

Impact of Experience and Education on Risk Attitude and Risk Perception of Supply Chain Management Professionals

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ABSTRACT

Globalization and technology have allowed supply chains to be geographically spread across the world. Supplier evaluation and selection play a major part in the continuity of these supply chains. Our study attempts to answer three fundamental questions related to the risk attitude and risk perception of Supply Chain Management (SCM) professionals in the evaluation and selection of suppliers. What is the relationship between their risk attitude and risk perception? How do SCM professionals with different risk attitudes differ in the way they perceive risk? Last, do factors such as education and experience affect the relationship? We test these questions using empirical data from a sample of 307 randomly selected SCM professionals. Prospect theory and bounded rationality theory are both used in efforts to mutually develop the scope of this study. Our findings suggest a negative relationship exists between risk attitude and risk perception and that the relationship is strongly significant. The results showed that experience did not moderate the relationship; however, formal education in supply chain management moderate the relationship. SCM professionals with formal education in SCM tend to perceive a higher risk of supply chain disruptions for given scenarios compared to SCM professionals without formal education in SCM.

Keywords: *risk attitude, risk perception, supply chain management, supply chain disruption*

1. INTRODUCTION

The supply chain plays a critical role in determining the level of profitability in an organization. The more efficient and productive the supply chain, the greater the profit potential of the organization. Conversely, the less efficient and less productive, the higher the supply chain costs and the lower the profitability. Supply chain management (SCM) is the active management of supply chain activities, which includes sourcing, production, and logistics (Coyle *et al.*, 2017; Zijm *et al.*, 2019). The primary goals of SCM are to

ensure that goods are positioned at the right place, at the right time, at the right quantity, and the right quality. These goals affect customer service and thus together play a vital role in the success of a firm. Managing the basic flows in a supply chain is paramount if an organization has any hope of achieving the aforementioned goals. The basic flows within a supply chain are the movement of goods downstream from suppliers to customers, the movement of information upstream to suppliers in the form of customer orders and downstream to the customer in the form of the product catalog and tracking, and the movement of money upstream from customer to suppliers for the payment for the goods (Coyle *et al.*, 2017; Zijm *et al.*, 2019).

Globalization and technology have had a significant impact on the design of supply chains allowing supply chains to be geographically spread across the world (Khan *et al.*, 2019). As a consequence, many firms have either outsourced some or all of their manufacturing needs to foreign contract manufacturers or offshored some or all of their manufacturing operations to other countries. Several reasons have been given to why firms select outsourcing-offshore manufacturing strategies. The main reason given has been profit-maximizing through low-cost production in countries such as China and Mexico, which is based on Heckscher-Ohlin international trade theory, an economic theory that proposes countries export what they have in abundance (Hill and Hult, 2016). Given China has an abundant labor force of low to high skill workers, the lower labor wages have attracted U.S.-based firms to set up manufacturing operations in that country. China has been the biggest offshoring destination for U.S.-based firms. As a result, Chinese labor wages have been approximately 10-25% of the U.S. labor wages. Further, outsourcing and/or offshoring from more developed countries to less developed countries offer firms not only lower labor wages but decreased tax burdens and relaxed governmental regulations. The

computer and electronic product sector and machinery/electrical equipment sector have been the two largest U.S.-based manufacturing sectors with manufacturing based in China.

After goods are produced, the foremost goal of SCM is to ensure the smooth flow of goods from manufacturing facilities at offshoring and/or outsourcing locations to end customers along the supply chain (Ivanov and Dolgui, 2019). However, many firms have experienced various degrees of supply chain disruptions, resulting from unanticipated events that impede “the normal flow of goods and/or materials within a supply chain” (Craighead *et al.*, 2007; Gupta and Ivanov, 2020). These disruptions may be attributed to many factors both man-made and nature hampering productivity for partner firms that negatively affect their abilities to satisfy their customers (Ellis *et al.*, 2010). In some cases, the operating costs can be driven higher due to the excess material handling premium for expediting goods through the supply chain (Hendricks and Singhal, 2003). Depending on the severity of the disruption and the partner firms’ abilities to recover, the effect could be short- or long-term, (Kraljic, 1983; Sheffi and Rice, 2005; Gupta and Ivanov, 2020). Empirical studies have found that supply chain disruptions may also negatively affect shareholder value and a firm’s operating and long-term stock price performance (Hendricks and Singhal, 2003, 2005; Han *et al.*, 2020).

