Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 2009 Proceedings

Americas Conference on Information Systems (AMCIS)

2009

The Moderating Effect of Information Technology on the Relationship between Comprehensive Planning Processes and Flexible Responsiveness

Joseph Skipper
Air Force Institute of Technology, joseph.skipper@afit.edu

Dianne Hall
Auburn University Main Campus, halldia@auburn.edu

W. Heath Landrum
Auburn University, landrwh@auburn.edu

Joe Hanna
Auburn University, hannajb@auburn.edu

The Moderating Effect of Information Technology on the Relationship between Comprehensive Planning Processes and Flexible Responsiveness

Joseph Skipper
Air Force Institute of Technology
joseph.skipper@afit.edu

Dianne Hall
Auburn University
halldia@auburn.edu

W. Heath Landrum
Auburn University
landrwh@auburn.edu

Joe Hanna
Auburn University
hannajb@auburn.edu

ABSTRACT

Uncertainty and disruptions often cause significant effects on businesses worldwide. As part of ever increasing efforts to combat these issues, many businesses often seek to improve their flexibility. This study examines two antecedents of flexible responsiveness – information technology and comprehensive planning processes. A model was developed and then tested using survey data collected from supply chain managers and analyzed using partial least squares techniques. Based on the sample used, information technology moderates the effect of comprehensive planning on flexible responsiveness.

Keywords

Flexible responsiveness, contingency planning, planning comprehensiveness, information technology, IT.

INTRODUCTION

Supply chain disruptions can have tremendous impacts on business operations from the local to global marketplace. Numerous examples exist of disruptions caused not only by natural disasters (e.g., Bosman, 2006) but also by routine failures and closures that can also result in a ripple effect throughout the supply chain of the organization involved (Pickett, 2006). As organizational units become more interdependent, single disruptions will have ever-growing consequences (Peck, 2005).

Organizations must understand the risks they face, and position themselves to react quickly to unforeseen or unusual circumstances. It is important that the underlying foundation of such flexible responsiveness be well understood; several studies, including Fawcett, Calantone, and Smith (1996), Goldsby and Stank (2000), Fredricks (2005), and Swafford et al. (2006) found that organizations characterized by higher levels of flexible responsiveness are more capable of responding to unexpected events such as a disruption in a more successful manner when compared to their non-flexible counterparts. This study examines the interaction of information technology (IT) and comprehensive planning processes to determine the effect on response flexibility.

FLEXIBLE RESPONSIVENESS

Flexible responsiveness (FR) has been defined as a capability to react to changes in environment or conditions with minimal loss of time, cost, or performance (Sawhney, 2006). In the supply chain context, flexible responsiveness represents a multi-faceted perspective based on many established functions including procurement (Narasimhan and Das, 1999), manufacturing (Koste and Malhotra, 1999), and distribution (Fawcett and Clinton, 1996). Vickery et al. (1999) identified and defined five distinct flexibilities making the conclusion that supply chain flexible responsiveness must be examined from a bigger picture such as an integrative point of view that takes into account a customer perspective. Others suggest that supplier responsiveness and integration are keys to flexibility (Wang, Tai and Wei, 2006). Building on Vickery et al. (1999), Duclos, Vokurka, and Lummus (2003) argue that previous efforts to define supply chain flexible responsiveness were incomplete because they failed to consider both inter- and intra-organizational concerns. This study defines flexible responsiveness as the ability to adapt to unexpected circumstances or unusual circumstances, thus utilizing a higher level lens from which to view the phenomenon. This requires that the organization engage in the

process of anticipating and planning for events, both within the organization and with external partners and supply chain members.

The process described above is contingency planning; the purpose of the contingency plan is to minimize loss by identifying, prioritizing, and safeguarding assets that need protection in the event of a disruption or disaster, but also includes preparing assets and procedures to respond to unusual requests or circumstances. The plan allows an organization to be resilient and responsive (Rice and Caniato, 2003); the planning should be an integration of formalized procedures and resource information (Barnes, 2001).

Organizations that can respond flexibly are not only able to minimize the negative effects of unusual circumstances, but may also be able to respond in a manner that exploits opportunity. It is therefore necessary to understand at a basic level how to allocate resources to support flexible responsiveness.

