LTL) and truckload carrier for a wide variety of customers ranging from Fortune 500 to small local entities. Specializing in what they call the

white glove treatment for products that require a little more care and equipment to ensure safe transit, the company does approximately 27,500 shipments annually. Liberty Linehaul uses both Facebook and Twitter to post about company events, employee recognition, community involvement, safety messages, as well as for driver recruiting (SMPB, 2014).

In addition to using social media to recruit drivers and market their services, some are finding innovative ways to provide for the movement of freight. MercuryGate International Inc. and Con-way Inc. are two such organizations. Both use social media to move freight. In 2010, Con-way Multimodal, a division of Con-way Inc., initiated a service called "TweetLoad." TweetLoad allows carriers to access available loads from Con-Way Multimodal via Twitter. Carriers who follow @ConwayTweetLoad on Twitter can see the latest available shipments as well as links to additional information on the company's link board. Load information is updated on Twitter every 15 minutes, thus allowing carriers who follow @ConwayTweetLoad to have real-time information on available loads. The former president of the American Trucking Associations (ATA), Bill Graves, was quoted as saying, "With this novel use of Twitter, Con-way Multimodal is leading the industry in maximizing the best features of new technology to improve their processes. This is a great example of how innovative transportation companies can make it easier for carriers to do business with them, which will be a benefit to our industry overall." (Fronetics, 2014).

In 2011 MercuryGate International Inc. launched Freight Friend. Freight Friend is a relationship-based load and truck internet posting service for shippers, brokers and carriers. Freight Friend creates a private network between transportation partners and utilizes technology to automatically identify appropriate matches. The combination of the technology utilized, and the relationship-based nature of Freight Friend allows companies to have real-time visibility to book trucks and find freight with companies they trust. According to Mr. Graves, "FreightFriend is perfect for carriers, shippers, brokers, 3PLs and freight management firms who only want to share information with companies they trust. They can keep their current information in one place, knowing that friends – and only friends – will have constant access. While public load boards fill a real need, they come at a cost – a lot of unknown companies bidding to carry the freight. Private boards are often useful too, but they're inconvenient to carriers with multiple clients asking them to check their bid portals. FreightFriend solves the dilemma with a single service where carriers can easily communicate with all of their clients and brokers can find available capacity from carriers they trust." (Fronetics, 2014).

Alexander (2014) discussed the actual and potential use of social media in emergency, disaster, and crisis situations, noting that just-in-time information can be provided on how to cope with developing situations. He documented how social media may be used in seven different ways within the emergencies field for disaster response, recovery, and risk reduction including; listening, monitoring, integration into planning and crisis management, collaborative development, creating cohesion, furthering causes, and enhancing research. Alexander (2014) further details the need for emergency managers to adapt organizational practices and embrace the use of social media in crisis management. Some supply chain disruptions, by their very nature, can make detection problematic. The concepts of information sharing, collaboration, and integration between organizations could rest at the center of building the continuity and resiliency necessary to detect and manage supply chain disruptions (Autry and Moon, 2016).

LISTENING AND MONITORING

Social media is often referred to as the new "newswire." According to Fronetics (2014), a digital content and marketing firm focused on the supply chain, social media has supplanted traditional news organizations such as the Associated Press and Bloomberg for breaking news. Major events such as the recent earthquake in China, the Boston Marathon bombing, the death of Osama bin Laden, and the engagement of Prince William to Kate Middleton were all stories that broke on the social media website Twitter. Twitter is a micro-blogging

application allowing users to "tweet" a message of up to 280 characters. Because of the nature of its quick bursts of information, Twitter may be particularly useful where supply chain risk detection and disruption recovery is concerned. Quick detection is considered an essential element in the effort to mitigate the impact of most supply chain disruptions (Sheffi, 2015). For example, the United States Geological Survey currently monitors Twitter to detect earthquakes (Sheffi, 2015). "In some cases, it gives us a heads-up that it happened before it can be detected by seismic wave," according to Paul Earle, a seismologist with the US Geological Survey (Sheffi, 2015).