Notable supply chain disruptions have been reported over the past decade, highlighting vulnerabilities in both individual companies and industries globally (Vakil, 2005; Chopra and Sodhi, 2014). Instances of unforeseen events that led to supply chain disruptions are as follows. Two massive earthquakes occurred in Japan: March 2011 off the Pacific coast of Tōhoku and April 2016 in the city of Kumamoto in southern Japan. These earthquakes resulted in major supply chain disruptions, leading Toyota, a Japan-based automobile manufacturer, to close several of its manufacturing plants around the world due to part shortages (Tajitsu and Yamazaki, 2016).

The Hanjin Shipping Company, once the largest container carrier in South Korea, filed for bankruptcy on August 31, 2016. The bankruptcy, unfortunately, left \$14 billion of goods stranded on ships and ports around the world (Paris and Phillips, 2016). Most recently is the coronavirus (COVID-19), an infectious disease first identified in Wuhan, the capital of Hubei, China in December 2019. The virus caused an outbreak that forced temporary closure of many factories as many countries and state governments issued “stay-at-home” orders. Given China is a major sourcing location for Apple, the company was unable to meet its production plans for smartphones and iPad Pro for the first quarter of the year 2020. After making a public announcement on February 17, 2020, the company’s stocks lost 15% of their market value or \$34 billion (White, 2020). Tesla, a leading manufacturer of electric vehicles with production and market presents in China, is another U.S.-based company whose stocks lost roughly 16% of its market value or \$90 billion (Ivanov *et al.*, 2017).

According to the New York Times, even in 2021, the pandemic continues disrupting nearly every aspect of the global supply chain, resulting from a shortage of shipping containers and dock workers. First, poor container management is cited as the reason for the container shortage. Several containers were shipped to regions in West Africa

and in South Asia delivering much-needed protective gear such as masks and hospital gowns; however, because countries in these regions did not ship any products back to China, several empty containers begin to stockpile in these regions. This resulted in the increase in cost to move cargo. For instance, the typical cost to move a container from Shanghai to Los Angeles costs around \$2,000; the shortage of containers increases that cost to nearly \$25,000 (Goodman, 2021).

Secondly, the high demand at the shipping ports in the United States and Europe, created port traffic jams and blockages. For instance, the Business Insider reported that dozens of ships were forced to anchor in at ports in Los Angeles and Oakland, California for days before they could be loaded and unload, trapping nearly 500,000 shipping containers. Georgia Ports Authority reported ships waiting more than nine days with more than 20 ships waiting to be loaded and unloaded. Because of the lack of dockworkers and truck drivers, shipping containers were strained on the docks for weeks consuming space needed to unload the other containers from the ships (Hanbury, 2021).

Given the negative effect supply chain disruptions have on partner firms’ financial and operational performances, managers have been driven to gain insights into events that lead to supply chain disruptions with the hope of preventing the disruptions or mitigating the negative impact. Many scholars have explored supply chain risk management (SCRM), which has been defined as the coordinated efforts of an organization to identify, monitor, detect and mitigate threats to supply chain continuity and profitability (Ho *et al.*, 2015). The related streams of research have been quantifying the negative implications of supply chain disruptions (Ivanov *et al.*, 2017). Tordecilla *et al.* (2021) used simulation-optimization methods to design and assess the resilience of supply chain networks under uncertainty scenarios. Etemadi *et al.* (2021) evaluated the impact of the capabilities of blockchains to enhance supply chain resilience. These research studies have lent significant insights into the causes and effects.