THEORETICAL FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Current business trends towards increased global markets and increased dependence highlight the need for flexible responsiveness. In today's marketplace, flexibility is often characterized as doing things fast, being responsive to the market, or providing a company with the opportunity to pursue innovation and allowing for adaptability to changing circumstances (Goold and Campbell, 2002; Stalk Jr, 1988). If flexibility is achieved, it can be the cornerstone of an organization's ability to respond more quickly than competitors, thus placing an organization in a position of competitive advantage (Fawcett et al., 1996). FR permits an organization to continuously improve customer satisfaction by leveraging routine performance to high levels of non-routine compliance (Bowersox, Daugherty, Drogue, Germain and Rogers, 1992).

Information Technology

An organization's ability to generate, combine, and make use of information is vital. The firm's ability to capture information for use in the planning process is critical to selecting and developing appropriate capabilities to deal with disruptions (Fawcett, Calantone and Roath, 2000). Organizations need information and the ability to share that information in order to develop contingency plans, to manage the planning process, and to control daily operations (Kaplan, 1991). Within supply chain organizations, flexible responsiveness allows an organization to deal with changes in time, volume, products or services over a great range of changes in environment and magnitude of uncertainty (Abrahamsson, Aldin and Stahre, 2003). Central to the ability to plan is the exchange of large amounts of information within and between organizations (Sanders and Premus, 2002). Information allows for agile and flexible responses to contingencies (Whipple, Frankel and Daugherty, 2002).

IT capabilities include the application of hardware, software and networks to enhance information flow and facilitate decisions. IT enables an organization to maintain key information in an accessible format, process requirements, and make operating and planning decisions. Information systems allow an organization to implement strategy and planning by making decisions more quickly (Stank and Lackey, 1997), improving organizational performance (Daugherty, Richey, Genchev and Chen, 2005; Sanders and Premus, 2005) and flexibility (Cash Jr and Konsynski, 1985; Patterson, Grimm and Corsi, 2003) Boyson et al., (2003) add that the key to enhanced operations is not just efficient information transfer, but also the timely availability of information.

Hypothesis 1: IT usage in the CP process is positively related to flexible responsiveness.

Comprehensiveness Planning

The role of planning is to establish the organization's direction by evaluating objectives, alternatives, and the resources required (Hayes, Wheelwright and Clark, 1988). The comprehensive aspect of the planning process assists an organization in the configuration and coordination of operations more effectively and thus increases the level of organizational flexible responsiveness (Fawcett, Stanley and Smith, 1997; Kuicalis, 1991). Defee and Stank (2005) add that the concepts that support a comprehensive, integrated plan support enhanced performance.

A comprehensive plan must follow a formal planning process identified by the organization to ensure appropriate planning aspects and planning steps are included in different functional areas. Formality is the incorporation of the analysis of risks and benefits, documentation of alternatives, and communication of organizational objects and strategy (Fawcett et al., 1996). This study borrows the definition used by Fawcett, Calantone, and Roath (2000) stating that comprehensiveness is the extensive analysis of risks and benefits, documentation of alternatives, and communication of organizational objectives and strategy implementation processes to relevant management levels.

Hypothesis 2: Comprehensiveness of the CP process is positively related to flexible responsiveness.

Because many processes in comprehensive planning are cross-functional within the organization and, particularly in the case of contingency planning, extend beyond the borders of that organization, we argue that the use of IT in the planning process will facilitate the transfer of information across and between organizations. When IT is used, planners may be able to focus more on the processes and outcomes, and less on the tasks of information sharing and searching. We argue that IT use will moderate the effect of comprehensive planning on flexible responsiveness. Thus, we posit:

Hypothesis 3: The influence of the comprehensive planning process on flexible responsiveness is moderated by the use of information technology.

RESEARCH METHODOLOGY

For this research, we utilized a survey methodology so that we are able to empirically test the relationships between IT, planning comprehensiveness, and flexible responsiveness. Survey methodology is recognized as a suitable means of assessing unobservable phenomena (Gall, Gall and Borg, 2003; Schneider, Ashworth, Higgs and Carr, 1996; Smith and Dainty, 1991) such as perception of organizational members or, as in this case, the relationships between various processes and their attributes.

