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Decision-Making Uncertainty, Need for Cognitive Closure, and Supply Chain Performance

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DECISION-MAKING UNCERTAINTY, NEED FOR COGNITIVE CLOSURE, AND SUPPLY CHAIN PERFORMANCE

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This dissertation is dedicated to my parents

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DECISION-MAKING UNCERTAINTY, NEED FOR COGNITIVE CLOSURE, AND SUPPLY CHAIN PERFORMANCE

ABSTRACT

Most firms must acquire materials or services from their suppliers. They use these materials or services, add value to them, and sell them to others. Supply disruptions, commonly known as the bullwhip effect, have been a major challenge facing supply chain firms. Although previous research of operational or structural causes of supply disruptions or supply disruption risk created by situational factors and buyer perceptions and associated impacts on supply chain performance has been conducted, it has not linked the relationship of decision-making uncertainty and need for cognitive closure (NFCC) with impacts on SCP.

This study identifies and enhances the current operations management (OM) model by creating a new construct (consolidated buyer decision-making uncertainty (DMU_{Σ})), and integrating the existing construct (NFCC), to model behavioral impacts on supply chain performance (SCP). It references and builds on over 120 literature sources. It targets purchasing managers that are extensively involved in the decision-making processes for purchasing decisions and are responsible for managing supply disruption risk.

This study explores the individual's effect on supply chain dynamics by analyzing the information search behavior of supply chain members in a complex decision process.

An individual's bounded rationality is inherent in the decision-making process. This study adds to the literature the use of $DMU_{\sum}$ in connection with NFCC.

Findings reveal that high NFCC purchasing decision-makers (vs. low NFCC) that are motivated to reduce discomfort associated with DMU_{Σ}, are also motivated to close on a decision. Individuals with high NFCC significantly correlated to increased overall SCP. However, knowledgeable and experienced high NFCC purchasing managers consistently make better purchasing decisions (high SCP) for their firms than less experienced high NFCC purchasing managers. The less experienced high NFCC purchasing managers may need training to better utilize supplier performance facts and data to develop confident decisions, reduce decision errors and biases, and improve their work performance. By reducing supply disruption risk through managing NFCC pitfalls, this study expects buying firms to improve their performance.

Keywords: Buyer-Supplier Relationships (BSRs); Consolidated Buyer Decision-Making Uncertainty ($DMU_{\sum}$); Need for Cognitive Closure (NFCC); Supply Chain Management (SCM); Supply Chain Performance (SCP)

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CHAPTER I

INTRODUCTION

Buying firms encounter supply disruption risk. Supply disruption risk is defined as unforeseen events that interfere with the normal flow of goods and (/or) materials within a supply chain (Craighead et al., 2007). As the market becomes more competitive, buying firms face increasing risks of supply disruption (Ellis et al., 2010). Purchasing managers struggle to balance competing demands on their time and resources. Decision-making accuracy reflects their ability to acquire materials meeting or exceeding the firm's quality, cost, and schedule requirements. Decision-making accuracy and management of risk measure a purchasing manager's effectiveness.

Perceptions of risk influence the purchasing decisions. Executive decision-makers often are overwhelmed with information, some of which may not be appropriate to the current decision (Feldman and March, 1981; March and Shapira, 1987). Several studies have suggested that experienced decision-makers make better decisions since they are more efficient and skilled in sorting and processing information (Kleinmuntz, 1990; Nonaka, 1994). Some decision-makers may form clear-cut and often extreme opinions regardless of the uncertainty of the situation, whereas others may experience discomfort

about rendering a definite judgment and prefer to suspend it in even the safest of environments (Kruglanski and Chun, 2007). However, few research studies in operations management (OM) have taken into account such individual differences.

Supply disruptions, commonly known as the bullwhip effect, have been a major challenge facing supply chain firms. Both the probability and the magnitude of supply disruption are important to buyers' overall perceptions of supply disruption risk (Ellis, 2010). This study focuses on the purchasing manager's behaviors and traits that may affect timing and volume decisions, which impact supply disruption risk. Researchers have taken different approaches to address the problem. A stream of research in OM has been developed around the operational or structural causes of supply disruption. Research has highlighted the causes of supply disruption risk, assisting buyers in making decisions in a wide range of areas at both the strategic and operational levels (Williams, 1998). Those structural causes include inventory rationing, order batching, and price variations (Lee et al., 1997a, b). Ways to alleviate these structural problems include improved demand forecasting techniques (Chen et al., 2000), staggered order batching (Cachon and Lariviere, 1999), and everyday low pricing (Sogomonian and Tang, 1993).

Other OM studies examine supply disruption risk created by situational factors (e.g., production and marketing factors) and buyer perceptions (Sterman, 1989, 2000; Zsidisin, 2003; Croson and Donohue, 2006; Ellis et al., 2010). Behavioral theory provides further insights into factors effecting supply disruption risk (Zsidisin, 2003). A behavioral view of supply disruption risk, rather than objective measures, was used in the research of Ellis et al. (2010). While these research streams give significant insights into the causes and effects of supply disruption risk, none of the studies measure decision-

making behavioral factors that influence supply chain performance or measure an individual's ability to cope with decision outcome uncertainties.

Studies in the psychology of individual choice have identified numerous cognitive and other bounds on human rationality, often producing systematic errors and biases (Sterman, 1989, 2000). The "irrational" behavior is in line with previous behavior research (Schweitzer and Cachon, 2000), which shows that individuals often exhibit some form of decision bias in business settings. The 1994 study of Yates et al. discussed the decision-making behavior when purchasing managers have objective measures supporting their decision-making, but continue to seek additional information. Napoleon (1994) suggests that while the team-oriented purchasing function affects suppliers, there are many aspects of decisions that will continue to be made by the individual purchaser.

This research paper measures and explains the behavioral cause impact on an individual's ability to manage supply chain performance by integrating research measurements from the area of psychology with OM studies. The "need for cognitive closure (NFCC)" (Kruglanski, 1989) explores how efficiently the buyers can deal with information and decisions in an uncertain environment. NFCC is defined as the desire for a firm answer to a question compared to uncertainty, ambiguity, or confusion (Kruglanski, 1989). NFCC is an independent variable that influences risk tolerance and other dependent variables. As NFCC increases, the preference for predictability increases and risk tolerance decreases.

This study empirically investigates the indirect effects of buyer and supplier relationships (BSRs) on supply chain performance (SCP) through a new construct labeled "consolidated buyer purchasing decision-making uncertainty ($DMU_{\sum}$)". It further

investigates how SCP is affected by the decision-maker's NFCC. To understand how SCP is directly and/or indirectly impacted by the decision-maker's NFCC, this study develops a new OM model incorporating the NFCC and DMU_{Σ} indicators in the supply chain process. This study assumes that an individual's irrational decision and information intensity requirements (sometimes referred to as "analysis paralysis") impact supply disruption risk. An "irrational decision" is a business decision, based on an individual's decision bias when faced with difficult decisions (Schweitzer and Cachon, 2000). Information intensity is the amount of useful information that an individual requires to make a buying decision. Buying decisions vary based on the individual's NFCC (Sterman, 1989, 2000). This study focuses on the influence of the individual's *information intensity* when making a buying decision. This study assumes that the influence of the individual's information intensity is different according to the individual's NFCC.

Peterson (2003) tested his general hypotheses that the individual's trait is related to decision-making group processes, and the group process is related to organizational financial performance. Results from the pre-test supported the critical nexus between leader's personality and firm performance. Thus, this study considers an executive decision-maker who represents the group and is responsible for purchasing decisions.

A thorough review of literature across diverse disciplines provided the basis to analyze the relationships between the NFCC and $DMU_{\sum}$ constructs, and to investigate direct and indirect effects of NFCC on the SCP construct. This study uses the same scale items to measure the BSRs, NFCC, and SCP constructs as supported in the literature

(Chen and Paulraj, 2004a; Webster and Kruglanski, 1994b). To establish the $DMU_{\sum}$ construct, this study identifies four different uncertainties existing in the OM research: 1) environmental uncertainty (Chen and Paulraj, 2004a), 2) business uncertainty (Lai et al., 2008), 3) buyer decision-making uncertainty (Gao et al., 2005), and 4) operational uncertainty (Achrol and Stern, 1988). This study requires the $DMU_{\sum}$ construct to be an inserted relation between BSRs and SCP. The statistical results revealed that insertion of $DMU_{\sum}$ between BSRs and SCP produced findings consistent with previous studies (Carr and Pearson, 1999; G. Kwon and Suh, 2004; Chen and Paulraj, 2004a). Results of a good model fit from the partial model (BSRs- $DMU_{\sum}$- SCP) provided the foundation on which this study builds and adds the NFCC construct to the model. The hypotheses tested by the relationships in the model, after adding the NFCC construct, improved the model fit. One of the contributions to the literature from this study is the consolidation of multiple decision-making uncertainties ($DMU_{\sum}$) and relational connection to the existing NFCC construct.

Findings reveal that high NFCC purchasing decision-makers (vs. low NFCC) are motivated to reduce discomfort associated with $DMU_{\sum}$. This directly correlates to increased overall SCP. A high NFCC purchasing decision-maker with the knowledge and experience to make consistently great decisions, exhibits higher SCP. This knowledge and experience includes efficient sorting and processing information (Kleinmuntz, 1990; Nonaka, 1994), information intensity scoping skills, and decision bias control.

The benefit of this study is the recommendation for firms to select knowledgeable and experienced high NFCC people who consistently make great decisions as their purchasing managers to achieve high SCP. Less experienced purchasing managers with

high NFCC who deliver low SCP need to be aware of high NFCC pitfalls to be better prepared for entry into the purchasing process. They may need training in the information intensity scoping, efficient sorting and processing of the purchasing information, and decision bias realization, to be experienced and achieve high SCP.

By reducing supply disruption risk through managing purchasing managers' high NFCC pitfalls, this study expects the buying firms to increase their SCP. The theoretical constructs and the framework illustrated in this study can also help managers better understand the scope of both problems and opportunities associated with decision-making processes.

CHAPTER II

LITERATURE REVIEW

This study reviewed the literature covering overall supply chain management (SCM). It focused on BSRs, $DMU_{\sum}$ and SCP. This study also reviewed the psychology and behavioral literature for the individual's NFCC. Although prior literature provides the theoretical foundation for this study, little guidance has been provided to operationalize the impact of NFCC on the supply chain decision-making aspects and assessment of the buying firm's SCP. The literature taxonomy is provided in Table I.

Table I: Literature review taxonomy

Author	Foundation	BSRs	NFCC	$DMU_{\sum}$	SCP
Achrol, R. S. and Stern, L. W. (1988)				*	
Agor, W. H. (1984)			*	*	
Ahire, S. L. et al. (1996)	*				
Anderson, J.C. and Gerbing, D.W.(1988)	*				
Aramyan, L. H. *et al.* (2007)					*
Armstrong, J.S. and Overton, T.S.(1977)	*				
Beamon, B. M. (1999)					*
Bello, D. C. and Gilliland, D. I. (1997)					*
Bentler, P. M. (1989)	*				
Bentler, P. M. and Bonett, D. G.(1980)	*				
Brislin, R. (1970)	*				
Brockmann,N. and Simmonds,G.(1997)			*	*	*

Author	Foundation	BSRs	NFCC	$DMU_{\sum}$	SCP
Brossard, H. L. (1998)				*	
Byrd, T. and Turner, D. (2001)	*				
Cachon, G. and Lariviere, M. (1999)					*
Carr, A. S. and Pearson, J. N (1999)		*			*
Chen, I. J. *et al.* (2004)		*			*
Chen, I. J. and Paulraj, A. (2004a)		*		*	*
Chen, I. J. and Paulraj, A. (2004b)		*			*
Chirumbolo, A. and Areni, A. (2010)			*		
Chirumbolo, A. *et al.* (2004)			*		
Choi, J. A. *et al.* (2008)			*		
Choi, Thomas Y. (2003)	*				
Christopher, M. (1998)					*
Chun, W. Y. *et al.* (1998)					*
Clay, W. D. (1997)	*				
Craig, S. and Gunter, H. (2006)					*
Craighead, C. W. *et al*. (2007)				*	
Croson, R. and Donohue, K. (2006)	*				
Dillman, D. A. (1978)	*				
Duncan, R. B. (1972)				*	
Dwyer, F. R. et al. (1987)		*			
Eisenhardt, K. M. (1989)			*	*	
Ellis, S. C. *et al.* (2010)			*	*	
Fawcett, S. E and Clinton, S. R. (1996)					*
Feldman, M. S. and March, J. G. (1981)	*				
Flynn, B. B. *et al.* (1993)	*				
Fornell, C. and Larcker, D (1981)	*				
G. Kwon, I. W. and Shu, T. W. (2004)		*			*
Gao, T. *et al.* (2005)		*		*	
Ganesan, S. (1994)		*		*	
Giunipero, L. *et al.* (1999)				*	
Haffer, R. and Kristensen, K. (2008)	*				
Håkansson, H. et al. (1976)				*	
Hatcher, Larry (1994)	*				
Heide. J. B. and Weiss, A. M. (1995)				*	
Houghton, D. C. and Grewal R. (2000)			*		
Houghton, D.C. and Kardes, F.R. (1998)			*		
Isenberg, D. J. (1984)			*	*	
Janelli, R. L. (1993)	*				
Joreskog, K. G. and Sorbom, D. (1989)	*				
Josh, A. Arnold (2007)			*		
Joshi, A. W. and Stump, R. L. (1999)		*		*	
Kardes, F. R. *et al.* (2002)			*		
Klassen, R. D. and Jacobs, J., (2001)	*				
Klein, S. and Roth, V. J. (1993)				*	
Kleinmuntz, B. (1990)	*				