According to Alexander (2014), listening is the sampling of varied output on social media. Whereas listening is passive, monitoring is conducted to improve reactions to better manage an event by learning what people are thinking and doing. Firms have the ability to "listen in" using social media, but they also must be vigilant with rapid and targeted responses (Crawford, 2009). Crawford (2009) noted that the value of organizations listening using social media could be considered in three ways. The first is being seen to participate within a community, the second is utilizing a rapid and lower-cost form of customer support, and the third is gaining global awareness of how a brand is considered and the patterns of both consumer use and satisfaction. For instance, O'Leary (2011) noted that Best Buy uses Twitter to listen, monitor and respond to customer inquiries. Dell employs staff to listen and monitor more than 130 Twitter feeds (Soller, 2009). As supply networks can be extensive and only a limited amount of management resources may be available to commit to the purpose of risk detection, a firm should have a cost-effective strategy for detecting and monitoring disruptions (Autry and Moon, 2016). Listening and monitoring could allow firms to be proactive instead of reactive by providing for quicker reaction and improved response to a disruption. Thus, the following proposition is offered:

> *P1. The use of social media for listening and monitoring is positively linked to improved supply chain resilience.*

The use of social media listening and monitoring for risk management will foster increased communication and significantly help with improved decision making during a disruption. As supply chain professionals are continuously communicating with a broad community of partners and consumers, the use of social media to improve communication may lead to increased information sharing and improved collaboration. In this rapidly changing and competitive environment, the widely accepted use of social media by individuals globally speaks to the application of the Dynamic Capabilities where resources may be used most effectively and with little training.

SOCIAL MEDIA AND COLLABORATIVE DEVELOPMENT

The philosophy of supply chain management is based upon the collaboration of supply chain partners (Stank et al., 2001). Collaboration in a supply chain relates to the capability of firms to work effectively together in both planning and executing supply chain operations toward shared goals (Cao et al., 2010). Higher-level collaboration that brings the resources of diverse supply chain members together in both innovative and distinct ways promises a heightened level of uniqueness and lasting success (Lavie, 2006). The supply chain literature details specific collaboration-driven benefits including faster new product development cycles, shorter delivery lead times, better quality, lower inventory levels, higher productivity, lower materials and manufacturing costs and improved relationship quality among partners (Ferdows, Lewis, and Machuca, 2004; Lee, 2004; Fawcett et al., 2012). Furthermore, effective supply chain collaboration has also been associated with higher levels of customer satisfaction (Frohlich and Westbrook, 2001), differential firm performance (Frohlich and Westbrook, 2001) and the development of new competencies (Nooteboom, 2004). Supply chain collaboration between organizations is a core concept of supply chain management and is considered an important part of current SCRM practices (Scholten et al., 2014; Scholten and Schilder, 2015).

Hammer (1990, 2004) contended that information technology can be employed to dramatically rethink and redesign the core processes responsible for creation of value within the supply chain. An organizations ability to use IT to collect, analyze, and disseminate information need to synchronize decision-making is referred to as supply chain connectivity (Fawcett et al., 2010). When supply chain partners are connected, improved decision-making, along with higher levels of coordination, thus collaboration is possible (Fawcett et al., 2010). Collaboration supports the development of synergies among partners, enables joint planning and fosters the real-time exchange of information (Scholten and Schilder, 2015) necessary for firms to prepare for, respond to and recover from supply chain disruptions while reducing their impact. Pettit et al., (2013) revealed that low collaboration, lack of excess capacity, and minimal flexibility are the major causes of poor supply chain resilience. Wieland and Wallenburg (2012) identified that communicative and cooperative (i.e. collaborative) relationships have a positive effect on resilience.

Information technology is considered an important enabler of supply chain collaboration allowing organizations to share resources and coordinate efforts (Fawcett et al., 2008). Social media is a technology which can allow participants to join forces and connect on a larger scale than most traditional communication methods. This larger network brings greater potential for increased supply chain connectivity and value-added to those who are attached through the network. Given the risks inherent in the global supply chain, especially with sourcing, the use of social media can lead to closer supplier relationships, moving beyond collaboration. The continued need for improved visibility necessitates increasingly closer relationships with key suppliers. Creating a "community" of suppliers, where crucial information, including information about disruptions can be shared in real-time, could provide for increased resilience. Social media platforms such as Twitter, are suitable to be the foundations for such supplier communities. Therefore, we propose the following:

P2. The use of social media for collaborative development is positively linked to improved supply chain resilience.