Measures

Each of the constructs in this study was measured using five-point Likert-scale items adapted from previously used multi-item scales. The three items used to measure flexible responsiveness were developed by Fawcett, Calantone, and Smith (1996), wherein FR is defined as the ready capability to react and adapt to changing conditions. The construct measures employees' perceptions of their organizations ability to handle change. The original study reported a Cronbach's alpha measure of .91 for this construct (Fawcett et al., 1996). The comprehensiveness construct measures the influence of the comprehensiveness of the planning process on the FR of the planning process. This five item scale was developed by Fawcett et al., (1997) and resulted in an initial Cronbach's alpha measure of .91. This study utilized a four-item scale developed by Stank and Lackey (1997) with an initial reported Cronbach's alpha measure of .84 to measure employees' perceptions of IT use in the planning process.

In addition to the items above, demographic information was collected, including job title, experience, length of employment, and size of the respondents' organizations. Respondents were asked to categorize the size of their organization as less than 50 employees, 51-100 employees, 101-200 employees, 201-300 employees, or more than 300 employees. These variables were gathered to be used as control variables as necessary; only organization size was significant in the model, and, therefore, it is analyzed in the results below.

Participants

The sample for this study was 74 personnel involved in contingency planning either as planners (59%) or as implementers (41%). This sample was drawn from an informal group of supply chain managers, practitioners, and subject matter experts. Respondents were initially asked if they participated in contingency planning for their organization's supply chain. The sample was intentionally designed to draw from a broad range of experience, position, organizational type, and involvement, in the respondent's organizational planning efforts. This was done to ensure the widest range of response and to support generalizability of our results. Of the 400 individuals who were contacted, 74 responded for a response rate of 18.5%. To minimize non-response bias, effort was made to increase participation through repeat contact. Although there is always non-response bias in survey data, we do not anticipate significant differences between our respondents and our target sample. Most non-response bias manifests in differences between the individuals who respond and do not respond (such as age, education, etc.).

Partial Least Squares (PLS) analysis is used in this study. Although PLS requires fewer observations for model validation than other modeling techniques (Bock, Zmud, Kim and Lee, 2005), we chose our sample size based on an a priori evaluation of sample size based on multiple regression techniques with an acceptable power of .8, an effect size of .15, and an alpha of .05. This calculation indicates a sample size requirement of 70. The PLS rule of thumb of 10 times the number of items in the most complex construct (Gefen, Straub and Boudreau, 2000) indicates that a sample size of 50 is acceptable. Our sample of 74 exceeds both of these requirements and is therefore adequate to detect an effect size of .15 or greater.

Each respondent filled out an on-line questionnaire by considering their most recent contingency planning experience at their local level, i.e. their realm of responsibility. Respondents were mid- or upper-level managers (78%); each

respondent represented a different organizational unit. In addition, they represented numerous functions. Industries in the sample include federal, state, and local government, municipal and commercial utilities, manufacturing, transportation, and logistics third party providers. Thirty-four percent of the organizations represented had fewer than 50 employees; organizations with 51-100 and 101-200 employees were represented by 20% each of the sample size; 10% of the respondents represented organizations of 201-300 employees, while the remaining participants represented organizations with more than 300 employees. Our respondents averaged five years in their current positions, ten years with their current organization, and 10 years of contingency planning experience.

DATA ANALYSIS AND RESULTS

Before presenting the analysis and results, it is important to recognize that all research has some limitations that may impact the generalizability of the results. This research is limited in that it has solicited the perceptions of individuals involved with the planning process. It could be that different results may be found if other individuals within organizations are surveyed. Further, this research is based on the perceptions of 74 individuals from different organizations. It is possible that multiple respondents in the same organizations or more respondents from individual organizations may modify the results. Like most research, this study could be affected by common method bias which may threaten the validity of conclusions about relationships between measures (Nunnally, 1978; Spector, 1987). However, to help minimize the risk of common method bias, the research presented here was conducted in accordance with Podsakoff et al. (2003). Care was taken to address potential pitfalls such as priming effects, context induced mood bias, evaluation, and social desirability.

When using PLS, the measurement model is first assessed for convergent validity, the condition under which items thought to measure a construct show high correlations with each other (Straub, Boudreau and Gefen, 2004). Convergent validity is indicated when each measurement item loads on its latent construct with a significant t-value (Gefen and Straub, 2005) in the outer model. Of the original items, one did not pass this test and was eliminated from the analysis. Convergent validity is also indicated by a high composite reliability score. As shown in Table 1, all composite reliability scores more than exceed the suggested value of .7 (Chin and Newsted, 1999; Fornell and Larker, 1981).