Author	Foundation	BSRs	NFCC	$DMU_{\sum}$	SCP
Kohli, A. (1989)				*	
Kossowska, M. *et al.* (2002)	*		*		
Kruglanski, A. W. (1989)			*		
Kruglanski, A. W. et al.(1993)			*		
Kruglanski, A. W. and Webster, D. M. (1996)			*		
Kruglanski, A. W. (2000)			*		
Kruglanski, A.W. (2004)			*		
Kruglanski, A.W. and Chun, W.Y.(2007)			*		
Kroglanski, A. W. *et al.* (2007)			*		
Lai, K. H. *et al.* (2008)				*	
Lapide, L. (2000)					*
Lederer,A.L and Smith,G.L.Jr (1988/89)			*	*	
Lee, H. *et al.* (1997a)	*				
Lee, H. *et al.* (1997b)	*				
Lorenzi, P. (1980)				*	
Lorenzi, P. *et al.* (1981)				*	
M. Hsiao, J. M. (2006)				*	*
Mannetti, L. *et al.* (2007)			*		
TMarch, J. G and Shapira, Z (1987)			*	*	
Meier, R. L. *et al.* (1998)		*			
Morgan, R. M. and Hunt, S. D. (1994)		*		*	
Moriarty Jr., R. T. and Spekman, R. E. (1984)				*	
Mulaik, S. A. *et al.* (1989)	*				
Napoleon, L. (1994)	*				
Nonaka, I. (1994)	*				
Noordewier, T. G. *Et al.* (1990)				*	
Patterson, J. L. and Forker, L. B. (1995)		*			
Peterson, R. S (2003)			*	*	
Pierro, A. *et al.*(2004)			*		
Raven, R. V. *Et al.* (1994)				*	*
Ringle, C.M. *et al.* (2005)	*				
Rosenzweig, E. D. (2009)	*				
Sanders, N. R. (2007)	*				
Saunders, M. *et al.*(2003)	*				
Scholten, L. *et al.* (2007)			*	*	
Schweitzer, M. E. and Cachon, G. P. (2000)	*				
Sezen, B. (2008)					*
Sinaiko, H. W. and Brislin, R. W. (1973)	*				
Smeltzer, L. R. (1997)		*			
Smith J. B. and Barclay, D. W. (1997)		*		*	
Sogomonian, A. and Tang, C. (1993)	*				
Spekman, R. E. et al. (1985)		*		*	
Stalder, Daniel R. (2010)			*		
Steckel, J. H. *et al.* (2004)	*			*	
Sterman, J. D. (1989)	*		*	*	*

Author	Foundation	BSRs	NFCC	$DMU_{\sum}$	SCP
Sterman, J. D. (2000)	*				
Suh, T. W. *et al.* (2005)		*			
Sullivan, J. and Peterson, R. (1982)		*			
Tsikriktsis, N. (2005)	*				
Vermeir, I. and Kenhove, P. V. (2005)			*		
Vermeir *et al.* (2002)			*	*	
Voss, C.A. (1990)	*				
Wagner, R. K. (1987)			*	*	
Webster, D. M. and Kruglanski, A.W. (1994a)			*		
Webster, D. M. and Kruglanski, A.W. (1994b)			*		
Webster, D. M. and Kruglanski, A. W. (1998)			*		
Webster, D. M. *et al.* (1996)			*		
Webster, D. M. *et al.* (1997)			*		
Williams, A. J. (1998)	*			*	
Williamson, O. (1979)				*	
Wilson, D. T. (1971)			*		
Wisner, J. D. *et al*. (2008)					*
Yates, J. F. *et al*. (1994)			*		
Zaheer, A. and Venkatraman, N. (1995)				*	
Zsidisin, G. A. (2003)			*	*	

* means the particular topic was discussed in the particular article. For example, the first asterisk means supply management was discussed in Achrol and Stern, 1988.

2.1. Buyer-Supplier Relationships (BSRs)

Buyer-supplier relationships (BSRs) have long been a popular topic of purchasing, industrial marketing, and strategy and policy research due to their importance in promoting desired economic behavior from suppliers and customers and in managing the inefficiencies of the exchange process that can increase the cost of conducting business (Patterson and Forker, 1995). As buyer-supplier alliances or partnerships are becoming more important, much of the literature has analyzed the various factors and characteristics of successful cooperative BSRs. Smeltzer (1997) addresses *trust* as an important variable in the development and maintenance of relationships. Sullivan and Peterson (1982, p. 30) summarize the role of trust as "… where the parties have trust in

one another, then there will be ways by which the two parties can work out difficulties such as power conflict, low profitability, and so forth." Meier et al. (1998) state that shared trust, mutual commitment, and long-term cooperation lead to sustaining relationships. Carr and Pearson (1999) suggest the importance of strategic purchasing along with the importance of cooperative relationships with key suppliers. Chen and Paulraj (2004a) provide numerous critical components, which can foster greater commitment and trust in BSRs: 1) Supplier Base Reduction, 2) Long-term Relationship, 3) Communication, 4) Cross-functional Teams, and 5) Supplier Involvement.

2.2. Consolidated Buyer Decision-Making Uncertainty (DMU_{Σ})

Uncertainty is a psychological state that results primarily from a lack of adequate information or knowledge (Duncan, 1972). It is not merely change or the rate of change, but unpredictable change, in variables that affect critical dependent relationships (Lorenzi, 1980, 1981).

Decision-making uncertainty (DMU) is the degree to which an individual or organization cannot anticipate or accurately predict the environment. DMU is defined as "…the degree to which an individual or organization cannot anticipate or accurately predict the environment" (Ganesan, 1994). The study suggests two components of DMU: 1) *environmental volatility,* which relates to the rapidity and velocity of specific market or customer demand changes and 2) *environmental diversity,* which pertains to uncertainty in the competitive environment. According to the theory of transaction cost analysis, DMU is another key factor to consider in formulating governance decisions. It

is defined as the inability to predict partner behavior or changes in the external environment.

Håkansson et al. (1976) suggest three generic attributes of buyer uncertainty based on perceived demand: (1) need uncertainty, which relates to difficulties of interpreting the exact needs and wants; (2) market uncertainty, which involves concerns about developing commitments with particular suppliers; and (3) transaction uncertainty, which involves problems of compatibility of process between the buyer and suppliers with regard to technology, delivery ability, etc.

Considering the fast-paced business environment, purchasing managers can be uncertain about when they have adequate information for making future decisions regarding the amount of materials they should purchase from their suppliers and how confident they are in their ability to make future decisions (Morgan and Hunt, 1994. Uncertainty in decision-making refers to the extent to which a purchasing manager (1) has enough information to make key decisions, (2) can predict the consequences of those decisions, and (3) has confidence in those decisions (Achrol and Stern, 1988).

From the literature review, this study identifies four uncertainty attributes in OM research: 1) environmental uncertainty, 2) business uncertainty, 3) buyer decision-making uncertainty, and 4) operational uncertainty (Chen and Paulraj, 2004a; Lai et al., 2008; Gao et al., 2005; Achrol and Stern, 1988).

2.2.1. Environmental Uncertainty

Environmental uncertainty is defined as the extent that uncertainty decreases as an industry matures; the benefits that accrue to integration presumably decline (Williamson

1979). Environmental uncertainty increases a firm's information requirement (information intensity) to deal with the uncertainties.

The review of the marketing channel literature has suggested that DMU is a related, but separate construct to environmental uncertainty (Raven et al., 1994). Consumer diversity and perceived environmental dynamism had increasing effects on DMU, while increased concentration and capacity had a lowering effect (Achrol and Stern, 1988). Chen and Paulraj (2004a) propose three different sources of environmental uncertainty: 1) supply uncertainty, 2) demand uncertainty, and 3) technology uncertainty. Supply uncertainty includes indicators that represent quality, timeliness, and the inspection requirements of the suppliers. Demand uncertainty is measured in terms of fluctuations and variations in demand. Technology uncertainty measures the extent of technological changes evident within the industry.

2.2.2. Business Uncertainty

Business uncertainty is defined as unanticipated changes in business circumstances surrounding an exchange such as product availability (Noordewier et al., 1990). Business uncertainty has been commonly employed as a determinant of transaction costs in the behavioral decision theory literature on pressures for vertical integration (Zaheer and Venkatraman, 1995). From the buyer's perspective, business uncertainty is about the difficulty in predicting the outcomes of a purchase decision (Kohli, 1989). Lai et al. (2008) examine the dynamics of channel relationships under business uncertainty, looking into the moderating effect of business uncertainty on the relationships between trust and commitment.

2.2.3. Buyer Decision-Making Uncertainty

DMU measures variances in predicting purchase decision outcomes in terms of the likely benefits and costs (Duncan, 1972; Kohli, 1989). Gao et al. (2005) measure buyer decision-making uncertainty (DMU) through multiple indicators; 1) the buyer trust, 2) buyer-perceived supplier trust, 3) buyer-perceived supplier commitment, and 4) buyer-perceived supplier dependence. They developed a conceptual model on whether the organizational buyer's DMU can be reduced by the buyer's perceptions of supplier trust, commitment, and dependence and proved the relationship between "Relationship factors" and "Buyer's DMU", with "Relationship factors" used as exogenous factors and "Buyer's DMU" as an endogenous factor. Findings suggest 1) a negative effect of buyer's trust in the supplier on their uncertainty in purchase decisions, 2) buyer's trust can be enhanced if the buyer perceives the suppliers to be trusting of the buyer and if the buyer perceives the suppliers to be highly committed to the relationships, and 3) buyer's perception of the supplier's dependence does not significantly increase the buyer's trust, but it does have a direct effect on DMU.

2.2.4. Operational Uncertainty

DMU is defined operationally at the level of three derived concepts (Duncan 1972; Achrol and Stern, 1988; Raven et al., 1994): 1) the adequacy of available information from all sources for making a key decision, 2) predictability of the consequences of these decisions, that is, the gain or loss to the organization if the

decision is correct/incorrect, and 3) the degree of confidence of the decision-maker when making these decisions.

Measuring DMU is a complex issue, containing an abundance of possible metrics that in many cases also are interrelated. Therefore, this study consolidates the four uncertainty measures articulated above (environmental, business, buyer decision-making, and operational) into the $DMU_{\sum}$ construct as part of the theoretical model.

2.3. Need For Cognitive Closure (NFCC)

Need for (nonspecific) cognitive closure (NFCC) is a variable dependent on each individual's personality that measures the decision-makers' information requirements in the supply chain process. NFCC is defined as the desire for a firm answer to a question, as opposed to uncertainty, ambiguity, or confusion (Kruglanski, 1989, 2004). There are significant differences between individuals with high and low NFCC with regard to the amount of information sought (information intensity), the amount of information used, the use of decision rules, and the level of confidence in their decisions (Vermeir et al., 2002). Time pressure creates a heightened NFCC (Kruglanski, 2004). A high NFCC individual has a desire to have closure urgently and maintain it permanently. Hence, individuals with a high NFCC tend to urgently seize the information to permit a judgment on a topic of interest, ultimately resulting in the freezing of information on such a judgment (Kruglanski and Webster, 1996). NFCC is an independent variable that influences risk tolerance and other dependent variables. In general, as NFCC increases, anything that could potentially delay closure, like unpredictability, uncertainty, or risk, is

perceived as “bothersome” in Kruglanski’s words, and is disliked more as a deadline approaches. Individuals with higher NFCC exhibit high preference for predictability and little preference for ambiguity to avoid risk tolerance (Kruglanski and Webster, 1996). When an individual is faced with a judgment, people with high NFCC exhibit more autocratic decision-making patterns; they are less tolerant of uncertainty and more likely to make a quick, firm, and final decision through quick and confirmatory information compared to those with low NFCC (Kruglanski and Webster, 1996; Houghton and Grewal, 2000; Kruglanski and Chun, 2007). Houghton and Grewal (2000) show the significance of the NFCC construct in a (consumer) behavior context; the study empirically tests and proposes that individuals with strong “importance of product to self (IPS)” and a high NFCC would engage in the least amount of information. Their findings suggest that an individual with a high NFCC does not want to waste time, and, hence, delay closure by conducting a lengthy information search. According to Choi et al. (2008), high NFCC individuals prefer the attribute-based search (so-called compensatory rule) over the alternative-based search (non-compensatory rule) and seek smaller amounts of information. Most relevant to the present study, the status quo preference of high NFCC individuals is also supported by the results of a study concerning reactions to normative violations (Pierro et al., 2004). This shows that high NFCC scores are associated with more aggressive responses to normative violations. Mannetti et al. (2007) tested the hypothesized role of NFCC in experiencing regret after decision choices between status-quo and non-status-quo alternatives.

2.4. Supply Chain Performance (SCP)

A simple definition of good SCP is to get the right product to the right place at the right time at the lowest cost. SCP is the effectiveness and value of the supply chain. Another definition of SCP is the degree to which a supply chain fulfills all participants' requirements, including buyer and supplier, measured at any point in time using relevant performance indicators (Aramyan et al., 2007). The strategic purchasing function is described as a part of the firm's strategic planning process and has a positive impact on firm performance (Carr and Pearson, 1999). SCP and effective management of supply chains have been increasingly recognized as critical factors in gaining competitive advantage for firms (Christopher, 1998; Simchi- Levi et al., 2000). High levels of trust, strong commitment, and extensive information sharing among supply chain partners are key elements to achieving successful supply chain performance (G. Kwon and Suh, 2004).

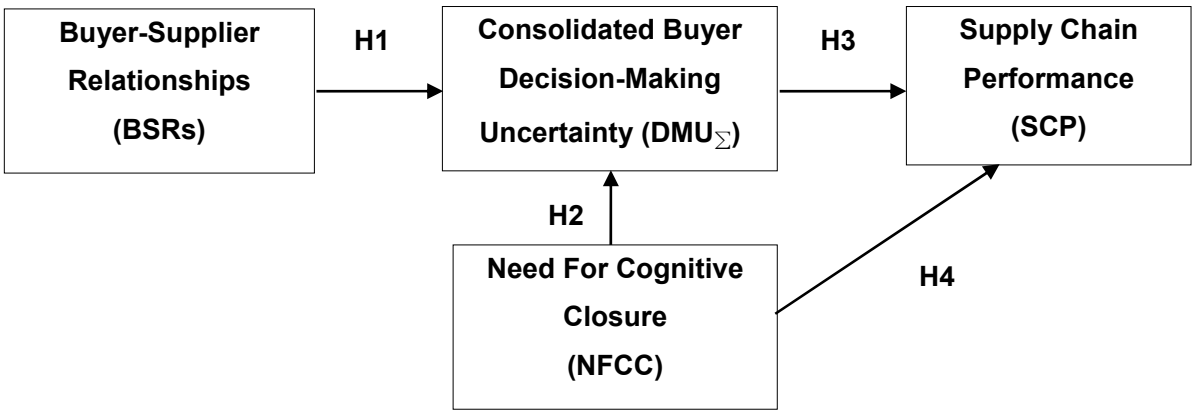
Though the concept of organizational performance measurement is widely accepted, it is not widely adopted yet. Few have provided practical advice to firms seeking to develop such a SCP measurement, even though several studies have developed a conceptual model for the selection of performance measures for the supply chain systems (Beamon, 1999; Lapide, 2000; Chen and Paulraj, 2004a; Craig and Gunter, 2006; Sezen, 2008).