Collaboration is a precursor to integration. The integration of social media into supply chain management has required firms to better understand the characteristics of integration and the potential effects and impacts for improved supply chain resilience. The motivation for increased collaboration and information sharing is at the heart of the application of the Dynamic Capabilities. Organizations that collaborate will find that their resources, especially their human capital is free to focus on core competencies when using an already familiar technology.

SOCIAL MEDIA INTEGRATION

According to Autry and Moon (2016) a prerequisite for creating and maintaining a resilient supply chain is IT integration. It is considered a chief catalyst for competitive advantage within the context of supply chain management. Moreover, an integrated IT infrastructure is the foundation upon which all modern supply chain activities and processes are built (Autry and Moon, 2016). Access to information from anywhere at any time is critical for effective and timely responses to environmental changes within the supply chain and IT infrastructure integration is considered especially important to ensure that access.

The corporate sector was quick to realize the many advantages of using social media to promote closer relationships with customers, to gain information about products and services, and to enhance public image (Crawford, 2009). Skylar (2009) noted, social media is seen as a relationship tool. Many firms, including companies such as Dell, have used social media to deliver news and provide special offers to customers. However, social media it is now becoming integrated into all business areas. The world's leading enterprise resource planning suite, SAP, currently provides organizations with the capability to integrate with social media platforms. This integration affords social capabilities both

where and when they are required within a firm's business processes while keeping the connection to the working environment. Using SAP Jam, the social collaboration platform from SAP, the social collaboration tools provide structure to social exchanges and work to quickly drive actions, make essential decisions, or to solve crucial business problems (SAP, 2018).

The use of Radio Frequency Identification (RFID) can also be used to generate Twitter messages (O'Leary, 2011). RFID has long been used in logistics and supply chain management to track the movement of products. Alexander (2014) notes an example of a project at the University of Waterloo. RFID-marked cows are robotically milked. Twitter messages summarizing a variety of variables are then generated and sent once the milking process in completed. Based upon RFID events, Twitter can be used to facilitate supply chain transparency and the speed of information flow (O'Leary, 2011).

As previously noted, there is evidence within the literature that integration through information sharing and collaboration provides for improved resilience (Ambulkar et al., 2016; Scholten et al., 2014; Scholten and Schilder, 2015; Harland et al., 2003). Esper et al. (2010) note that an integrated supply chain decision making capability can be paramount when it aids supply chain partners in more effectively managing disruptions. Supply chain integration can be a dynamic capability that assists the firm in overcoming supply chain disruptions in its upstream supply chain (Autry and Moon, 2016). Thus, the following proposition is offered:

> *P3. The integration of social media for supply chain risk management is positively linked to improved supply chain resilience.*

Risk is a variable that can only be mitigated. The nature of risks is that they are often unknown or unforeseen events. The effective and efficient use of resources, such as freely available social media technology to quickly adapt to such events, may provide for improved risk mitigation.

MANAGERIAL IMPLICATIONS

The inclusion and integration of any new technology presents organizational challenges. The introduction of social media applications into supply chains may seem less intrusive due to the general acceptance of its use. However, any new process or procedural change is likely to impact the resiliency of a supply chain. The listening and monitoring capabilities are basically a different form of instant messaging, the differences being the platform and the general acceptance of social media communication. Collaboration is also not a new concept to organizations. Firms have partnered in Electronic Data Interchange [EDI] and Enterprise Resource Planning [ERP] implementations for decades (Iacovou et al., 1995; Young et al., 1999). Collaboration within the supply chain affords involved parties' efficiencies and perhaps potential solutions to ineffective supply chain resilience. It is a certainty that managers must be adept and ready to address the new opportunities, and the new challenges.

While seemingly a minor issue, determining whether to use personal or business devices must be addressed. Most people already carry smart phones with the ability to access social media in its various forms like Twitter® and Facebook®. Should businesses require employees to use their personal devices? Would separate business-only devices be more secure but add additional expense? How should lost or stolen business devices be handled in terms of potential confidential data being exposed? These questions can be addressed by comprehensive policies not unlike those required with the introduction of laptop computers and flash memory drives.

Regardless of built-in safeguards, people remain instrumental in the success or failure of any system. The use of a mobile device and social media introduces potential points of failure as well as opportunities for improvement. While impossible to list all potential failure points, all mobile devices users have experienced issues as simple as a discharged battery. Cellular network outages or lack of coverage may also be a hindrance, and at key

points in communication. The question remains, what additional potential risk areas might occur, especially when dealing with instant communication?