Supplier evaluation and selection, two critical activities of SCRM, are important because of the strategic role that suppliers play in the competitive landscape of the supply chain (Narasimhan and Talluri, 2009). Decision-making plays a significant role in supplier selection (Sen *et al.*, 2020; Wieteska, 2020). As a result, much attention has been given to the supplier selection decision (Kull *et al.*, 2014). Past research has shown that choosing the right supplier is a complex decision that is made by SCM professionals; selecting the wrong supplier may result in severe supply chain disruptions (Husdal, 2009; Ivanov *et al.*, 2017). In response to the complexity of the supplier evaluation and selection problem, scholars have proposed heuristics to enhance SCM professionals in the decision-making process (Viswanadham and Samvedi, 2013; Ruiz-Torres *et al.*, 2013). These heuristics typically assumed that SCM professionals are rational decision-makers following some prescribed rational procedure such as maximizing expected utility theory (Mantel *et al.*, 2006), where procedural rationality is identified as “the extent to which the decision process involves the collection of information relevant to the decision, and the reliance upon analysis of this information in making the choice” (Dean and Sharfman, 1993). The term “procedural rationality” was first coined by Simon (1978).

A distinction exists between procedural rationality and substantive rationality. Substantive rationality measures the degree to which suitable courses of action are chosen, and procedural rationality explains the processes used to select an action knowing the cognitive powers and limitations of humans. Most individuals are bound in their rationality. Procedural rationality has long been known as a crucial aspect of the decision-making process, and for having a significant impact on decision outcomes.

Nonetheless, SCM professionals do not always function completely as rational agents. According to Kull *et al.* (2014), SCM professionals introduce biases in the SCM decision-making process, whether consciously or unconsciously; it is essential to consider the effect individual behavior has on the traditional SCM setting. Due to bounded rationality and difficulties of assessing complete information on supply chain disruptions, SCM professionals may not have the complete information necessary for some proposed heuristics such as maximizing expected utility theory. Further, according to Hult *et al.* (2010), supplier selection is a decision with inherent uncertainty. Empirical evidence has shown that environmental uncertainty creates deviations from rational decision-making and that outcomes are based on the decision maker's risk attitude, risk perception, and expected gains or losses (Sarafan *et al.*, 2018). As such, SCM professionals may place more or less confidence in their intuition, experience, or subjective judgments to deal with emerging SCM issues.

Risk attitude is an individual attribute of the decision-maker that exists before the decision; it is defined as "a generic orientation (as a mindset) towards taking or avoiding a risk when deciding how to proceed in situations with uncertain outcomes" according to Rohrmann (2008). On the other hand, risk perception is defined as the overall assessment of the risk inherent in a situation and magnitudes of potential gains or losses associated with a decision (Baird and Thomas, 1985; Dowling, 1986; Sitkin and Pablo, 1992; Zheng *et al.*, 2018). Risk perception was originally introduced as a concept into psychological studies of consumer behavior by Bauer (1960); risk perception has been related to individuals' personal beliefs, attitudes, judgments, and feelings (Akintoye and MacLeod, 1997).

Given the existence of risk and the different attitudes toward the risk and expected benefits/rewards, different decision-makers produce different decision-making behaviors. Risk attitude is posited to bias choice because individuals will emphasize expected gains and losses differently. Thus, the decisions of SCM professionals in supplier selection are ultimately subject to the decision maker's risk attitude, risk perception, and the expected gains or losses (Husdal, 2009).

A few studies have focused on behavioral SCM research (Sanders *et al.*, 2016). Nevertheless, Wieland *et al.* (2016) found behavioral research that looks at SCM professionals to be lacking. Recent research has sought to understand the risk attitude and risk perception of SCM professionals and how those attitudes affect the decision-making process (Heckman *et al.*, 2015). These papers provide a deeper understanding of behavioral is needed to shed light on the risk attitude and risk perception of SCM professionals. For instance, Ellinger *et al.* (2015) explored how cultural and behavioral factors affect supply chain risk management. Specially, they investigate how the learning

orientation of the organization supply chain integration influence the supply chain risk management.

A few scholars have proposed mathematical models to examine the problem of supplier selection under disruption risk. These studies make assumptions about the risk aversion of the decision-maker then use an objective function to assess the quality of the decision. However, the risk behavior literature suggests that individual loss aversion depends not only on the personality of the decision-maker but also on the context and the stakes of the decision (Chai and Ngai, 2020). Dupont *et al.* (2018) proposed a stochastic mixed-integer linear programming model that uses profit-and-loss targets. The model provides visual decision-making support that shows the elasticity of expected losses versus expected profits for different supplier selections. It shows how the minimum value of the required gross margin impacts the supply strategy.