Next, discriminant validity is assessed using two methods (Gefen and Straub, 2005). First, discriminant validity can be assessed by examining average variance extracted values presented by the PLS model. Discriminant validity is evident when the square root of the average variance extracted (presented in bold in Table 1) is larger than the correlation of the other constructs (Gefen and Straub, 2005). As indicated by Table 1, each correlation is less than the corresponding square root of the average variance extracted. In addition, Table 1 provides the values for composite reliability (CR) which is analogous to Cronbach's alpha; these values all exceed the established level of .7 (Cronbach, 1951).

Construct	Items	Mean	Std. Dev.	Skew	Kur-tosis	C. R.	Flex	CP	IT
Flexible responsiveness	3	4.08	1.07	-.96	-.03	.94	**(.92)**		
Comprehensiveness	5	3.78	.99	-.74	.01	.94	0.52	**(.87)**	
Information Technology Use	4	3.66	1.01	-.32	-.93	.95	0.57	0.38	**(.91)**

(The square root of the average variance extracted is presented in bold along the diagonal)

Table 1. Descriptive Statistics and Correlations of Constructs (n=74)

Discriminant validity is also indicated when the measurement items for one construct differ from those of other constructs (Straub et al., 2004) and is demonstrated when the items used to measure a construct result in high loadings on their assigned construct and relatively lower loadings on the other constructs (Gefen and Straub, 2005). Analysis of items loadings indicated that each item loaded well on its construct, loaded lower on other constructs, and the difference between the two exceeded the recommended 15% (Gefen and Straub, 2005), thus indicating discriminant validity. Table 2 presents the result of the factor analysis. The above model assessment indicates that the model is valid and that the results presented below are interpretable.

	Flexible responsiveness	Comprehensiveness	IT Use
Flex1	**.915**	.531	.519
Flex2	**.949**	.526	.560
Flex3	**.900**	.381	.502
Comp1	.464	**.920**	.369
Comp2	.499	**.911**	.370
Comp3	.481	**.881**	.388
Comp4	.442	**.805**	.240
Comp5	.360	**.761**	.178
ITUse1	.472	.315	**.888**
ITUse2	.513	.320	**.894**
ITUse3	.592	.407	**.945**
ITUse4	.498	.345	**.918**

Table 2. Confirmatory Factor Analysis Results

RESULTS

Partial Least Squares is a regression-based path modeling technique that estimates path coefficients and partials out variance for the model. PLS can be used to analyze structural models with multiple item constructs (Ahuja, Galletta and Carley, 2003), and is particularly suited to predictive applications and theory-building (Gefen et al., 2000). Path coefficients are interpreted in the same manner as standardized regression coefficients. PLS is unique in its ability to map reflective, formative, or mixed variables; independent variables may be continuous, categorical, or a combination of both. Reflective constructs are represented by items that share a common theme whereas formative constructs are defined by its indicators that may not share a common theme. The predictor and moderator variables in this study are reflective; the outcome variable (flexible responsiveness) is a combination of reflective items and formative sub-constructs. Because of the formative nature of our outcome variable, PLS is the appropriate method of analysis. In addition, PLS is extremely useful for analyzing complex relationships "when the importance shifts from individual variables and parameters to packages of variables and aggregate parameters" (Wold, 1985, p. 589).

Figure 1 shows the results of the PLS analysis. Each path is labeled with its respective hypothesis, path loadings, and t-values. Significant paths are indicated with bold lines; insignificant paths by dashed lines. Hypotheses 1, 2, and 3 are supported.