CHAPTER III

THEORETICAL MODEL AND HYPOTHESIS

Although there is growing evidence from organizational scholars, as seen in the literature review and the taxonomy given in Table I, of connections between specific individual traits with particular group processes and their effect on the firm performance, no study specifically investigates these. This is probably due to the level of difficulty in collecting appropriate data concerning those connections. This study investigates the effects of BSRs on SCP and how they are mediated by $DMU_{\sum}$. This study also examines the direct and indirect effects of NFCC on SCP. Figure 1 presents the model examined in this research.

Figure 1: Proposed theoretical model



3.1. BSRs – DMU∑

The literature has identified the connections between BSRs and DMU∑. It suggests that trust decreases a partner's uncertainty of decision-making because the trusting partner has confidence that the trustworthy party can be relied on. Håkansson et al. (1976) suggest that communication may aim at decreasing or increasing perceived decision-making uncertainty between buyer and suppliers. BSRs involve analogous benefits and costs; those include reduced uncertainty, managed dependence (Spekman et al., 1985; Dwyer et al, 1987).

Trust reduces DMU (Gao et al., 2005; Morgan and Hunt, 1994). Gao et al. (2005) suggest that when the buyers perceive their suppliers as trustworthy, they report lower DMU. Their model shows that relational factors are an antecedent to buyer DMU in the purchasing organization. The findings suggest that the buyer's trust in the supplier plays a pivotal role in reducing buyer DMU. This study posits that relationship commitment will reduce DMU. As trust grows between the buyer and the supplier, we expect uncertainty

to decrease, as both the buyer and supplier feel that their partners are more likely to take actions consistent with the trusting party's best interest. As such, mutual trust and commitment help both the buyer and the supplier to have less uncertainty in their purchase and supply decision-making process.

Since this study targets highly experienced purchasing decision-makers, it posits that their behavioral uncertainties are adequately indicated by $DMU_{\sum}$ and the level of uncertainty is the direct result of trust with their business partners (Morgan and Hunt, 1994; Joshi and Stump, 1999). Therefore, it is hypothesized that there is a negative relationship between BSRs and $DMU_{\sum}$.

H1. *There is a negative relationship between BSRs and* $DMU_{\sum}$

3.2. NFCC – $DMU_{\sum}$

NFCC refers to the way in which individuals approach and reduce cognitive uncertainty (Kruglanski and Webster, 1996). Findings from the studies in the psychology of individual choice have suggested that individuals with high NFCC are motivated to reduce the discomfort associated with uncertainties in decision-making as fast as possible, usually by seizing on whatever cognitive cues and information is easily available in an effort to achieve clarity. The literature has identified the connections between the individual's NFCC and $DMU_{\sum}$. Wilson (1971) suggests that an individual's need for certainty and information may be a good predictor of his decision-making style. Information sharing has a direct, negative relationship with DMU by virtue of its definition; best practices in information sharing should reduce DMU. High need for information is associated with conservative decision-making. Conversely, low need for

certainty and information is associated with normative decision-making. Individuals with a low need for information may be able to accept uncertain alternatives without experiencing discomfort. The findings also suggest that individuals with high dispositional NFCC consider less relevant information before making a judgment, expect to be more confident in their judgment, and to require less time to form it. Williams (1998) offers some solution to the structure problems from his consumer behavior research. He mentions the "intelligence phase" as one solution that involves collecting information, internally and externally, that allows the decision-maker to form a frame of reference concerning the basic issue. Digesting information from multiple sources encourages the consideration of numerous options that otherwise would have gone unnoticed. Brossard (1998) evaluates the behavior of organizations in search of information during a complex decision process. He sets three phases (recognition of need, search for alternatives, and vendor-selection) used by Moriarty and Spekman (1984) during his interviews. The results indicate that the importance of information sources depends on the phases of the decision process. Their work also indicates that personal commercial sources, such as salespeople and trade shows, are systematically considered more important than impersonal sources, such as advertising in trade publications, sales literature, or news publications during a decision process. Giunipero et al. (1999) examine the use of "tacit knowledge" in making purchasing decisions. Tacit knowledge refers to explicit knowledge that is transferable, informal, systematic language (e.g., practical intelligence, know-how about the real world, a personal competence, or thinking in practice; Nonaka, 1994). The result implies that purchasing managers are willing to use tacit knowledge and common sense in making decisions (e.g., their own experience

and knowledge base). Further, purchasing managers feel comfortable using their own common sense to fill in the gaps caused by incomplete or lacking information.

NFCC varies not only across individuals but also across situations. The tendency toward cognitive closure is elevated in situations in which the importance of taking action and making a decision looms large, such as time constraint situations (Kardes et al., 2002), mental fatigue (Webster et al., 1996), or alcohol intoxication (Webster and Kruglanski, 1994a). For example, people are more inclined to draw conclusions and avoid uncertainty and ambiguity under time pressure than they would be otherwise. Kardes et al. (2002) also suggest that NFCC moderates the effects of consideration set evaluation processes on choice deferral in that more choice deferral is found in comparative (vs. singular) judgment tasks with low (vs. high) NFCC. Steckel et al. (2004) proposed that it is crucial to begin a systematic research effort aimed at understanding the efficacy of reengineering the traditional supply chain under various environmental scenarios where the critical role of human judgment, decision-making, and the interaction between these factors affect the uncertainty. Their findings suggest that sharing information between buyer and supplier is unambiguously beneficial in a step-up demand pattern, however, when the demand pattern was S-shape, sharing information actually hurt performance. Croson and Donohue (2006) suggest that buyer perception of supply disruption risk are not solely a result of operational complications, but also a result of cognitive limitations on the part of managers and difficulties inherent in managing a complex dynamic system. Mannetti et al. (2007) tested their hypothesized interactive effect of NFCC by comparing people with high NFCC to people with low NFCC. They found that high NFCC people perceive the non-status-quo choice as less

"normative" and would produce a larger amount of counterfactual thinking leading to more post decisional regret. Lederer and Smith (1988/89) explore that individual differences play a role in a real-world decision-making task using different levels of aggregation of information. Their finding reveals that experienced managers prefer more rather than less information. They strongly prefer more disaggregate information.

NFCC concepts have been investigated a considerable number of times in relation to information processing and other decision-making variables. A common idea is that those with high NFCC experience discomfort about uncertainty but require less time to make a confident decision. They tend to ignore multiple perspectives and stick to initial conclusions without sufficient adjustments. Their confident decisions may be suitable in a rapid changing business environment, while judgmental errors and biases may be aggravated with high NFCC. Therefore, it is hypothesized that individuals with NFCC are motivated to reduce $DMU_{\sum}$ based on acceptable perceived risk.

H2. *Individuals with NFCC are motivated to reduce* $DMU_{\sum}$

3.3. $DMU_{\sum}$ – SCP

Literature has focused on various aspects of uncertainty that could affect SCP. Klein and Roth (1993) examine satisfaction in the international marketing channel with economic performance. Their findings show that a firm's domestic performance, previous experience, uncertainty, and ability to change and monitor marketing channel operations, provide significant explanations for management satisfaction. Raven et al. (1994) suggest that higher levels of DMU will have a greater negative effect on performance in export channels than in domestic channels; the hypothesis of "economic performance in the

export channel was negatively related to DMU" is supported ($p<.05$). G. Kwon and Suh (2004) also suggest that more information is needed to convince decision-makers that the supply chain implementation improves their operational performance. The study proposes that both satisfaction and performance are adversely affected by uncertainty. Present research contends that relationship behavioral factors play an important role in increasing or mitigating channel members' perceived uncertainty in their supply or purchase decision-making. M. Hsiao (2006) suggests in his thesis that a retailer/supplier's DMU can erode the performance of the supply chain and highlights the need for efficiency and effectiveness improvements in some areas of the supply chain. Suh et al. (2005) propose that DMU is mediated by the relationship between a specific asset investment (SAI) and three dependent variables: commitment, trust, and conflict in an exchange relationship.

Uncertainty is the unpredictability of the tasks in a specific environment. Uncertainty would appear to hamper the effectiveness of the purchasing process, and thus negatively relate to buyer SCP. Therefore, it is hypothesized that $DMU_{\sum}$ has a negative influence on overall SCP.

H3. *$DMU_{\sum}$ has a negative influence on overall SCP*

3.4. NFCC – SCP

The literature presents various viewpoints about the relationships between NFCC and SCP. Traditional NFCC research has suggested that an individual with a higher NFCC will make more errors than an individual with a lower NFCC, having a negative impact on overall supply chain performance (Chun et al., 1998). Croson and Donohue (2006) studied the behavioral causes of supply disruption risk. The study proposes that

cognitive limitations contribute to increase risks of supply disruptions that lead to the bullwhip effect. Results from the study suggest that the bullwhip effect is not solely a result of operational complications, but also cognitive limitations of managers and difficulties inherent in managing complex dynamic systems. However, it found that information counteracts the bias and improves performance.

Other studies have identified differing roles of NFCC on performance. According to Vermeir et al. (2002), individuals with low NFCC used more variable patterns of decision rule usage. Individuals with high NFCC used the same decision rules for successive choice decisions since they achieved much success. They confront new (or uncertain) situations by immediately searching for a large volume of information on their choice problem to enable them to make a clear and confident decision. When they make a decision, they use many attributes to compare products because they are not certain whether they are using the right decision rules. They believe that the resulting decision rules let them make high-quality decisions (Vermeir et al., 2002). Josh (2007) proposes that managers with a high NFCC are more likely to use an autocratic procedure to resolve conflict. These resolutions produce win–lose results and quickly set direction. Findings from Chirumbolo and Areni (2010) suggest that experienced managers with high NFCC positively correlate to increased firm performance because higher NFCC through experience creates a buffering effect in conditions of higher insecurity. In this case, experienced managers with high (vs. low) NFCC report better job performance. Therefore, it is hypothesized that an individual with NFCC correlates to increased SCP based on acceptable timing.

H4. *Individuals with NFCC correlates to increased SCP*

CHAPTER IV

RESEARCH DESIGN AND METHODOLOGY

At this point, this study has derived the model from literature review, made four hypotheses, and devised a measurement system to collect and segment the data for analysis. This section is divided into two parts: 1) survey design and 2) the sample. The study uses the questionnaire appendixed.

4.1. The survey

The survey instrument was developed based on a broad review of the literature. The review examined literature in the areas of strategic purchasing, supply management and behavior management. The survey instrument contained 99 survey questions in four different sections measuring on a seven-point Likert scale. All questions used in this study were adapted from previous literature.

The survey instrument was initially pre-tested with a sample of 33 firms to gauge the time required for completion and to ensure that the questions were relevant and easy to understand. Modifications were made to the survey instrument based on the pretest results (see details in Section 5.2).

This study used a mixed-mode survey combining web, email, and postal mail. This mix of on-line and off-line sampling was conducted to maximize response rate (Klassen and Jacobs, 2001; Saunders et al., 2003).[*] Following Dillman's (1978) survey methodology, initial mails were followed by reminder postcards after 2 weeks and follow-up phone calls. This study encouraged the participants to choose one of the following three survey methods: 1) the web-survey, 2) email, or 3) direct mail where we enclosed a survey instrument along with a return envelope.

To design a survey instrument that could be used in South Korea, translation of questionnaires were made following the standard translation–back translation method cited in cross-cultural research to ensure the equivalence of meanings (Brislin, 1970; Sinaiko and Brislin, 1973). Checking for the cross-cultural invariance of NFCC, the study of Kossowska et al. (2002) supported the generalizability of NFCC across cultures. Their findings revealed that the NFCC has the same basic meaning and structure cross-nationally in the American and Asian samples including South Korean. Two experienced OM researchers from South Korea initially reviewed the translation of the survey.[**] The Korean version showed an acceptable level of reliability (Cronbach's alpha = 0.89). There was no assurance that a more general questionnaire could be developed.

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[*] Evidence presented at the American Association for Public Opinion Research (AAPOR, 2009) conference suggested that one particular mode combination, mixing mail and web, might prove useful in extending the coverage of the survey and increasing the response rates.

[**] Moon, J. B., Konkuk University, Korea (also helped postal mail collection) ; Choi, K. H., Hansung University, Korea

4.2. The sample

The survey was taken in South Korea. Business executives in Asia's developing countries have been surveyed numerous times on common business practices of the region for OM research (Voss, 1990; Flynn et al., 1993; Clay, 1997 and others). South Korea is large enterprise oriented, but has also been developing small and medium enterprises (SMEs) in recent decades (Choi, 2003). Buying firms in South Korea were qualified for this study's survey sample and were very responsive to our requests by the ROK Army's official request for cooperation. This study surveyed large, medium, and small sized buying firms (under the two-digit Standard Industrial Classification (SIC) codes range from 15 to 73 which cover most industry) contained within two prominent Korean national business directories: 1) Korea Chamber of Commerce and Industry (KCCI) list was used for large firms with 250 or more employees. 2) Korea Federation of Small and Medium Business (KBIZ) list was used for small and medium sized firms with less than 250 employees. Considering that South Korea's defense industry is also widely developed, this study obtained a list of firms engaged in Military logistics/acquisition from the Defense Acquisition Program Administration (DAPA) and added it to the sample frame.

From the above sample, this study first identified higher-level managers in charge of purchasing decisions following the same procedure as Carr and Pearson in 1999. A list of 1,895 potential respondents were developed using the KCCI, KBIZ and DAPA directories in various industries. We sent the survey two times in late May to June 2010 followed by reminder postcard.

Of the 1,895 surveys mailed, 142 surveys had incorrect contact information and were returned incomplete by the postal service. 230 surveys were received, of which 15 surveys were unusable due to lack of responses on the survey or inconsistent data, and 14 surveys were excluded due to the responses coming from inappropriate non-targeted personnel. Thus yielding a sample size of the 201 surveys used in this study. The response rate was 12%. This 12% response rate was consistent with Byrd and Turner (2001) and Sanders (2007) survey sampling of higher-level managers. Accordingly, the analysis that follows and all reported statistics were based on a sample of 201 buying firms.