Mena *et al.* (2020) investigated the topic of supply chain risk and resilience as it affects how individuals make choices and how the factors surrounding that decision-maker influence their choices. This study explores how two specific factors: systemic resilience communication and the decisions maker's exposure to resilience-influence the behavioral intentions of a decision-maker. Their study explored the mechanisms by which risk and resilience influence decision-making. If the resilience of an individual's organization is perceived to be high, then the individual could be persuaded to those greater risks; conversely, if the perception is of low organization resilience, then they will be more careful in their decision making.

- 1) This research seeks to determine whether and in what manner risk attitudes of SCM professionals sway their risk perceptions in the SCM context. This study investigates this phenomenon by centering on three research questions: What is the relationship between risk attitude and risk perception of SCM professionals?
- 2) How do SCM professionals with different risk attitudes differ in the way they perceive risk?
- 3) Do factors such as education and experience affect the relationship between risk attitude and risk perception?

The remainder of this paper is organized as follows. In Section 2, we provide an overview of the literature. In Section 3, we describe the applied methodology. In Section 4, we present the research findings. Lastly, in Section 5, we analyze and discuss our findings, suggest avenues for future research, and derive managerial implications.

2. THEORY AND HYPOTHESES

2.1 Prospect Theory

Prospect theory and bounded rationality are two theories that form the basis for this research. Prospect theory has been applied to SCM problems dealing with the newspaper vendor model (Uppari and Hasija, 2018). The theory was developed by Daniel Kahneman and Amos Tversky in 1979. This theory is one behavioral factor that has garnered the attention of scholars when focusing on individual risk attitude and risk perception with gains and losses (Liu *et al.*, 2013, 2014). Liu *et al.* (2015) have studied this phenomenon in e-commerce, and Choi (2016) has studied it in the fashion industry. Prospect theory examines the same core points as utility theory, which assumes rationality that individuals under risk make decisions that

maximize their utility (Kahneman and Tversky, 1979). However, prospect theory uses a utility function and focuses on three basic principles: loss aversion, reference point, and risk aversion, and risk-seeking behavior. Under loss aversion, the assumption is that individuals abhor losses more than they relish gains. Under reference point, individuals have expectations; gains or losses revolve around this reference point that allows individuals to compare past and current positions based on expectations. Finally, prospect theory identifies when individuals are most likely to be risk-averse and/or risk seekers. Given the domains of gains and losses, studies have shown that though individuals enjoy gains, they are more risk-averse while seeking those gains. On the other hand, individuals abhor losses; they are more risk-seeking under the loss environment. We posit that SCM professional decisions are influenced by their risk attitudes and that there is a negative relationship between risk attitude and risk perception.

H1: *SCM professionals' risk attitude is negatively associated with risk perception.*

2.2 Bounded Rationality Theory

Knowledge is a crucial component of risk perception. The term "bounded rationality" was first introduced by Hubert Simon in 1957 (Ibrahim, 2009; Takahashi, 2015). The authors posited that bounded rationality theory discusses cognitive limitations of individuals in the areas of skills, values, and knowledge, which impact rational decision-making. The theory deals with human limitations of information processing capacities (Fiori, 2011). Individuals are constrained by the limits of the information that is assembled and processed and by the limits of computational capabilities, which emerge when they face situations perceived as complex. Given these limits, Fiori (2011) notes that the decision-making process applies when problems needing solutions occur. Sometimes this knowledge is gained through experience and/or through education. Bounded rationality theory has been applied to several SCM problems, especially in the global SCM (Connelly *et al.*, 2013).

The objective of this research is to better understand how direct experience and education motivates SCM professionals in their decision-making process. Understanding this process helps untangle the factors that directly influence the risk perceptions in influencing actual behavior and incentives aimed at mitigating supply chain disruptions. Direct experience with a domain is separate from subject knowledge of that domain. As a result, the potential mediating influence of SCM professionals' risk perceptions ensure a risk reduction in behavior. We explore the impact of direct experience and education on the risk perception of SCM professionals.