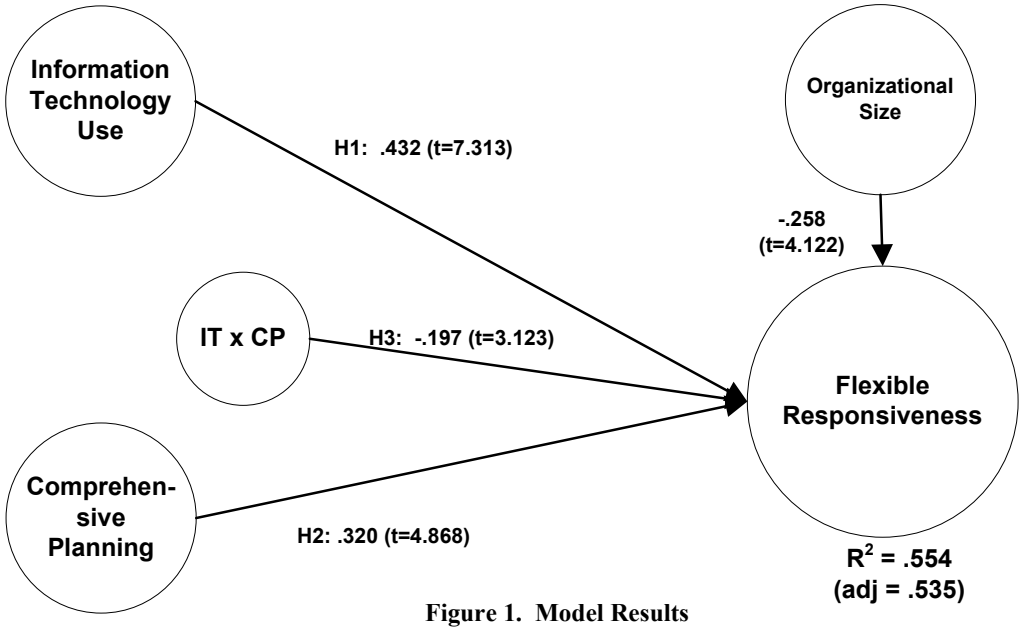

Figure 1. Model Results

DISCUSSION

In response to supply chain disruptions, organizations must work quickly and efficiently to identify and counteract potentially devastating conditions. Flexible responsiveness is a capability that has been shown to support such action. Planning to minimize supply chain risk, particularly of a global nature, is critical. This study demonstrates the importance of a comprehensive contingency planning process to facilitate FR that allows organizations to react quickly to events and minimize the impact. Our results indicate that a comprehensive planning process is a critical part of preparing for minimizing supply chain risk and increasing flexible responsiveness. Over half of the variance in FR is explained by a comprehensive planning process supported by IT.

Information technology is a means of facilitating the flow of information necessary to react quickly in a dynamic context (Dyer, 1997; Sambamurthy and Zmud, 2000). For example, formal IT systems are implemented to help enrich the process of information transfer; these systems may include centrally planned systems dedicated to the creation, storage, transfer, and application of information within an organization (Orlikowski, 2000). Our research demonstrates the importance of IT to organizational flexible responsiveness, both as a direct effect and through moderation of the effect of a comprehensive planning process. When resources are limited, it is important that organizations appropriate those resources to areas that are most likely to bring profitable returns. Investment in IT results in increased levels of FR regardless of the comprehensiveness of the planning process. Figure 2 shows the effects of varying levels of IT use on different levels of planning comprehensiveness.