Responses were collected from a wide range of firms based on types of industry served (based on SIC) and products sold. The majority of firms returning our surveys were from electrical/electronic equipment with 48 usable responses (24%). Miscellaneous machining returned 26 usable responses (13%). Military logistics/ acquisition returned 23 usable responses (11.5%). Gross sales was used as an indicator of a firm's financial size. 83 firms (52.5%) had gross sales below $100 million. 32 firms (16%) had between $100 million to $500 million. 64 firms (31.5%) had gross sales over $500 million dollars.

Responses from firms represented gross sales dollars and number of employees. The majority of the respondents held positions at the President or CEO level in their respective firms (42%). This reflects the cultural philosophy in Korea where important decisions are typically made by high-level managers after some team discussions (Janelli, 1993). Table II presents the results of each section.

Table II: Sample demographics

Segmentation	Frequency	Percentage
Industry groupings (SIC code)		
Electrical/electronic equipment (36)	48	24
Miscellaneous manufacturing (39)	26	13
Military logistics/acquisition (39)	23	11.5
Service industry (72/73)	16	8
Automotive/parts manufacturing (37)	15	7.5
Fabricated metal (34)	14	7
Communication related manufacturing (48)	10	5
Machinery manufacturing (35)	7	3.5
Transportation/equipment manufacturing (37)	6	3
Computer/equipment manufacturing (35)	5	2.5
Apparel manufacturing (23)	5	2.5
Food manufacturing (20)	5	2.5
Wood or Paper product manufacturing (24/26)	5	2.5
Medical equipment (38)	5	2.5
Construction (15/16)	4	2
Chemical (28)	3	1.5
Printing supplies manufacturing (27)	1	0.5
Rubber and plastic (30/31)	1	0.5
Other (39)	2	1
Sales volume		
< 50 million	62	42
51 – 100 million	21	10.5
101 – 500 million	32	16
501 – 1,000 million	11	5.5
Over 1 billion	53	26

Number of employees		
< 25	61	30
25 – 100	52	26
101 – 250	39	19.5
251 – 500	4	2
501 – 1,000	7	3.5
Over 1,000	38	19
Respondent title (decision-maker/ members)		
President	38	19
CEO	47	23
Vice-president	13	6.5
Director	28	14
General manager	34	17
Senior Manager	18	9
Other	23	11.5
Number of main suppliers		
< 5	41	20
5 – 10	57	28.5
Over 10	103	51.5

CHAPTER V

DATA ANALYSIS

This study tested non-response bias. The method was tested for significant differences between early and late received surveys based on the assumption that the opinions of late respondents are representative of the opinions of non-respondents (Armstrong and Overton, 1977). The first 30 survey responses received were compared to the last 30 responses received. *t*-tests using a random variable, such as number of employees, shows that no statistical significant differences were found at 5% level (*t*-value = 1.36).

In order to improve the treatment of missing data in model-based procedure, expectation maximization technique was used (Tsikriktsis, 2005).

There were very few instances (14) of missing data from sample surveys. This study pulled those surveys out and compared them to the complete surveys. No significant difference were found between the two samples (chi-square differences were found to be insignificant: chi-square = 6.45, $p > 0.05$). Then, missing data were replaced with values obtained through the expectation maximization algorithm, since this method

has been shown to be better than other substitution and elimination techniques (Hair et al., 1998).

5.1. Scale development

The scale items used to measure each of the constructs were derived from an extensive review of literature and were adapted from the literature. There were 19 factors split among the 4 constructs of the theoretical model. This study formed a composite DMU_{Σ} index by averaging responses to these measures (after reverse scoring the DMU_{Σ} measures, which this study assumed to be related inversely to other constructs; Webster et al., 1997). Measures are presented in the Appendix.

5.1.1. BSRs

The Chen and Paulraj (2004a) tightened up model incorporates some key aspects of BSRs including: 1) supply base reduction, 2) long-term relationships, 3) communication, 4) cross-functional teams, and 5) supplier involvement. This study follows the same measurement tool used by Chen and Paulraj (2004a) which was supported by high factor loadings.

5.1.2. DMU_{Σ}

From the literature review, this study found that four uncertainty indicators exist in the OM literature: 1) environmental uncertainty, 2) business uncertainty, 3) buyer decision-making uncertainty, and 4) operational uncertainty.

Chen and Paulraj (2004a) suggest that there are three forms of *environmental uncertainty* that plague supply chains: 1) supply uncertainty, 2) demand uncertainty, and

3) technology uncertainty. Using a slightly different meaning of environmental uncertainty, *business uncertainty* was defined as unanticipated changes in business circumstances surrounding an exchange (Lai et al., 2008). Gao et al. (2005) empirically tested buyer's perceptions of seller-side relational variables, since they reflect the buyers' interpretations of intent and performance of various relationship-building efforts by the supplier (*Buyer decision-making uncertainty*). In addition, Raven et al. (1994) measured *operational uncertainty* by the modification of the Achrol and Stern (1988) three-concept measure (see also, Duncan, 1972): information uncertainty, predictability of consequences, and confidence in decision-making.

DMU was adequately indicated by the four consolidated uncertainty indicators (environmental, business, buyer DM, and operational). Results from the factor analysis using pre-test data (n = 99) indicate that all four scale items were well loaded to the DMU $_{\sum}$ construct in the theoretical model with the factor loadings of 0.89, 0.65, 0.72 and 0.78 (Cronbach's alpha = 0.845) each. This result shows that the scale items have a strong relationship to each other with high internal consistency. The measure for DMU captures the degree of predictability of a partner's behavior for the respondent firm and measures the predictability of a partner's performance. The result supports the use of all four scale items to measure the $DMU_{\sum}$ construct.

5.1.3. NFCC

As a dispositional construct, NFCC is treated as a latent variable. Webster and Kruglanski (1994b) develop the Need for Closure Scale (NFCS), which consists of five subscales that help to develop an understanding of NFCC: 1) preference for order and

structure, 2) discomfort with ambiguity, 3) tendency toward decisiveness, 4) desire for predictability, and 5) closed-mindedness. The NFCS constitutes a 42-item self-report instrument designed to assess individual differences related to NFCC.

Webster and Kruglanski (1994b) used a 42-item scale for measuring NFCC. Although it was very thorough, it is quite cumbersome to employ in an experimental setting. Houghton and Grewal (2000) refined the 42-item scale down to 20 items. The 20 items consisted of four items for each of the five sub-constructs (Preference for Order and Structure, Preference for Predictability, Decisiveness, Discomfort with Ambiguity, and Closed-Mindedness). This study adopted use of this 20 item scale for NFCC.

Unlike the original study of Houghton and Grewal (2000), participants in this study rated each item on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) instead of six-point, because it will give a better normal spread of observations. Items 63, 64, 66, 67, 72, 73, 74, and 75 were designed to tap respondents' need to avoid closure; hence, these items are reverse scored (Webster and Kruglanski, 1994b).

5.1.4. SCP

High levels of SCP occur when the strategies at each of the firms fit well with overall supply chain strategies. Thus, SCP measures should be designed around each important supply chain activity and contain detailed performance descriptors instead of merely sales or cost figures (Wisner et al., 2008). SCP measures need to be closely aligned with buyers, suppliers, manufacturers, distributors, and end customers to improve

upon major problem areas identified by diagnostic assessments (i.e., performance of the supply chain in terms of effectiveness/efficiency/etc. as well as overall firm profitability).

An effective performance measurement is essential for SCM because it 1) provides the basis to understand the system, 2) influences behavior throughout the system and 3) provides information about the results of system efforts to the supply chain members and outside stakeholders (Fawcett and Clinton 1996). Researchers have found that measuring SCP in and of itself leads to improvements in overall performance (Bello and Gilliland 1997). A SCP measurement that focuses only on operational items or only on finance items is not sufficient (Chen and Paulraj, 2004b). Chen and Paulraj (2004a) indicate SCP is measured based on supplier operational performance, buyer operational performance, and buyer financial performance.

Researchers have suggested different types of measurements to evaluate SCP. This study adapts measures from Chen and Paulraj (2004a) since the indicators for this construct are integrated from the research: 1) supplier performance, 2) buyer operational performance, and 3) buyer financial performance. First, the supplier performance construct is measured by quality, cost, flexibility, delivery, and prompt response. The buyer performance is measured by indicators of operational performance; such as delivery speed, new product development time, delivery reliability/dependability, new product introduction and manufacturing lead-time. The financial indicators are measured by return on investment, profit, present value, and net income.

* The constructs, their measurement items, and the coefficient *a* levels are shown in Table V.

5.2 Pre-test

This study discovered that the model required two different units of analysis to address individual and firm performance behaviors. This study was going back and forth between individuals and firms as two different units of analysis throughout the paper. For instance, NFCC is at the individual level and then H2 and H4 are at the firm level. Mixing two units of analysis in one frame is possible when stated explicitly and the theoretical reasoning explained.

To examine the critical nexus between leader personality and firm performance behaviors, as well as to see if revision of the items and scales of the Web survey were needed (Rosenzweig, 2009), this study conducted a pre-test. With the support of the Korean government, this study was able to obtain lists of 92 potential buying firms in various industries to cooperate in the survey. The lists were officially passed through the DAPA to us. The pre-test survey targets two groups: 1) the final purchasing decision-makers (Group 1), and 2) the individuals who participate on its decision-making process (Group 2). Since each firm has different organization and structure, this study first contacted the person shown on the given list by phone (or email) to identify and profile the decision-making participants (Group 2). After completing that process with each firm, this study sent the survey two times in January to February 2010 followed by a reminder postcard to survey all the persons required in this study. For large size firms which have numbers of sub-divisions, this study randomly selected 2~5 persons (e.g., closest birthday from the date) to represent Group 2. This study was able to identify 66 (Group 2) persons from 33 sample firms. This study collected the required data from the initially identified 99 respondents from 33 sample firms with a response rate of 25.85% (99/383). Since

Peterson (2003) measured the relationship between CEO personality and Top Management Team (TMT) group with 9 firms sample data derived from quantitative sources, our 33 buying firms sample to the pre-test was sufficient to meet the research needs. Two ambiguous expressions due to the translation in the items and scales (SCP-1-8 and SCP-2-8) were found and revised to be understood. This study also found that those two groups (Group 1 and Group 2) are highly correlated with the average NFCC correlation coefficient of 0.721 (p-value < 0.001). This result gives validity to the study that a leader can represent firm performance, which correlates to previous findings (Peterson, 2003).

Participating 33 buying firms from multiple industries had an average sales volume in the rage of $101-500 million per year and an average number of employees in the rage of 251-500. Industries most frequently represented were electrical/electronic equipment and military logistics/ acquisition with 8 responses (24%) each. Respondents for Group 1 consisted of buying firm CEOs (46%). Respondents for Group 2 consisted of general manager (27%). Table III shows the pre-test profile of respondents.

Table III: Profile of pre-test survey respondents

Respondent title	Group 1 (33)	Group 2 (66)
President	8 (24%)	-
CEO	15 (46%)	6 (9%)
Vice-president	4 (12%)	1 (2%)
Director	3 (9%)	7 (11%)
General manager	3 (9%)	18 (27%)
Senior Manager	-	11 (16%)

Other	-	23 (35%)

To identify the survey items that correlate with each other, this study used the SAS PROC Corr procedure. The outcome of the correlation analysis was as anticipated, based on the survey pretest. The correlation matrix shown in Table IV presents all of the variables that were included in the model.