O'Leary (2011) discusses building relationships with customers. These relationships built largely on mutual trust, extend to supply chain partners. Goolsby (2010) discussed the fear of inaccurate information as being one of the critical factors in the success or failure in these relationships. General acceptance by people requires an understanding of what your employees are thinking (O'Leary, 2011). Further, this may include groups formed outside of the purview of the organization allowing workers to criticize management. This may be viewed as spying on employees and data may become scarce or even tainted. Developing bonds of trust with employees is the first step in any successful system. Anonymization of data and perhaps sharing summarized results with employees may be a step in the right direction.

Strategic alignment with any "system" is key to successful implementation and sustainable use. The use of social media for supply chain resiliency will require management to align that use with the strategic mission of the organization. This topic is pervasive across the literature related to information system implementations (Goepp and Avila, 2015; Velcu, 2010; Schniederjans and Cao, 2009). There may be more questions than answers at this point. Does the use of social media offer some new innovative approach to communications across the supply chain, or does it simply replace current forms already in existence? Simply replacing one form of electronic message with another does not address the efficiency or the effectiveness of a supply chain process. This replacement must afford reasonable opportunities for improvement to be justified. The further intrusion of the human element into the process may also introduce data errors or exacerbate efficiency. The introduction of technologies like IoT, or Internet of Things, may mitigate the risk of human error. Because this technology is not reliant upon third-party logistics sources, the inherent higher speeds and accuracy with smart embedded devices may offer solutions to management in relation to integration. As more devices become capable of listening, monitoring, and collaborating automatically, the integration of IoT solutions is almost a certainty.

Yet another area of technological innovation is the explosion of big data and analytics. Ittmann (2015) concludes with an insistence that supply chain managers embrace the reality of big data analytics and its impacts on identifying value in data. Supply chain analytics is using the data collected from within the supply chain and performing appropriate analysis to provide fast, accurate results to improve decision-making (Ittmann, 2015). Because of the variety of data, the increasing volume of available data, and the requirements for veracity and velocity (Minelli et al., 2013), big data analytics techniques and technology is critical to ensuring that efficiency and effectiveness gains using social media for supply chain resiliency isn't lost. A key factor for the use of big data and analytics is the potential for enhanced visibility of data across the supply chain (Ittmann, 2015; Milliken, 2014, 2015). Milliken illustrates the "transformation of big data into supply chain analytics" from the use of descriptive analytics to the construction of decision modelling.

It is important to remember an important concept first offered by Peter Drucker (1973),

> *"Innovation is not a technical term. It is an economic and social term. Its criterion is not science or technology, but a change in the economic or social environment, a change in the behaviour of people as consumers and producers, as citizens, as students or as teachers…"* (p.785).

According to Gallouj et al. (2018) the traditional model is for technological change to drive service and social innovation, interestingly enough, the adoption and use of social media technology by individuals is driving the technological innovation in supply chain resiliency applications. As organizations introduce emerging technologies into the strategic flow, it is always important to remember the rationale is not to use the latest software or gadget, the intent must always be to improve the profitability of the business. In this case, improving the channels

of communications, arming managers with instantaneous information, and providing visibility across the supply chain are key criteria in strategic alignment of social media as a tool to enhance supply chain resiliency.

LIMITATIONS AND FUTURE RESEARCH

The potential for the extensibility of any research findings is an exciting attribute of the widespread use of social media in its various forms. Social media is so widely accepted globally, repeating research studies should be possible. Understanding various cultural norms, carefully ensuring model constructs are valid, and other common practices will remain necessary. The limitation of this research is that no real data is collected to assist in determining the validity of our propositions. The need to further study the propositions should be addressed with not only quantitative research, but also qualitative studies to assist in developing themes and additional propositions. As the IoT expands, additional work is needed to understand how to best integrate technology and where human intervention is still required.

Future research could include how is information, leveraged through the collaboration capability social media provides, could be used to increase competitive elements beyond productivity, brand management and customer satisfaction. Additionally, an under-explored area within supply chain management is that of small and medium-sized enterprises (SMEs). Research on the potential use of social media for improved resilience in small and medium enterprises could prove fruitful. Finally, additional case studies related to social media and its use within the supply chain would provide valuable insight.