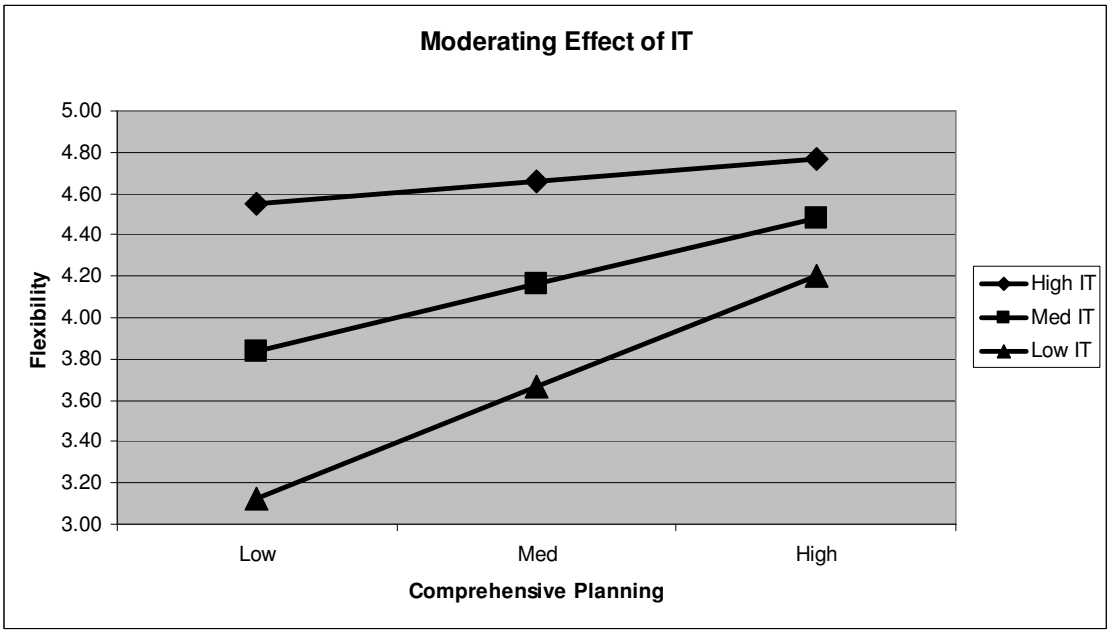

Figure 2. Moderating Effect of IT

When IT is widely available and is frequently used in the organization, the direct effect of planning comprehensiveness is less important to the outcome of flexible responsiveness. This case results in the highest level of flexible response; there is little difference whether the organization engages in low or high levels of comprehensiveness when IT use is high. The greatest difference in the amount of FR reported occurs when IT use is low. In this case, low planning comprehensiveness results in little ability to respond flexibly, but high comprehensiveness increases flexible responsiveness. FR also varies with medium levels of IT, again showing that high levels of planning comprehensiveness are necessary if IT use is not at an appropriate level; however, the effect of varying levels of comprehensiveness is not as dramatic on flexible responsiveness as it is under conditions of low IT use.

Although not an item of interest in this study, it is important to address the significant negative effect of organizational size on flexible responsiveness. As organizational size increases, flexibility decreases. This may be the result of planning formality. In larger organizations, it may be that planning comprehensiveness is mandated. In these cases, respondents may see the planning process as interfering with, rather than enhancing, flexibility or they may see the process as being too complicated (Berman, Gordon and Sussman, 1997). Formal plans may cause a respondent to feel confident in his or her ability to react to a contingency; however, the formal nature itself may prevent free flow of information which, in turn, decreases flexibility. While not directly tested here, this is an area that should be investigated further. Larger organizations are likely to have more resources to devote to IT, but their size may inhibit information

sharing. Smaller organizations, on the other hand, may have limited financial resources but their size may enhance information sharing.

Our findings indicate that organizations striving to increase their ability to respond to disruptions and other contingencies must take into consideration both comprehensiveness of planning and IT use. First, providing appropriate technology, training, and accessibility will increase flexible responsiveness. Second, developing and using a comprehensive planning process will also contribute to the organization's ability to respond to unusual events. In addition, managers need to make sure that the two processes are appropriately balanced to achieve the desired effect. While high levels of comprehensiveness and IT involvement obviously results in the most flexibility, increasing the level of IT involvement will increase the effect of comprehensiveness on FR. Further, organizations should be particularly aware of the devastating effect of low levels of both factors on their ability to react quickly to events. Perhaps not surprisingly, in cases where an organization does not have an effective comprehensive planning process and is behind in its use of IT, the likelihood of progressively addressing potential disruptions or reacting effectively to any event once it occurs is low.

Despite the focused nature of this study, a number of future directions are evident. Further investigation of organizational size differences in relation to comprehensiveness, flexible responsiveness and IT use may help organizations better understand the impact of growth on flexible responsiveness. Further examination of IT use is also encouraged. What systems are particularly supportive, and which systems may cause bottlenecks? Are organizational members freely interacting with the technology in a way that enhances information sharing? It is also necessary to continue to examine information sharing and its relationship to flexible responsiveness. Given that comprehensive planning is likely to become more prominent in the future, how can we design information sharing processes to directly benefit flexible responsiveness? What other antecedents of FR exist and what is their relationship with those investigated here? Do flexible responsiveness and its various antecedents vary over time? As discussed earlier in this research, much effort has been applied to strategic planning. However, little academic research has been applied specifically to designed flexible responsiveness. This research provides a foundation for examining designed flexible responsiveness in the context of extreme events.

CONCLUSION

This research effort contributes to our understanding of the relationships among IT use and comprehensive CP planning and their relationship to organizational flexible responsiveness. We combine academic rigor and practitioner relevance to achieve maximum benefit from the research results. For practitioners, the effort provides support for managerial decision-making by providing an understanding of the interrelationships evident in this research. From an academic perspective, this effort is a step toward a better understanding of organizational flexible responsiveness and helps to fill a gap in planning literature.