Figure 2: Empirical model estimated

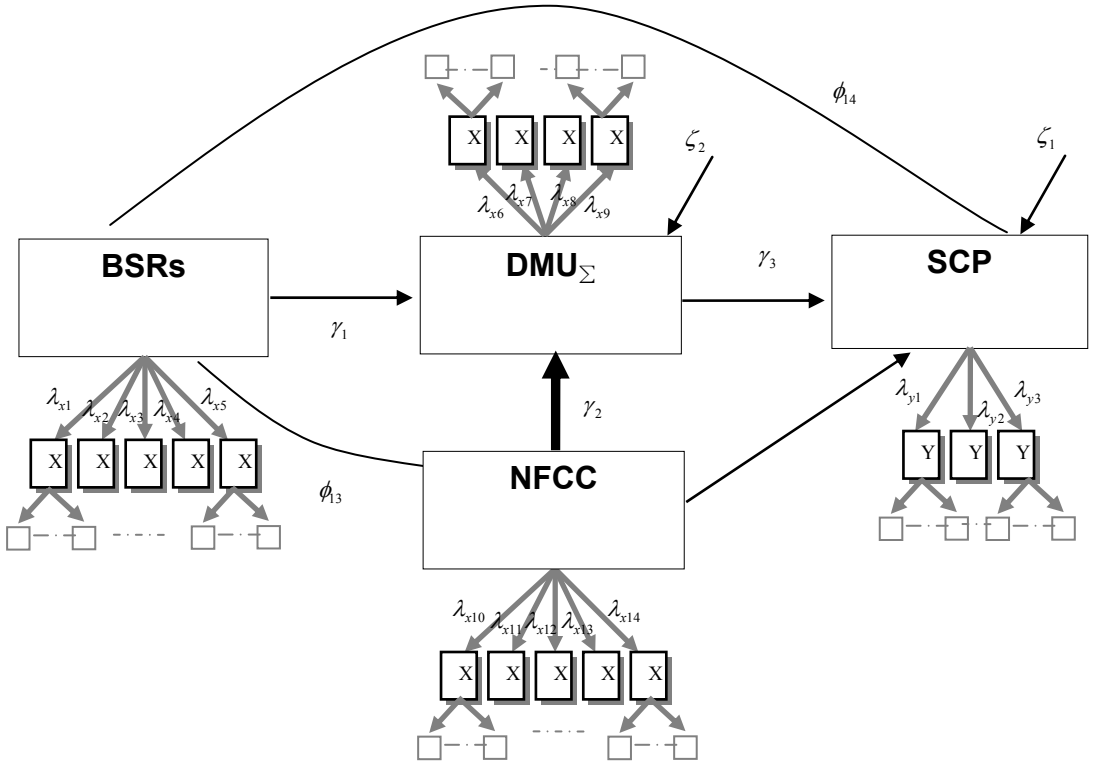


Table IV: Intercorrelations for manifest variables and descriptive statistics

VAR	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	Var9	Var10	Var11	Var12	Var13	Var14	Var15	Var16	Var17	Var18	Var19
Var1	1.000																		
Var2	0.725	1.000																	
Var3	0.688	0.783	1.000																
Var4	0.640	0.747	0.750	1.000															
Var5	0.741	0.737	0.774	0.735	1.000														
Var6	0.233	0.238	0.203	0.213	0.200	1.000													
Var7	0.255	0.273	0.230	0.188	0.228	0.624	1.000												
Var8	0.253	0.330	0.275	0.283	0.292	0.548	0.610	1.000											
Var9	0.202	0.289	0.205	0.197	0.182	0.573	0.648	0.547	1.000										
Var10	0.263	0.325	0.262	0.254	0.295	0.550	0.625	0.490	0.575	1.000									
Var11	0.122*	0.182	0.143*	0.159*	0.145*	0.466	0.598	0.538	0.417	0.471	1.000								
Var12	0.233	0.219	0.205	0.287	0.247	0.107*	0.158*	0.190	0.090*	0.078*	0.091*	1.000							
Var13	0.280	0.317	0.242	0.244	0.277	0.181	0.275	0.221	0.223	0.253	0.139*	0.442	1.000						
Var14	0.428	0.458	0.399	0.389	0.464	0.223	0.297	0.305	0.262	0.320	0.193	0.457	0.567	1.000					
Var15	0.443	0.433	0.399	0.412	0.424	0.211	0.439	0.297	0.284	0.327	0.212	0.381	0.495	0.628	1.000				
Var16	0.427	0.414	0.379	0.357	0.450	0.211	0.322	0.285	0.258	0.263	0.149*	0.454	0.512	0.703	0.634	1.000			
Var17	0.401	0.473	0.444	0.404	0.465	0.316	0.355	0.287	0.269	0.235	0.214	0.148*	0.256	0.428	0.340	0.391	1.000		
Var18	0.385	0.499	0.436	0.410	0.446	0.343	0.414	0.348	0.312	0.270	0.275	0.144*	0.204	0.373	0.304	0.434	0.723	1.000	
Var19	0.325	0.469	0.342	0.337	0.382	0.312	0.340	0.363	0.281	0.252	0.256	0.127*	0.229	0.363	0.299	0.352	0.654	0.714	1.000
MEAN	4.632	4.702	4.479	4.426	4.587	4.193	4.229	4.357	4.139	4.154	4.065	4.344	4.379	4.589	4.073	4.463	4.540	4.290	4.353
S.D.	1.164	1.233	1.227	1.178	1.203	1.051	0.794	0.715	0.995	0.716	0.978	0.875	0.806	0.979	0.931	0.977	0.960	0.919	0.995

n = 201. *Indicates the correlation is *not* significant at $p < 0.05$

5.3. Testing the hypotheses

As recommended by Anderson and Gerbing (1988), this study followed a two-step approach to causal modeling using the SAS system's PROC CALIS to test the latent variable models. The first step shows how to develop adequate measurement models. The second step shows how to test the (theoretical) causal models of interest. Within this approach, the first step involves use of confirmatory factor analysis (CFA) to develop an acceptable measurement model. By testing a measurement model, this study looked for evidence that indicator variables really are measuring the underlying constructs of interest, and that the measurement model demonstrates an acceptable fit to the data. This measurement model does not specify any causal relationships between the latent constructs of interest; at this stage of the analysis, each latent variable was allowed to correlate freely with every other latent variable (Hatcher, 1994). The path analysis with latent variables then built by testing a structural equation model (SEM). By performing SEM, this study predicted specific causal relationships between the latent variables by performing latent variable path analysis. Performing this type of path analysis allowed us to test hypotheses that certain latent constructs have causal effect on other latent constructs.

Table V: PROC CALIS Output from analysis of measurement model

Indicator variables and their underlying factors	Standardized loadings	Standard error	*t*-value	R^2
BSRs (Cronbach's alpha = 0.93)				
Var 1	0.81	0.069	13.64	0.65
Var 2	0.88	0.069	15.68	0.78
Var 3	0.88	0.069	15.57	0.77
Var 4	0.84	0.069	14.37	0.70
Var 5	0.87	0.068	15.41	0.76
$DMU_{\sum}$ (Cronbach's alpha = 0.93)				
Var 6	0.74	0.066	11.70	0.54
Var 7	0.86	0.046	14.78	0.75
Var 8	0.73	0.045	11.49	0.53
Var 9	0.75	0.063	11.9	0.56
Var 10	0.73	0.045	11.43	0.53
Var 11	0.66	0.064	10.01	0.43
NFCC (Cronbach's alpha = 0.93)				
Var 12	0.54	0.060	7.80	0.29
Var 13	0.65	0.053	9.83	0.42
Var 14	0.85	0.058	14.21	0.72
Var 15	0.76	0.058	12.11	0.58
Var 16	0.83	0.059	13.7	0.68
SCP (Cronbach's alpha = 0.93)				
Var 17	0.82	0.058	13.55	0.68
Var 18	0.88	0.054	15.10	0.78
Var 19	0.80	0.061	13.04	0.64

5.4. Measurement model

An adequate fit to the data was achieved for a measurement model. A measurement model is a factor analytic model in which this study identifies the latent constructs of interest and indicates which observed variables will be used to measure each latent construct. The measurement model allows each latent construct to covary (correlate) with every other latent construct. Testing a measurement model focuses exclusively on how to estimate measurement models and how to assess their reliability and validity.

The Hatcher (1994) process was followed to assess the fit between model and data. It reviewed overall goodness of fit indices (such as the chi-square test, the CFI, and the NNFI) and then utilized fit indices to provide detailed assessment of fit (significance tests for factor loadings, R^2 values, normalized residuals, and modification indices).

5.4.1. Reviewing the chi-square test

The most widely reported goodness of fit index used in path analysis is the chi-square test. When the proper assumptions are met (e.g., large sample, multivariate normal distribution), the chi-square test provides a statistical test of the null hypothesis that the model fits the data (Hatcher, 1994). The *p*-value associated with the test indicates the likelihood of obtaining a chi-square value this large or larger if the null hypothesis were true (i.e., if the model fits the data).

Reviewing the chi-square test in Table VI (Chi-square = 166.52, *df* = 146, Chi-square/*df* ratio = 1.14 (< 2.0), Pr > chi-square = 0.1175), it provides a good fit because the chi-square value is relatively small and the corresponding *p*-value is relatively large.

(the large *p*-value (above 0.05) means that this study could not reject the null hypothesis of good model fit.)

Table VI: Output of goodness of fit indices, analysis of initial measurement model

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function			0.8326
Goodness of Fit Index (GFI)			0.9249
Root Mean Square Residual (RMR)			0.0392
Parsimonious GFI (Mulaik, 1989)			0.7897
Chi-Square			166.5191
Chi-Square DF			146
Pr > Chi-Square			0.1175
RMSEA Estimate	0.0265	90%C.I. [., 0.040]	
Bentler's Comparative Fit Index			0.9900
Bentler & Bonett's (1980) Non-normed Index			0.9894
Bentler & Bonett's (1980) NFI			0.9316
James, Mulaik, & Brett (1982) Parsimonious NFI			0.7954
Z-Test of Wilson & Hilferty (1931)			1.1876
Bollen (1986) Normed Index Rho1			0.9199
Bollen (1988) Non-normed Index Delta2			0.9910
Hoelter's (1983) Critical N			212

5.4.2. Reviewing the non-normed fit index and the comparative fit index

Bentler and Bonett's (1980) normed-fit index (NFI) has been proposed as an alternative to the chi-square test with values over 0.9 indicative of an acceptable fit of the model to the data. Since NFI has the disadvantage of sometimes underestimating goodness of fit in small samples, a variation on the NFI is the non-normed fit index (NNFI, Bentler and Bonett, 1980) has been shown to better reflect model fit at all sample sizes (Bentler, 1989; Anderson and Gerbing, 1988). NNFI values over 0.9 are also viewed as desirable. Bentler's (1989) comparative fit index (CFI) is similar to the NNFI in that it provides an accurate assessment of fit regardless of sample size. In addition, the CFI tends to be more precise than the NNFI is describing comparative model fit (Bentler, 1989) with values over 0.9 indicating a relatively good fit.

The NNFI and CFI appear in Table VI, in the same table that contained the chi-square statistic. These indices provided mixed signals concerning the model's fit. The NNFI and CFI suggest that the present model provides an acceptable fit with both indices at 0.99 respectively.

5.4.3. Reviewing significance tests for factor loadings

This study primarily focused on problematic items whose loading on the intended construct was lower than one or more cross-loadings. The results of the CFA show that there were no problematic items found. No items had cross-loadings above 0.4 (Hair et al., 1998) on the wrong construct. This study then examined the factor structure within each construct. Factor loadings are important because they help us interpret the factors that are responsible for the covariation in the data (Hatcher, 1994). A factor loading is

equivalent to a path coefficient from a latent factor to an indicator variable. Table V present the standardized loadings of the SAS output along with the corresponding standard errors and large-sample *t*-values. Factor loadings were statistically significant at $p < 0.1$, which indicate that the factors ($V_{1\text{-}19}$) really were measuring their underlying constructs (BSRs, $DMU_{\sum}$, NFCC, and SCP) and (Table IV; Table V). The result shows that the standardized loadings range in size from 0.54 to 0.88, and that only one is under 0.60. This means that all loadings were moderately large. In addition, since there are no near-zero standard errors, no problematic standard errors of this nature appear in the results. The *t*-values represent large-sample *t*-tests of the null hypothesis that the factor loading is equal to zero in the population. The obtained *t*-values in the Table V show that all factor loadings were significant at $p < 0.001$.

5.4.4. Reviewing the residual matrix and normalized residual matrix

If the model provides a good fit to the data, entries in the residual matrix are expected to be zero or near zero. Reviewing the normalized residual matrix, the residuals were centered around zero, but the distribution is somewhat asymmetrical due to one outlying residual in the interval from 3.25 to 3.5 (i.e., 3.47 for v15:v7 variable pair). The average standard residual was 0.81 but it contained a few large normalized residuals exceeded 2.0. This study compared entries from the actual covariance matrix and the predicted covariance matrix for a few of the large residuals (e.g., raw/predicted covariance between v15 and v7 is 0.11/ 3.47). It found that the pattern of these large residuals were caused by either the indicator variables being incorrectly assigned to the wrong factor or the indicator variables actually being influenced by more than one factor.

The most effective way of improving the model's fit is to modify it so that there is a path from the variables. However, the normalized residuals for the current analysis did not display a pattern of residuals that fit neatly into either of the above misspecifications. This was because, although the large residuals appear to be multidimensional, they appear to be influenced by only one other factor in addition to the one to which it was correctly assigned. In addition, the residual summary table output is not perfectly symmetrical but is centered around zero. This is the expected pattern of results when there is a moderately acceptable fit between model and data (Hatcher, 1994).

5.4.5. Assessing reliability and validity of constructs and indicators

Latent variable analyses assess the reliability and validity of the study's variables. Reliability refers to consistency of measurement. Validity refers to the extent to which an instrument measures what it is intended to measure. A CFA using PROC CALIS method assesses item reliability, composite reliability, variance extracted estimates, convergent validity, and discriminant validity. Combining these procedures provide evidence concerning the extent to which the indicators used in the study are producing reliable data and are measuring what they are intended to measure.

The R^2 values are the indicator reliabilities. The R^2 indicates the percent of variance in each indicator, accounted for by the common factor to which it was assigned. This can be computed in a way by simply squaring the standardized factor loadings obtained in the analysis. For example, the standardized factor loading for LV1F1 is 0.81. The square of this loading is 0.65, meaning that the reliability for V1 is 0.65.

Table VII provides the indicator reliabilities vary from a low of 0.29 for V12, to a high of 0.78 for V2. For example, F3 (NFCC) is assessed by indicators (V12 to V16) relatively low reliabilities (only 0.29, 0.42, 0.72, 0.58, and 0.68 respectively). This may not necessarily mean that the model is unacceptable, as the Table VII shows the composite reliability for F3 is .851, which is in the acceptable level of reliability (0.70 is preferable).

Composite reliability reflects the internal consistency of the indicators measuring the given data. Variance extracted estimates assess the amount of variance that is captured by an underlying factor in relation to the amount of variance due to measurement error. Table VII provides the reliabilities for all variables included in the final measurement model. This study adapted Fornell and Larcker (1981) formula for the index of composite reliability and variance extracted estimates. All constructs exhibit acceptable level of reliability and variance extracted estimate for instruments used in this study (Fornell and Larcker, 1981).

Table VII: Composite reliability and variance extracted estimates

Indicator variables and their underlying factors	Standardized loadings	*t*-value [a]	Reliability	Variance Extracted Estimate
BSRs			0.932 [b]	0.909 [c]
Var 1	0.81	13.64	0.65	
Var 2	0.88	15.68	0.78	
Var 3	0.88	15.57	0.77	
Var 4	0.84	14.37	0.70	
Var 5	0.87	15.41	0.76	
$DMU_{\sum}$			0.883	0.807

Var 6	0.74	11.70	0.54	
Var 7	0.86	14.78	0.75	
Var 8	0.73	11.49	0.53	
Var 9	0.75	11.90	0.56	
Var 10	0.73	11.43	0.53	
Var 11	0.66	10.01	0.43	
NFCC			0.851	0.758
Var 12	0.54	7.80	0.29	
Var 13	0.65	9.83	0.42	
Var 14	0.85	14.21	0.72	
Var 15	0.76	12.11	0.58	
Var 16	0.83	13.70	0.68	
SCP			0.874	0.831
Var 17	0.82	13.55	0.68	
Var 18	0.88	15.10	0.78	
Var 19	0.80	13.04	0.64	

[a] All *t*-tests were significant at $p < 0.001$

[b] Denotes composite reliability (0.70 or larger is preferable)

[c] Denotes Variance extracted estimates (0.50 or larger is preferable)

Convergent validity is demonstrated when different instruments are used to measure the same construct and scores from these different instruments are strongly correlated. Convergent validity is assessed by reviewing the *t*-tests for the factor loadings. If all factor loadings for the indicators measuring the same construct are statistically significant (greater than twice their standard errors) this is viewed as evidence supporting the convergent validity of those indicators. The results in Table VII show that all *t*-tests

were significant and all indicators were effectively measuring the same construct (Anderson and Gerbing, 1988).