CONCLUSION

Supply chains are no longer simply a cost of doing business, they have become a platform for growth allowing organizations to reach new markets to touch new customers. To be successful, companies must innovate to compete. Social media has the potential to be an instrumental tool for supply chain managers looking to recognize new innovations, identify new trends and collaborate with stakeholders, and improve relationships with partners and suppliers. Supply chain disruptions are an inevitable occurrence in today's tumultuous business environment (Skipper and Hanna 2009). According to a report in the Financial Times from May 2015, supply risks have more than tripled since 1995. An organization can and should attempt to mitigate potential risks via traditional supply chain risk management practices but cannot prevent all disruptions from occurring.

When it comes to supply chain risk management, having information about what is happening in real time is essential. Whether it is learning about a natural disaster that happened near your manufacturing plant, information that may alter planned travel routes, or observing the path and intensity of an on-coming hurricane; real time information is critical and will enable an organization to make more informed and timely decisions on how to manage or mitigate risk. Alexander (2014) examines the use of social media in the mitigation of disaster risk and improving the management of crisis response. The concepts of a "listening function" and a "monitoring function" (p. 720) are discussed. Social media has the potential to be an invaluable tool for supply chain professionals attempting to collaborate with stakeholders, improve existing processes, increase efficiencies, mitigate risk and promote recovery following a supply chain disruption. The ideas of listening and monitoring, collaborative development, and integration between organizations could be at the core of creating a resilient supply chain (Autry and Moon, 2016). Social media could be an effective tool to add to an organization's risk management toolkit.

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BIOGRAPHIES

Scott R. Cox is an Assistant Professor of Management at Western Kentucky University, scott.cox@wku.edu. He received his Ph.D. in Logistics and Supply Chain Management from Georgia Southern University, along with both a Master's in Management Information Systems and an M.B.A. from Georgia College and State University. His research interests include supply chain management technology, change management and the supply chain, and the behavioral dimensions of supply chain management. Email: scott.cox@wku.edu

Kirk Atkinson is an Associate Professor in Information Systems Western Kentucky University, kirk.atkinson@wku.edu. He teaches courses in principles of management information systems, systems architecture, and information technology strategy. Dr. Atkinson holds an Ed.D. degree in Adult and Higher Education from Ball State University and an M.B.A from Murray State University. His research interests include supply chain analytics, ethical dilemmas in higher education, rural broadband Internet solutions, and college student online learning readiness. He currently serves as the Director for the Gordon Ford College Center of Applied Data Analytics. Email: kirk.atkinson@wku.edu

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4. Article length should be in the range of 6000-7000 words including references. Tables and figures are in addition to the word count. However articles including all text, references, appendixes, tables and figures (but excluding front matter) should not exceed 30 double spaced pages in the format described below. Shorter articles are also acceptable. It will be difficult to publish articles much longer than 7000 words.

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1. First Page - Title of the paper, name and position of the author(s), author(s) complete address(es) and telephone number(s), e-mail address(es), and any acknowledgment of assistance. Times New Roman with 12 point font.

2. Second Page - A brief biographical sketch of each author including name, degree(s) held, title or position, organization or institution, previous publications and research interests. Include each author's email address at end. Maximum of 90 words per author. Times New Roman with 12 point font.

3. Third Page - Title of the paper without author name(s) and a brief abstract of no more than 125 words summarizing the article in Times New Roman 12 point font. The abstract serves to generate reader interest in the full article.

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4. The entire manuscript must be typed LEFT-JUSTIFIED, with the exception of tables and figures.

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2. Author(s) and affiliation(s) are to be printed in upper and lower case letters below the title. Author(s) are to be listed with affiliation(s) only. Times New Roman 12 point.

3. The abstract should be 125 words or less on a separate Abstract Page. Title should be repeated as in 1) followed by ABSTRACT in caps, bolded and 12 point also. The abstract should be in 12 point font.

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1. ONLY Tables and Figures are to appear in camera-ready format! Each table or figure should be numbered in Arabic style (i.e., Table 1, Figure 2).

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Table or Figure (#) About Here

_____

EQUATIONS, CITATIONS, REFERENCES, ENDNOTES, APPENDIXES, ETC.