REFERENCES

1. Abrahamsson, M., Aldin, N., and Stahre, F. (2003) Logistics Platforms for Improved Strategic Flexibility, *International Journal of Logistics: Research & Applications*, 6, 3, 85-106.

2. Ahuja, M., Galletta, D., and Carley, K. (2003) Individual Centrality and Performance in Virtual R&D Groups: An Empirical Study, *Management Science*, 49, 1, 21-38.

3. Barnes, J.C. (2001) A Guide to Business Continuity Planning, John Wiley & Sons, New York.

4. Berman, J.A., Gordon, D.D., and Sussman, G. (1997) A Study to Determine the Benefits Small Business Firms Derive from Sophisticated Planning Versus Less Sophisticated Types of Planning, *The Journal of Business and Economic Studies*, 3, 3, 1.

5. Bock, G., Zmud, R.W., Kim, Y., and Lee, J. (2005) Behavioral Intention Formation in Knowledge Sharing: Examining the Roles of Extrinsic Motivators, Social-Psychological Forces, and Organizational Climate, *MIS Quarterly*, 29, 1, 87-112.

6. Bosman, R. (2006) The New Supply Chain Challenge: Risk Management in a Global Economy, Factory Mutual Insurance Company.

7. Bowersox, D., Daugherty, P.J., Drogue, C.L., Germain, R.N., and Rogers, D.S. (1992) Logistical Excellence: It's Not Business as Usual, Digital Press, Bedford, MA.

8. Boyson, S., Corsi, T., and Verbraeck, A. (2003) The E-Supply Chain Portal: A Core Business Model, *Transportation Research Part E: Logistics and Transportation Review*, 39, 2, 175-192.

9. Cash Jr, J.I., and Konsynski, B.R. (1985) Is Redraws Competitive Boundaries, *Harvard Business Review*, 63, 2, 134-142.

10. Chin, W.W., and Newsted, P. (1999) Structural Equation Modeling Anlaysis with Small Samples Using Partial Least Squares, Sage, Thousand Oaks, CA.

11. Cronbach, L.J. (1951) Coefficient Alpha and the Internal Consistency of Tests, *Psychometrica*, 16, 297-334.

12. Daugherty, P.J., Richey, R.G., Genchev, S.E., and Chen, H. (2005) Reverse Logistics: Superior Performance through Focused Resource Commitments to Information Technology, *Transportation Research Part E: Logistics and Transportation Review*, 41, 2, 77-92.

13. Defee, C.C., and Stank, T.P. (2005) Applying the Strategy-Structure-Performance Paradigm to the Supply Chain Environment, *The International Journal of Logistics Management*, 16, 1, 28-50.

14. Dyer, J.H. (1997) Effective Interfirm Collaboration: How Firms Minimize Transaction Costs and Maximize Transaction Value, *Strategic Management Journal*, 18, 7, 535-556.

15. Fawcett, S.E., Calantone, R.J., and Roath, A. (2000) Meeting Quality and Cost Imperatives in a Global Market, *International Journal of Physical Distribution & Logistics Management*, 30, 6, 472.

16. Fawcett, S.E., Calantone, R.J., and Smith, S. (1996) An Investigation of the Impact of Flexibility on Global Reach and Firm Performance, *Journal of Business Logistics*, 17, 2, 167.

17. Fawcett, S.E., Stanley, L.L., and Smith, S.R. (1997) Developing a Logistics Capability to Improve the Performance of International Operations, *Journal of Business Logistics*, 18, 2, 101.

18. Fornell, C., and Larker, D.F. (1981) Structural Equation Models with Unobservable Variables and Measurement Errors, *Journal of Marketing Research*, 18, 1, 39-50.

19. Fredericks, E. (2005) Infusing Flexibility into Business-to-Business Firms: A Contingency Theory and Resource-Based View Perspective and Practical Implications, *Industrial Marketing Management*, 34, 6, 555-565.

20. Gall, M.D., Gall, J.P., and Borg, W. (2003) Education Research: An Introduction Allyn & Bacon, Boston, MA.

21. Gefen, D., Straub, D., and Boudreau, M.-C. (2000) Structural Equation Modeling and Regression: Guidelines for Research Practice, *Communications for the Association for Information Systems*, 4, 1-77.

22. Gefen, D., and Straub, D.W. (2005) A Practical Guide to Factorial Validity Using Pls-Graph: Tutorial and Annotated Example, *Communications for the Association for Information Systems*, 16, 91-109.