Discriminant validity is demonstrated when different instruments are used to measure different constructs, and the correlations between the measures of these different constructs are relatively weak. Constructs were tested for discriminant validity using 1) the chi-square difference test, 2) confidence interval test, and 3) variance extracted test suggested by Hatcher (1994). First, the constructs were tested for discriminant validity using the chi-square difference test (Ahire et al., 1996). This involved covarying each pair of constructs and measuring the chi-square differences when the correlation was free to be estimated, and when it was constrained to a value of 1.0. Table VIII shows that results for each pair of constructs yielded chi-square differences to be statistically significant at $p < 0.001$. Thus, all the constructs were distinct with items loading on their assigned constructs and not others, indicating good discriminant validity.

In addition to the chi-square difference test, this study also performed a confidence interval test to assess the discriminant validity. This test involves calculating a confidence interval of plus or minus 2 standard errors around the correlation between the factors, and all the confidence interval between two constructs does not include the value of 1.0, which means that it is very unlikely that the actual population correlation between two constructs is 1.0 (Table VIII). This finding supports the discriminant validity of the measures (Anderson and Gerbing, 1988). Finally, discriminant validity was tested with a variance extracted test (Fornell and Larcker, 1981). This study reviewed the variance extracted estimates for each construct (Table VII) and compared these estimates to the square of the correlation between each pair of constructs (Table VIII). All the variance

extracted estimates were higher than the square of the interfactor correlation. For example, the variance extracted estimates of BSRs (0.91) and NFCC (0.76) in Table VII are higher than the square of correlation between BSRs and NFCC (0.336) in Table VIII. This supports the discriminant validity of each pair of constructs.

In summary, the analysis provided support for the discriminant validity of the constructs and measures.

Table VIII: Discriminant validity test results

Construct	Chi-square difference test				Confidence interval test	Square of the interfactor correlation
	BSRs	$DMU_{\sum}$	NFCC	SCP		
BSRs	-					
$DMU_{\sum}$	475.81[a] 0.000[b]	-			0.352	0.128
NFCC	262.66 0.000	312.56 0.000	-		0.577	0.336
SCP	207.01 0.000	229.92 0.000	227.05 0.000	-	0.466	0.220

[a] Chi-square difference for CFA where the correlation between pairs of constructs is constrained to 1.0 and when the correlation is free to be estimated

[b] The *p*-value for the chi-square difference value. (A value of less the 0.05 indicates that the chi-square difference is statistically significant.)

5.5. Structural model

Structural equation modeling (SEM) was used to simultaneously estimate multiple relationships between latent constructs and observed variables, and between multiple latent constructs. Following the second step of Anderson and Gerbing's two-step procedure, SEM specifies causal relationships between the latent constructs. It

reviews a number of procedures and indices that can be used to determine whether the resulting theoretical model provides an acceptable and parsimonious fit to the data. The parsimony ratio (PR) for the theoretical model was 0.859 and the parsimonious fit index (referred as the parsimonious normed-fit index, or PNFI) was 0.793, which were above suggested criterion of 0.6 (Mulaik et al., 1989).

Following the same procedures used with the measurement model, this study followed Hatcher (1994) process to assess the fit between theoretical model and data.

5.5.1. Reviewing the chi-square test

Table IX presents the goodness of fit indices for the theoretical model. The model chi-square *p*-value was significant at 0.05 ($p = 0.0112$), suggesting that the null hypothesis of good model fit can be rejected at the 0.05 level of confidence. This may not necessarily mean that the model is unacceptable, as the chi-square statistic is known to be very sensitive to seemingly trivial differences between model and data (Hatcher, 1994). The chi-square/*df* ratio is 1.29, which meet the informal rule-of-thumb criteria that the ratio should be below 2.0.

Table IX: Goodness of fit indices for theoretical model

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.9448
Goodness of Fit Index (GFI)	0.9168
Root Mean Square Residual (RMR)	0.0656
Parsimonious GFI (Mulaik, 1989)	0.7881

Chi-Square			188.9615
Chi-Square DF			147
Pr > Chi-Square			0.0112
RMSEA Estimate	0.0378	90%C.I. [0.0190, 0.0526]	
Bentler's Comparative Fit Index			0.9815
Bentler & Bonett's (1980) Non-normed Index			0.9784
Bentler & Bonett's (1980) NFI			0.9224
James, Mulaik, & Brett (1982) Parsimonious NFI			0.7930
Z-Test of Wilson & Hilferty (1931)			2.2844
Bollen (1986) Normed Index Rho1			0.9098
Bollen (1988) Non-normed Index Delta2			0.9817
Hoelter's (1983) Critical N			188

5.5.2. Reviewing the non-normed index and comparative fit index

Table IX shows that the CFI for the theoretical model is 0.982, a bit lower than the CFI of 0.990 observed for the measurement model, but still in the acceptable range (Bentler, 1989). The NNFI for the model is 0.978, whereas the NNFI for the measurement model is 0.989 (Bentler and Bonett, 1980).

5.5.3. Reviewing significance tests for factor loadings and path coefficients

The scale indeterminacy problem involves the fact that an F variable is an unobserved variable that has no established unit of measurement. By fixing at 1.0 the path from the F variable to one of its manifest indicators, the unit of measurement for the F variable becomes equal to the unit of measurement for that indicator variable. For this reason, this study fixed at 1.0 the factor loading for the indicator variable identified from

the CFA of the measurement model, which represents best that latent construct (Joreskog and Sorbom, 1989): The path from F1 to V2, F2 to V7, F3 to V14, and F4 to V18.

Reviewing the standard errors for the factor loadings and path coefficients in Table X, none of the standard errors appears to be unacceptably small. The factor loadings have *t*-value greater than 1.96 and are therefore significantly different from zero.

Table XII shows that all of the path coefficients were significant except for the path from BSRs to $DMU_{\sum}$, which displayed a moderate *t*-value of -1.78. Consistent with this, the standardized path coefficients for the path from BSRs to $DMU_{\sum}$ was quite small (-0.104). This is possible and is an important finding because this moderate result may reflect the findings of recent studies that propose the possible positive influence of BSRs on $DMU_{\sum}$. Details will be discussed it in a Chapter VI.

Table X: PROC CALIS output from analysis of theoretical model

Indicator variables and their underlying factors	Standardized loadings	Standard error	*t*-value	R^2
BSRs (Cronbach's alpha = 0.93)				
Var 1	0.81	0.058	14.91	0.65
Var 2	0.88	-	-	0.78
Var 3	0.88	0.057	17.43	0.77
Var 4	0.84	0.057	15.84	0.70
Var 5	0.87	0.056	17.21	0.76
$DMU_{\sum}$ (Cronbach's alpha = 0.93)				
Var 6	0.74	0.096	11.88	0.54
Var 7	0.86	-	-	0.75

Var 8	0.73	0.065	11.68	0.53
Var 9	0.75	0.090	12.06	0.56
Var 10	0.73	0.066	11.60	0.53
Var 11	0.66	0.093	10.10	0.43
NFCC (Cronbach's alpha = 0.93)				
Var 12	0.54	0.073	7.70	0.29
Var 13	0.65	0.063	9.68	0.42
Var 14	0.85	-	-	0.72
Var 15	0.76	0.071	11.93	0.58
Var 16	0.83	0.073	13.40	0.68
SCP (Cronbach's alpha = 0.93)				
Var 17	0.82	0.072	13.53	0.67
Var 18	0.88	-	-	0.78
Var 19	0.80	0.074	13.22	0.64
F4 (SCP)				0.38
F2 (DMU∑)				0.21

Table XI: Goodness of fit of the structural equation modeling

Fit statistic	Notation	Model value	Acceptable value
Overall fit measures			
Chi-square to degrees of freedom	$\chi^2 / d.f.$	1.285	≤ 2.0
Root mean square error of approximation	RMSEA	0.0378	≤ 0.06
Goodness of fit index	GFI	0.9168	≥ 0.9
Normed fit index	NFI	0.9815	≥ 0.9
Non-normed index	NNFI	0.9784	≥ 0.9

Comparative fit index	CFI	0.9224	≥ 0.9
Parsimonious index	PNFI	0.7930	≥ 0.6

Table XII: Summary of hypothesis test results for theoretical model

Path	Path coefficient	Standard error	*t* value	Hypothesis supported?
BSRs → $DMU_{\sum}$	-0.104*	0.059	-1.78	*Yes*
NFCC → $DMU_{\sum}$	-0.283***	0.080	-3.53	*Yes*
$DMU_{\sum}$ → SCP	-0.387***	0.078	-4.17	*Yes*
NFCC → SCP	0.388***	0.093	4.97	*Yes*

Path significant at: * $p < 0.1$; *** $p < 0.001$

5.5.4. Reviewing R^2 values for latent endogenous variables

The R^2 values for the study's endogenous variables are presented on Table X. Of particular interest are the R^2 values for the structural model's latent endogenous variables F4 (SCP) and F2 ($DMU_{\sum}$). The results show that the independent F variables accounted for 38% of the variance in SCP and 21% of the variance in $DMU_{\sum}$.

5.5.5. Reviewing the residual matrix and normalized residual matrix

Similar to measurement model, the residuals from SEM are centered around zero with average of 0.97, but the distribution is somewhat asymmetrical due to one outlying residual at the bottom of the table (in the interval from 4.0 to 4.25). It is interesting to see that the three largest residuals involved the relationship between V2 (an indicator for F1: BSRs) and V17, V18, and V19 (all indicators for F4: SCP). A more likely interpretation

is that V2 is a complex variable, that it is affected by both F1 and F4. Although V2 and F4 results appear to correlate, reassignment of V2 to F4 to enhance SCP factors is not recommended since V2 does seem to be doing a good job of measuring F1 with factor loading of 0.88 and was statistically significant (Table X). It would be taking coincidental results and assigning them as valid factors to a construct (Hatcher, 1994).

Eliminating V2 from BSRs may be possible. However, by eliminating the indicator V2 from the analysis caused the model to worsen the overall fit to the data (Chi-square/*df* = 4.37(> 2.0), Pr > chi-square < 0.0001, CFI = 0.794, NFI = 0.751, NNFI = 0.755). In addition, dropping V2 from the analysis entirely may create identification problems for F1, because the indicators measuring this construct were proven by the previous literature (Chen and Paulraj, 2004a).

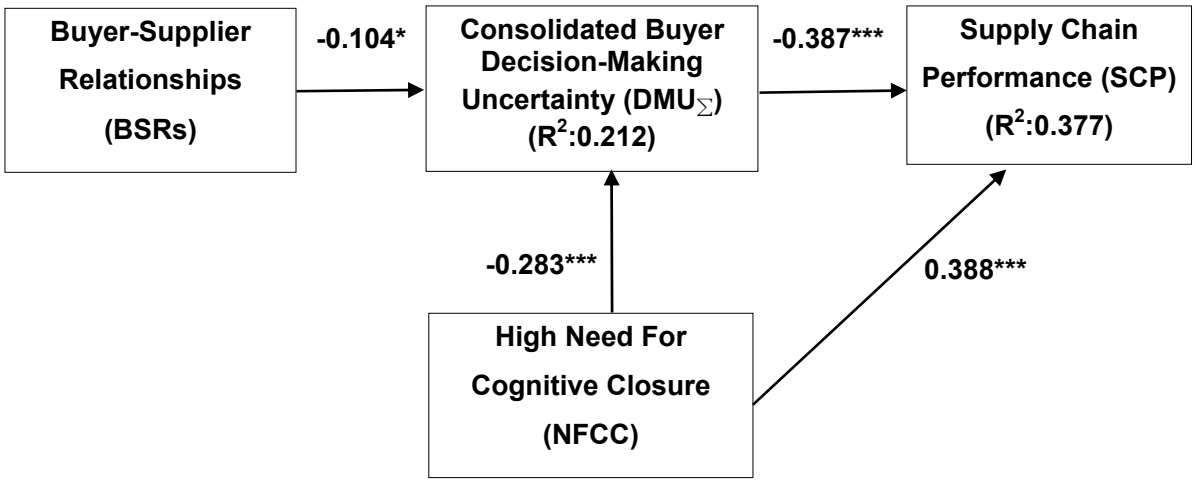
Although the current analysis of the theoretical model has provided evidence of acceptable fit, the involved large residuals by themselves will not cause us to reject the model, this study will make no decisions until we have reviewed the modification indices (in Section 5.6.2).

5.5.6. Reviewing the relative normed-fit index

The two-step approach tested here creates a problem that its measurement model consists of a relatively small number of latent variables, and a relatively large number of indicator variables. Consequently, indices of overall model fit (such as the NNFI and CFI) are often influenced much more by the fit of the measurement portion of the model than by the fit of the structure portion (Hatcher, 1994). This problem can be solved by using the results of the analysis to calculate a relative normed-fit index (RNFI; Mulaik et

al., 1989). The RNFI reflects the fit in just the structural portion of the model, and is not influenced by the fit of the measurement model. The RNFI for the theoretical model is .891 (RNFI = $(F_u-F_j)/[F_u-F_m-(df_j-df_m)]$, where F_u is model chi-square for the uncorrelated variables model, F_j is model chi-square for the model of interest, F_m is model chi-square for the measurement model, and df_m is degrees of freedom for the measurement model). This indicates the structural fit demonstrated by the structural portion of the theoretical model, irrespective of latent variables measurements. The RNFI of 0.891 indicates an acceptable fit between all of the constructs of the theoretical model.

Figure 3: Result of SEM analysis



Path significant at: * $p < 0.1$; *** $p < 0.001$

Figure 3 presents the results of the structural model tested. Table XI shows goodness of fit statistics and Table XII provides a summary of hypothesis test results for the structural model. The hypotheses tested by the relationships in the model were all

supported. The 'amount of variance accounted' was over 163% for all constructs (range from 1.63 to 2.95) which indicates that the constructs considered in this model correctly estimate the relationships, as evidenced by the resultant 'amount of variance accounted'.