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$y = c + ax + bx$
$y = a + 1x + 2x + 3x + ax$

2. References within the text should include the author's last name and year of publication enclosed in parentheses, e.g. (Wilson, 2004; Manrodt and Rutner, 2004). For more than one cite in the same location, references should be in chronological order. For more than one cite in the same year, alphabetize by author name, such as (Wilson, 2001; Mandrodt, 2002; Rutner, 2002; Wilson, 2003). If practical, place the citation just ahead of a punctuation mark. If the author's name is used within the text sentence, just place the year of publication in parentheses, e.g., "According to Manrodt and Rutner (2003) ...,". For multiple authors, use up to three names in the citation. With four or more authors, use the lead author and et al., (Wilson et al., 2004). References from the Internet should contain the site name, author/organization if available, date the page/site was created, date page/site was accessed, and complete web addresses sufficient to find the cited work.

3. Endnotes may be used when necessary. Create endnotes in 10-point font and place them in a separate section at the end of the text before References. (1, 2, etc.). Note: Endnotes should be explanatory in nature and not for reference purposes. Endnotes should NOT be created in Microsoft Insert Footnotes/ Endnotes system. The Endnotes section should be titled in 12 point, uppercase and bolded.

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7. All references to journals, books, etc., are *italicized,* NOT underlined. Examples are as follows:

Journal Article:
Pohlen, Terrance L. (2003), "A Framework for Evaluating Supply Chain Performance," *Journal of Transportation Management,* 14(2): 1-21.

Book Chapter:
Manrodt, Karl (2003), "Drivers of Logistics Excellence: Implications for Carriers," In J. W. Wilson (Ed.), *Logistics and Transportation Research Yearbook 2003* (pp. 126-154) Englewood Cliffs, NJ: Prentice-Hall, Inc.

Book:
Coyle, John J., Bardi, Edward J., and Novack, RobertA. (2004), *Transportation,* 6th ed., Cincinnati, OH: South-Western College Publishing.

Website:
Wilson, J. W. (2003), "Adapting to the Threat of Global Terrorism: Reinventing Your Supply Chain," [On-line]. Available: http//:georgiasouthern.edu/coba/centers/lit/threat.doc. Created: 11/01/02, Accessed: 11/12/03.

MANUSCRIPT SAMPLE

A FRAMEWORK FOR EVALUATING SUPPLY CHAIN PERFORMANCE

Terrance L. Pohlen, University of North Texas

ABSTRACT

Managers require measures spanning multiple enterprises to increase supply chain competitiveness and to increase the value delivered to the end-customer. Despite the need for supply chain metrics, there is little evidence that any firms are successfully measuring and evaluating inter-firm performance. Existing measures continue to capture intrafirm performance and focus on traditional measures. The lack of a framework to simultaneously measure and translate inter-firm performance into value creation has largely contributed to this situation. This article presents a framework that overcomes these shortcomings by measuring performance across multiple firms and translating supply chain performance into shareholder value.

INTRODUCTION

The ability to measure supply chain performance remains an elusive goal for managers in most companies. Few have implemented supply chain management or have visibility of performance across multiple companies (Supply Chain Solutions, 1998; Keeler et al., 1999; Simatupang and Sridharan, 2002). Supply chain management itself lacks a widely accepted definition (Akkermans, 1999), and many managers substitute the term for logistics or supplier management (Lambert and Pohlen, 2001). As a result, performance measurement tends to be functionally or internally focused and does not capture supply chain performance (Gilmour, 1999; *Supply Chain Management,* 200 I) . At best, existing measures only capture how immediate upstream suppliers and downstream customers drive performance within a single firm.

Table 1 about here

Developing and Costing Performance Measures

ABC is a technique for assigning the direct and indirect resources of a firm to the activities consuming the resources and subsequently tracing the cost of performing these activities to the products, customers, or supply chains consuming the activities (La Londe and Pohlen, 1996). An activity-based approach increases costing accuracy by using multiple drivers to assign costs whereas traditional cost accounting frequently relies on a very limited number of allocation bases.

$$y = a^2 - 2ax + x^2$$

REFERENCES

Manrodt, Karl (2003), "Drivers of Logistics Excellence: Implications for Carriers," In 1. W. Wilson (Ed.), *Logistics and Transportation Yearbook 2003* (pp. 126-154) Englewood Cliffs, NJ: Prentice-Hall, Inc.

Coyle, John J., Bardi, Edward J. , and Novack, Robert A. (2004), *Transportation,* 6th ed., Cincinnati, OH: South-Western College Publishing.

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