23. Goldsby, T.J., and Stank, T.P. (2000) World Class Logistics Performance and Environmentally Responsible Logistics Practices, *Journal of Business Logistics*, 21, 2, 187-208.

24. Goold, M., and Campbell, A. (2002) Do You Have a Well-Designed Organization?, *Harvard Business Review*, 80, 3, 117.

25. Hayes, R., Wheelwright, S.C., and Clark, K.B. (1988) Dynamic Manufacturing: Creating the Learning Organization, The Free Press, New York, NY.

26. Kaplan, R.S. (1991) New Systems for Measurement and Control, *The Engineering Economist*, 36, 3, 201(218).

27. Kuicalis, S. (1991) Determinants of Strategic Planning Systems in Large Organizations: A Contingency Approach, *Journal of Management Studies*, 28, 2, 143-160.

28. Nunnally, J.C. (1978) Psychometric Theory, McGraw-Hill, New York.

29. Orlikowski, W.J. (2000) Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations, *Organization Science*, 11, 4, 404-428.

30. Patterson, K.A., Grimm, C.M., and Corsi, T.M. (2003) Adopting New Technologies for Supply Chain Management, *Transportation Research Part E: Logistics and Transportation Review*, 39, 2, 95-121.

31. Peck, H. (2005) Drivers of Supply Chain Vulnerability: An Integrated Framework, *International Journal of Physical Distribution & Logistics Management*, 35, 4, 210-232.

32. Pickett, C. (2006) Prepare for Supply Chain Disruptions before They Hit, All Business, http://www.allbusiness.com/finance/business-insurance-risk-management/4101423-1.html.

33. Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., and Podsakoff, N.P. (2003) Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies, *Journal of Applied Psychology*, 88, 5, 879.

34. Rice, J.B., and Caniato, F. (2003) Building a Secure and Resilient Supply Network, *Supply Chain Management Review*, 7, 5, 22.

35. Sambamurthy, V., and Zmud, R.W. (2000) Research Commentary: The Organizing Logic for an Enterprise's It Activities in the Digital Era--a Prognosis of Practice and a Call for Research, *Information Systems Research*, 11, 2, 105.

36. Sanders, N.R., and Premus, R. (2002) It Applications in Supply Chain Organizations: A Link between Competitive Priorities and Organizational Benefits, *Journal of Business Logistics*, 23, 1, 65-83.

37. Sanders, N.R., and Premus, R. (2005) Modeling the Relationship between Firm It Capability, Collaboration, and Performance, *Journal of Business Logistics*, 26, 1, 1-23.

38. Schneider, B., Ashworth, S.D., Higgs, A.C., and Carr, L. (1996) Design, Validity, and Use of Strategically Focused Employee Attitude Surveys, *Personnel Psychology*, 49, 3, 695.

39. Smith, and Dainty, P. (1991) The Management Research Handbook, Routledge, London ; New York.

40. Spector, P.E. (1987) Method Variance as an Artifact in Self-Reported Affect And, *Journal of Applied Psychology*, 72, 3, 438.

41. Stalk Jr, G. (1988) Time--the Next Source of Competitive Advantage, *Harvard Business Review*, 66, 4, 41-51.

42. Stank, T.P., and Lackey, C.W. (1997) Enhancing Performance through Logistical Capabilities in Mexican Maquiladora Firms, *Journal of Business Logistics*, 18, 1, 91-123.

43. Straub, D., Boudreau, M., and Gefen, D. (2004) Validation Guidelines for Is Positivist Research, *Communications for the Association for Information Systems*, 13, 380-427.

44. Swafford, P., Ghosh, S., and Murthy, N. (2006) The Antecedents of Supply Chain Agility of a Firm: Scale Development and Model Testing, *Journal of Operations Management*, 24, 2, 170-188.

45. Wang, E.T.G., Tai, J.C.F., and Wei, H.L. (2006) A Virtual Integration Theory of Improved Supply-Chain Performance, *Journal of Management Information Systems*, 23, 2, 41-64.

46. Whipple, J.M., Frankel, R., and Daugherty, P.J. (2002) Information Support for Alliances: Performance Implications, *Journal of Business Logistics*, 23, 2, 67-82.

47. Wold, H. (1985) Partial Least Squares, Wiley, New York, NY.