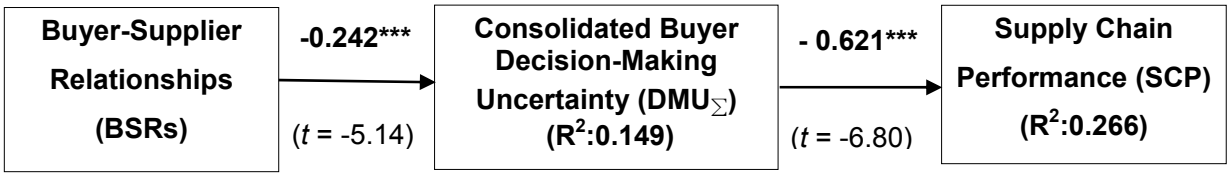
5.6. Alternative model

5.6.1. Partial model

G. Kwon and Suh (2004) proposed the positive relationship between BSRs and SCP. As shown previously, the theoretical model of this study required the $DMU_{\sum}$ construct relation between BSRs and SCP. The results revealed that insertion of $DMU_{\sum}$ between BSRs and SCP produced findings consistent with G. Kwon and Suh's research findings in 2005. The CFA results for the BSRs-$DMU_{\sum}$-SCP model shows that all the hypotheses tested by the relationships in the model were supported with evidence by CFA and SEM results; the factor loadings of the items ranged from 0.72 to 0.89 (*t*-values are significant at 0.001), and most fit indices from SEM results show a good fit (Chi-square/*df* = 1.83 (< 2.0); The GFI, CFI, NFI, NNFI greater than 0.9).

The BSRs-$DMU_{\sum}$-SCP model fit shown on Figure 4 and Table XIII is the foundation for which this study builds and adds NFCC to the model. Figure 3 and Table XII shows that the model fit improved after building and adding the NFCC construct to the model.

Figure 4: Path analysis of partial model (BSRs-$DMU_{\sum}$-SCP model)



Path significant at: *** $p < 0.001$

Table XIII: Summary of hypothesis test results for partial model

Path	Path coefficient	Standard error	*t* value	Hypothesis supported?
BSRs → $DMU_{\sum}$	-0.242***	0.047	-5.14	*Yes*
$DMU_{\sum}$ → SCP	-0.621***	0.091	-6.80	*Yes*

Path significant at: *** $p < 0.001$

5.6.2. Revised model: BSRs and SCP (ϕ_{13})

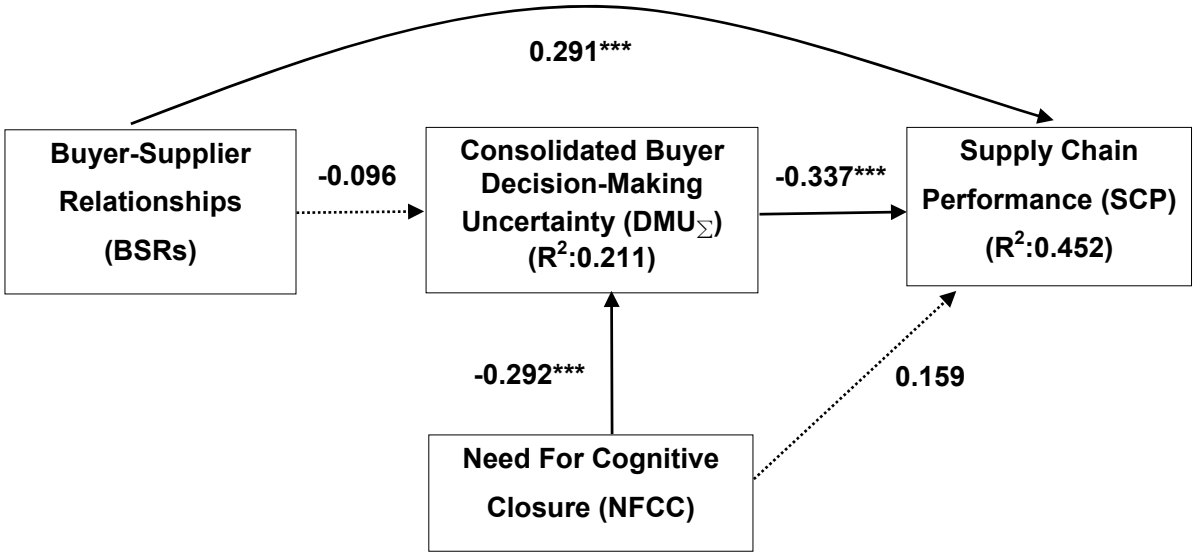
The marketing literature has shown that competitive, mediated power sources such as coercive, reward, and legal legitimate tend to prove detrimental to critical inter-firm relationship elements such as cooperation, commitment, and trust. Non-mediated, relational oriented power sources, however, have been shown to enhance such elements as well as improve performance and satisfaction (French and Raven, 1959).

Little research exists in the supply chain literature concerning the relationship between BSRs and SCP. Shin et al. (2000) suggest that an improvement (increase) in the supply management orientation (SMO) improves both the suppliers' and buyers' performance. In addition, the influence of the SMO on delivery- and quality-related

performance is more statistically significant than on cost or flexibility performance. G. Kwon and Suh (2004) propose that successful SCP is based on a high level of trust and a strong commitment among the supply chain partners. Chen and Paulraj (2004a) suggest that managing BSRs improve overall performance. Carr and Pearson (1999) provide empirical evidence that BSRs with key suppliers can directly impact the profits earned by the buying firms.

Figure 5 is the revised model in which the path from BSRs to SCP has been added in the SEM. We reviewed the modification indices due to the three largest residuals involved the relationship between V2 (an indicator for F1: BSRs) and V17, V18, and V19 (all indicators for F4: SCP) shown on Section 5.5.5. Figure 5 shows that the correlations were not statistically significant between BSRs and $DMU_{\sum}$ and NFCC and SCP. The model fit indices were slightly increased since latent factors were connected to be more complicated, but at the price of the model's parsimony. It was necessary that we make use of some indices that reflect a model's level of parsimony. The findings from revised model in Figure 5 and Table XIV provided a fit to the data that was significantly worse than that of the theoretical model tested in this study. This supports the model shown in Figure 3 as the study's final model.

Figure 5: Path analysis of revised model, in which the path from BSRs to SCP has been added



Path significant at: *** $p < 0.001$

Table XIV: The initial model latent variable correlations (*t*-values)

	BSRs	$DMU_{\sum}$	NFCC	SCP
BSRs	1.0			
$DMU_{\sum}$	-0.096 (-1.679)	1.0		
NFCC	-	-0.292 (-3.706)	1.0	
SCP	0.291 (4.771)	-0.337 (-3.842)	0.159 (1.869)	1.0

CHAPTER VI

DISCUSSION AND IMPLICATION

This study is the first empirical research to establish relationships among BSRs, $DMU_{\sum}$ and SCP with individuals NFCC using a structural equation model. This study attempts to bridge the gap between theory and practice concerning a complex decision environment by integrating NFCC. The implications of this study are also important because the results suggest that firms can improve their work performance and reduce the decision errors through increased emphasis of strategically managed decision-makers' personal traits. The data supports all of the hypothesized relationships depicted in the model; all of the path coefficients are significant and are shown in Figure 3. Each hypothesis is discussed below.

H1. There is a negative relationship between BSRs and $DMU_{\sum}$

Findings suggest that there is a *weak negative relationship* between BSRs and $DMU_{\sum}$. The path between BSRs and $DMU_{\sum}$ was negative (path coefficient = -0.104, standard error = 0.0585, *t*-value = -1.779) and supported at the $p < 0.1$ level. The results of the study show that close relationships between supplier(s) and buyer(s) does have

negative influence on uncertainty in supply chain, but not more influence than expected as evidence by the standardized coefficient of -0.104 in Figure 3, and a *t*-statistic of -1.78 in Table XII. It indicates that BSRs do have a negative influence on $DMU_{\sum,}$ but not more than expected. As trust increases, perceived uncertainty is reduced. Trust benefits business relationships by decreasing DMU. This may be attributed to when reliance on the trusted partner increases uncertainty and trustor vulnerability, the trusting party's decision may result in riskier outcomes (Morgan and Hunt, 1994; Smith and Barclay, 1997). This suggests that potential relaxation of due diligence when dealing with trusted partner results in riskier outcomes.

H2. Individuals with NFCC are motivated to reduce $DMU_{\sum}$

Findings suggest that individuals with *high* NFCC are significantly motivated to *reduce* the discomfort associated with uncertainties in decision-making. High NFCC individuals experience significantly higher discomfort about $DMU_{\sum}$ than low NFCC individuals do. The path between $DMU_{\sum}$ and NFCC was negative, highly significant (path coefficient = -0.283, standard error = 0.0802, *t*-value = -3.527), and supported at the $p < 0.01$ level.

As expected, individuals with high NFCC are significantly uneasy in uncertainty of decision-making. Our findings are supported in the literature. As shown on Table XV, individuals with higher NFCC exhibit high preference for predictability and little preference of ambiguity to avoid risk tolerance (Kruglanski and Webster, 1996). As time pressure creates a heightened NFCC (Kruglanski, 2004), high NFCC individuals must accept higher uncertainty, which may reduce SCP (Wilson, 1971). Since high NFCC

individuals prefer to close quickly the process of knowledge construction and hypothesis validation (Kruglanski, 2004), they narrow their information processing (Scholten et al., 2007). This weakens decision quality and may negatively impact SCP.

Table XV: Mean and Standard deviation for NFCC scales

Variable	High NFCC		*Low NFCC*	
	M	SD	M	SD
Preference for Order and Stature	3.55	0.84	6.51	0.40
Preference for Predictability	3.54	0.56	6.34	0.42
Decisiveness	3.58	0.60	6.13	0.36
Discomfort with Ambiguity	3.55	0.53	6.21	0.42
Close-Mindedness	3.57	0.81	6.31	0.33

H3. $DMU_{\sum}$ has a negative influence on SCP

Findings suggest that *increased* $DMU_{\sum}$ has a *significant negative* influence on SCP. The path between $DMU_{\sum}$ and SCP was negative, highly significant (path coefficient = -0.387, standard error = 0.0928, *t*-value = -4.173), and supported at the $p < 0.01$ level. Poor BSRs, less experience, and high NFCC lead to increase $DMU_{\sum}$. This significantly deteriorates SCP. This finding is supported in the literature (Gao et al., 2005; Kruglanski, 2004).

H4. Individuals with NFCC correlates to increased SCP

Findings suggest that individuals with *high* NFCC *significantly correlates* to *increased* SCP. The path between NFCC and SCP was positive, highly significant (path

coefficient = 0.387, standard error = 0.078, *t*-value = 4.965), and supported at the $p < 0.01$ level.

Individuals with high NFCC significantly correlated to increased overall SCP in our results are was supported at the $p < 0.01$ level. This was what we expected and is supported in the literature. Experienced high NFCC executive decision-makers handle organizational decisions more effectively. This is reflected in increased SCP when compared with less experienced high or low NFCC decision-makers SCP (Vermeir et al., 2002). Successful decision makers are more likely to use their tacit knowledge to buffer uncertainty for better work performance (Brockmann and Simmonds, 1997). Confidence in a manager's purchasing plans and their performance is related to experience and decision-making style (Lederer and Smith, 1988; 1989).

When confronting an uncertain environment, experienced managers with a higher NFCC show a buffering effect in condition of insecurity, exhibit fewer psychological complaints, and have a better work performance (Chirumbolo and Areni, 2010).

By removing survey data for those NFCC result contributions falling in the middle of the scale, this study classified the sample into two distinct groups (high and low NFCC) to analyze much stronger and richer results. Following the procedure used in previous research (Kruglanski et al., 1993; Vermeir and Kenhove, 2005), participants scoring above the 75th percentile composed the sample of the high NFCC participants (N=50) and those scoring below the 25th percentile comprised the low NFCC population (N=50). The results of each NFCC group analysis from the Partial Least Square (PLS)

analysis[***] support both H2 and H4 that individuals with high NFCC are greatly influenced by $DMU_{\sum}$ ($\beta = 0.50$, $p < 0.01$) and significantly correlate to increase firm performance ($\beta = 0.86$, $p < 0.01$). Yet, individuals with low NFCC are less influenced by $DMU_{\sum}$ ($\beta = 0.42$, $p < 0.01$) and less correlate to increase firm performance ($\beta = 0.23$, $p < 0.1$). The result indicates that low NFCC may not have as much influence on SCP.

Looking at the sample demographics in Table XVI, 74% (37 out of 50) of high NFCC participants were experienced senior level managers (e.g., President or CEO level in their respective firms), yet, only 28% (14 out of 50) of low NFCC participants were senior level managers. According to the test results of hypothesized relationships, purchasing managers with high NFCC achieve high SCP. This suggests that some high NFCC (26%) managers do not have high SCP, which may be due to level of experience. For example, 74% of the experienced purchasing managers in our study had a high NFCC and the knowledge and experience to consistently make great decisions (high SCP). While, 26% of less experienced high NFCC purchasing managers may not have the experience to consistently make great decisions as reflected in lower SCP. Those purchasing managers with high NFCC, but low SCP, can be trained to improve SCP.

[***] Partial Least Square (PLS) approach is designed to deal with multiple regressions when data has small sample size, missing values, or multicollinearity to use SEM. (Ringle et al., 2005; Haffer and Kristensen, 2008)

Table XVI: Split the Sample: high and low NFCC

	High NFCC Group	Low NFCC Group
Classification	75^{th} percentile (n=50)	25^{th} percentile (n=50)
Hypotheses test	β_{H2} =0.50, $p < 0.001$ β_{H4} =0.86, $p < 0.001$	β_{H2}=0.42, $p < 0.001$ β_{H4}=0.23, $p < 0.05$
Senior level proportion (President or CEO)	74% (37 out of 50)	28% (14 out of 50)

CHAPTER VII

LIMITATIONS AND FUTURE RESEARCH

This study identifies a number of limitations of this study and provides suggestions for future research.

7.1. Sample

This study has limitations related to characteristics of the sample upon which the hypotheses are tested. This study was limited to purchasing managers. Future research should broaden the scope of survey target to include all people engaged in purchasing decisions. This should take into consideration companies that utilize broader MRP and/or kanban like purchasing systems. We used overall group data. A future study could review a full explanation of the statistical analysis with the sample of classifying the participants as high and low NFCC groups (Houghton and Kardes, 1998; Pierro et al., 2004; Chirumbolo et al., 2004; Choi et al., 2008; Stalder, 2010). It could also analyze the results from the independent grouping of high and low NFCC group data to provide further insights.

The model was tested without industry or firm size considerations. We examined industry for the problematic item (V12 which has a low factor loading to F3). V12 is the

indicators of measuring "preference of order and structure". As shown on Table XVII the participants engaged in fast moving industries such as electrical/electronic equipment scored it lowest, while participants in firms engaged in military logistics/acquisition scored it very high. Those large variations in responses on the indicator V12 resulted in low factor loading to F3. This study did not look at specific details further. Future research should segregate the firms into large, medium, and small size industry groupings to access the impact on relationships within the model.

Table XVII: Sample demographics for V12 (Preference of Order and Structure) NFCC scores

Segmentation	Frequency	Percentage
Industry groupings (SIC code)		
Electrical/electronic equipment (**Lowest Scored**)	48	24
Communication related manufacturing	10	5
Computer/equipment manufacturing	5	2.5
Apparel manufacturing	5	2.5
Miscellaneous manufacturing	26	13
Service industry	16	8
Automotive/parts manufacturing	15	7.5
Medical equipment	5	2.5
Fabricated metal	14	7
Machinery manufacturing	7	3.5
Transportation/equipment manufacturing	6	3
Food manufacturing	5	2.5
Wood or Paper product manufacturing	5	2.5
Construction	4	2

Chemical	3	1.5
Printing supplies manufacturing	1	0.5
Rubber and plastic	1	0.5
Other	2	1
Military logistics/acquisition (**Highest Scored**)	23	11.5

7.2. Survey

The survey instrument contained multiple items for each factor this study was attempting to measure. None of survey items were dropped during the CFA. The goal in scale development was to keep all items supported by the literature. Therefore, all constructs and factors had more than the minimum number of items per scale. However, this study found that some factors may need to be refined during CFA analysis (e.g., V12 has a low factor loading (0.53) to F3; V2 for F1 involved the relationship with all indicators for F4). Although the coefficient *a* levels for this study were within the desired range (0.93), future research should refine factors or scale items for each construct to improve the model.

7.3. Model

This study focused on the impact of individual's NFCC exclusively, and not on other types of personal traits. Beyond NFCC scales, some studies in the psychology of individual choice have proposed various characteristics to measure personal traits that affect decision-making. For example, Kruglanski et al. (2000; 2007) tested hypotheses relating two personality constructs; NFCC and Locomotion tendency to an individuals'

ability to successfully handle organizational change. This study did not look at Locomotion tendency. Locomotion tendency is defined as a propensity toward action. According to Kruglanski et al. (2000), it is "the aspect of self-regulation concerned with movement from state to state and with committing the psychological resources that will initiate and maintain movement in a straightforward and direct manner, without undue distractions or delays." Across diverse organizational settings, populations studied, types of organizational change implemented, and measures of coping with change, the study finds that NFCC is negatively related, but Locomotion tendency is positively related, to coping with changes under uncertainty. Another example: Vermeir and Kenhove (2005) proposed that NFCC and perceived time pressure (PTP) are important determinants of search efforts for price and promotional information. Moreover, interaction effects are found between NFCC and PTP. This study did not look at PTP. This indicates that there are other factors not considered in this study. Therefore, future research could attempt to use different indicators for various perspectives of individual's ability to cope with the uncertainty.

Using combined uncertainties, this study provides empirical validation of NFCC on different uncertainty aspects. In this effort to understand drivers of $DMU_{\sum}$, this study experiences certain limitations that are commonly faced in survey-based research. Our need to measure $DMU_{\sum}$ combined all four measures (environmental, business, buyer decision-making, and operational). The results and the implications drawn from this study could be reviewed by looking at the effect of each (or different combination) uncertainty measurement to find out the impacts on model fit.

Despite the discussed own limitations, this study provides a starting point for future research concerning the influence of one type of purchasing managers' personal traits, NFCC, on decision-making under uncertainty and performance.

CHAPTER VIII

CONCLUSION

This study provides several contributions to the supply chain literature. To the best of our knowledge, this study is the first effort to develop a model of DMU_{Σ} of a firm, particularly as influenced by NFCC. Specifically, this study investigates the hypotheses about the impact of NFCC on DMU_{Σ} and SCP and the results show significant path coefficients between all of the hypothesized relationships in the model. Introducing NFCC indicators in OM for measuring behavioral factors was attempted for the first time. In addition, the DMU_{Σ} indicators consolidate all existing uncertainty measures in OM studies, such as environmental, business, buyer DM, and operational uncertainty. Although previous work has developed scales to identify determinant of uncertainties, this study is the first attempt to use multiple uncertainties in connection with a purchasing manager's NFCC. The statistical results in Figure 4 revealed that insertion of DMU_{Σ} between BSRs and SCP construct produced findings consistent with previous studies (Chen and Paulraj, 2004; G. Kwon and Suh, 2004). The model fit was improved after adding the NFCC shown on Figure 3. The results of testing the relationship between the

multiple uncertainties ($DMU_{\sum}$) and NFCC provide insights into attributes that enable a buying firm to achieve higher SCP.

It is also the first attempt to examine the direct and indirect effects of high NFCC on SCP. The NFCC exhibited multifaceted patterns to SCP through $DMU_{\sum}$. When this study simultaneously compared multiple relationships, this study noted that high NFCC lead to decrease $DMU_{\sum}$, which improves SCP. When confronting uncertainty, high NFCC purchasing managers are more likely use the same successful rules previously used where they had been successful. Thus, there are more chances for high NFCC purchasing managers to make successful decisions (Vermeir et al., 2002; Chirumbolo and Areni, 2010).

High NFCC had a positive direct relationship with SCP as we expected; under secure conditions, high NFCC reported increase SCP. With a high NFCC, purchasing managers narrow their information processing to reach a quick solution to a problem and become more focused on the task to be performed (Kruglanski, 2004). If this outcome weakens decision quality, it also forces the purchasing managers to be more focused on the tasks to accelerate their work performance (Chirumbolo and Areni, 2010). Practitioners have discovered through experience that their use of tacit, or hidden, knowledge is quite beneficial (Isenberg, 1984). Such benefits include a faster decision-making process (Eisenhardt, 1990), effective decisions (Agor, 1985), and fewer pertinent factors necessary for a decision (Wagner, 1987). Since high NFCC managers particularly want to make confident, smart, and successive decisions (Vermeir and Kenhove, 2005), firms may prefer decisive high NFCC purchasing managers knowledgeable in the nature

and timing of each event in their supply chain process regardless of the uncertainty of the situation.

According to the test results of hypothesized relationships in the model, this study identifies that experienced high NFCC purchasing managers have high SCP. Practical analysis revealed that placing emphasis on NFCC could benefit the purchasing managers by better preparing them for entry into the purchasing process. Firms aware of the importance of matching their purchasing managers' traits to the firm's strategic purchasing direction will maximize successful decision-making. Firms want to select high NFCC purchasing managers who were distinguished as experienced by their responses to several factors that translated to higher SCP. It is necessary for purchasing managers to begin the process of developing purchasing strategies to support both decision points and decision reviews on matters related to purchasing requirements and firm needs. These strategies must be based on the analysis and appropriate tradeoffs between cost, schedule, and performance. Purchasing managers need to ensure that their purchasing decisions are consistent and in alignment with the firm's plans and performance goals to accomplish this.

Purchasing managers need to realize how their personality influences their work performance and relationships with suppliers. In fast moving industries like the consumer electronics group, a purchasing manager with high NFCC but low SCP can be trained to improve SCP. In a slow moving industry group, like military procurement, NFCC may not have as much influence on SCP. With the results in mind, this study proposes that purchasing managers training is required to elevate high NFCC purchasing managers from low SCP to high SCP. Some high NFCC managers do not have high SCP and this

may be due to level of experience. A knowledgeable and experienced purchasing manager has a high NFCC and the experience to consistently make great decisions (high SCP). While, less experienced high NFCC purchasing managers may not have the experience to consistently make great decisions (lower SCP). This lower SCP group needs the training to achieve higher performance. Purchasing managers need to be sure that their choice of suppliers and associated purchasing decisions are driven by what is best for the situation, rather than what may be most comfortable. Purchasing managers need to reduce their decision errors and biases to improve their work performance by the effective use of performance facts and data on suppliers to develop confident decisions in all situations to improve their work performance.

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APPENDIX

MEASUREMENT OF RESEARCH CONSTRUCTS

Indicators
BSRs measurement model **Supply base reduction**: (Chen and Paulraj, 2004a)
1. We rely on a small number of high quality suppliers. 2. We maintain close relationship with a limited pool of suppliers. 3. We get multiple price quotes from suppliers before ordering. 4. We drop suppliers for price reasons. 5. We use hedging contracts in selecting our suppliers
Long-term relationship: (Chen and Paulraj, 2004a)
1. We expect our relationship with key suppliers to last a long time. 2. We work with key suppliers to improve their quality in the long run. 3. The suppliers see our relationship as a long-term alliance. 4. We view our suppliers as an extension of our firm. 5. We give a fair profit share to key suppliers. 6. The relationship we have with key suppliers is essentially evergreen.
Communication: (Chen and Paulraj, 2004a)
1. We share sensitive information (financial, production, design, research, and/or competition). 2. Suppliers are provided with any information that might help them. 3. Exchange of information takes place frequently, informally and/or in a timely manner. 4. We keep each other informed about events or changes that may affect the other party. 5. We have frequent face-to-face planning /communication.

6. We exchange performance feedback.
Cross-functional teams: (Chen and Paulraj, 2004a**)**
1. We collocates employees to facilitate cross-functional integration. 2. We coordinate joint planning committees with our suppliers. 3. We promote task force teams with our suppliers. 4. We share ideas and information with our supplier through cross-functional teams. 5. We use supplier involved ad hoc teams based on our strategic objectives. 6. We encourage teamwork between our suppliers and us.
Supplier involvement: (Chen and Paulraj, 2004a)
1. We involve key suppliers in the product design and development stage. 2. We have key supplier membership/participation in our project teams. 3. Our key suppliers have major influence on the design of new products. 4. There is a strong consensus in our firm that supplier involvement is needed in product design/development. 5. We involve our key suppliers in business and strategy planning. 6. We have joint planning committees/task forces on key issues with key suppliers.

Indicators
$DMU_{\sum}$ measurement model **Environmental uncertainty**: (Chen and Paulraj, 2004a)
Supply uncertainty:
1. The suppliers consistently meet our requirements. 2. The suppliers produce materials with consistent quality. 3. We have extensive inspection of incoming critical materials from suppliers. 4. We have a high rejection rate of incoming critical materials from suppliers.
Demand uncertainty:
1. Our master production schedule has a high percentage of variation in demand. 2. Our demand fluctuates drastically from week to week. 3. Our supply requirements vary drastically from week to week. 4. We keep weeks of inventory of the critical material to meet the changing demand. 5. The volume and/or composition of demand are difficult to predict.
Technology uncertainty:
1. Our industry is characterized by rapidly changing technology. 2. If we don't keep up with changes in technology, it will be difficult for us to remain competitive. 3. The rate of process obsolescence is high in our industry. 4. The production technology changes frequently and sufficiently
Business (Behavioral) uncertainty: (Lai, 2008)
1. We forecast our sales volume to the terminal operator.

2. We forecast the terminal operator's demand requirements for the items we supply. 3. We forecast the terminal operator's order size. 4. We forecast the terminal operator's order cycle.
Buyer decision-making uncertainty: (Gao et al., 2005)
1. We knew little about the possible performance of this supplier's product and whether it would really meet our purchase goals. 2. We had adequate information about the likely performance of this supplier's products. 3. We had limited amount of information about the likely outcomes of buying from this supplier. 4. It was very hard to evaluate the future performance of this supplier's products. 5. At the time of decision, we felt that this purchase decision was hampered by a lot of uncertainty.
Operational uncertainty: (Achrol and Stern, 1988)
1. We forecast which product models or brands to carry in stock. 2. We forecast how much inventory to carry. 3. We forecast which models/brands to "push" in sale strategy. 4. We forecast local sales promotions and advertising decisions.

Indicators
NFCC measurement model **Preference for Order and Structure**: (Houghton and Grewal, 2000)
1. I find that establishing a consistent routine enables me to enjoy my life. 2. I enjoy having a clear structured mode of life. 3. I like to have a place for everything and everything in its place. 4. I find that a well ordered life with regular hours suits my temperament.
Preference for Predictability: (Houghton and Grewal, 2000)
1. I dislike unpredictable situations. 2. I don't like to be with people who are capable of unexpected actions. 3. I prefer to socialize with familiar friends because I know what to expect from them. 4. I enjoy the uncertainty of going into a situation without knowing what might happen.*
Decisiveness: (Houghton and Grewal, 2000)
1. I tend to put off important decisions until the last moment.* 2. I usually make important decisions quickly and confidently. 3. I would describe myself as indecisive.* 4. I tend to struggle with most decisions.*
Discomfort with Ambiguity: (Houghton and Grewal, 2000)
1. I dislike it when a person's statement could mean many different things. 2. I feel uncomfortable when someone's meaning or intentions are unclear to me. 3. I feel uncomfortable when I don't understand the reason why an event occurred in my life.

4. When I am confused about an important issue, I feel very upset.
Closed-Mindedness: (Houghton and Grewal, 2000)
1. Even after I have made up my mind about something, I am always eager to consider a different opinion.* 2. When considering most conflict situations, I usually see how much both sides could be right.* 3. When thinking about a problem, I consider as many different opinions on the issue as possible.* 4. I always see many possible solutions to problems I face.*

* Reverse Coded

Indicators
SPC measurement model **Supplier operational performance**: (Chen and Paulraj, 2004a)
1. Volume flexibility 2. Scheduling flexibility 3. On-time delivery 4. Delivery reliability/consistency 5. Delivery lead time 6. Quality 7. Cost 8. Prompt response 9. Inventory risk reduction
Buyer operational performance: (Chen and Paulraj, 2004a)
1. Product Conformance to specifications 2. New product introduction time 3. Delivery speed 4. Delivery reliability/dependability 5. Delivery lead-time 6. Production costs 7. Production lead-time 8. Inventory reduction

9. Volume flexibility 10. Rapid confirmation of customer orders 11. Rapid handling of customer complaints 12. Customer satisfaction
Buyer financial performance: (Chen and Paulraj, 2004a)
1. Return on investment 2. Profits as a percent of sales 3. Firm's net income before tax 4. Present value of the firm