2.3 Experience

We examine the influence of direct experience on risk perception assessments. This modified process explains the factors that influence the formation of risk assessments that lead to actual decision-making. The evidence that direct experience with risk can influence behavior to mitigate the effects of the risk has mixed support in the literature. Direct experience can have a powerful impact on the recognition of risk and the willingness to protect oneself from that risk; it provides the mechanism by which individuals cope with the risk by making decisions that will lower the potential impact

of negative consequences.

According to Whitmarsh (2008), risk perception and behavior are influenced by direct experience. Experiences can invoke strong memorable feelings, possibly making them more dominant in processing (Loewenstein *et al.*, 2001). A large element of one's memory is based on previous experience, so logically perception of risk is also influenced by prior experience (Krallis and Csontos, n.d.). Newell and Simon (1972) wrote that difference in perceptions of individuals is based on the unique situations each has experienced. A rational decision-maker relies on past experiences to guide behavior. Accumulation of different experiences allow a person to form facts and values that act as filters during observations, thus impacting perception (Ibrahim, 2009).

Researchers generally accept that as individuals become more knowledgeable about a topic, they are more likely to develop risk and policy assessments congruent with those who are experts on that issue (Durant and Legge 2005; Evans and Durant 1995; Hansen *et al.*, 2003; Kellstedt *et al.*, 2008). According to the authors, there is a correlation between risk perception and knowledge about the issues involved with that particular risk. Shelley (1994) demonstrated the effects of direct experience with a risk on protective behavior led individuals to see the risks as more frequent and to view themselves as potential future victims, thus increasing their motivation to engage in risk reduction behaviors. Sattler *et al.* (1995) found that consumers tend to base their risk mitigation choices on the psychological stress of the past experiences with the risk.

Cliff (2003) suggested that risk perception varies both with the individual and with the level of experience, and, where a situation is familiar, the risk perception is lessened. Numerous researchers have found that perceived risk is enhanced immediately after an occurrence of a negative event but quickly subsides as time passes; they found that consumers' past experience influenced risk perception in the short run but not in the long term. Kaplan and Berman (2010) discuss this phenomenon in terms of attention fatigue in the context of environmentally responsible behavior. When a negative event is relatively infrequent, experience provides a limited, biased source of information for individuals.

We posit that experience affects the relationship between risk attitude and risk perception. Further, we posit that individuals with more experience perceive a risk to be lower than those with less experience.

H2a: *Experience moderates the relationship between risk attitude and risk perception.*

2.4 Education

The risk may be regarded as a subjective concept that depends on the individual's assessment of potential outcomes, rather than an objective concept (Ellis *et al.*, 2010). Past research in behavior decision-making has demonstrated that an individual's level of expertise is often disconnected from their decision-making performance (Arvai and Froschauer, 2010). The extant literature in expertise has consistently demonstrated that experts in a category have a greater awareness and knowledge about a particular risk and alternative strategies to deal with the risk (Lindell and Hwang, 2008). Education signifies the

cognitive ability and skills of an individual, and research has shown that individuals with high levels of education tend to make a significant positive impact on business performance (Ashraf *et al.*, 2019). Education is the key to success and development for stronger culture, and individuals with high education have developed the capacity for information processing and competence to discriminate among an array of stimuli (Schroder *et al.*, 1967). Specific information that is acquired through education can alter an individual's perceived risk leading to feelings of discomfort (Dowling and Staelin, 1994). When consumers are in this distressed state, they are motivated to get more information on the risk and to engage in problem solving activities. Educated individuals are likely to engage in boundary spanning, tolerate ambiguity, and show an ability for "integrative complexity" (Dollinger, 1984). Further research studies have shown that higher educational levels influence increasing risk perception (Weber and Milliman, 1997). We posit that education affects the relationship between risk attitude and risk perception.

H2b: Education moderates the relationship between risk attitude and risk perception.

3. METHODOLOGY

3.1 Sample

Our theoretical model is presented in **Figure 1**. A computerized structured questionnaire including a vignette was used to gather data from respondents. This questionnaire was delivered electronically to individuals through Qualtrics, a private software company that allows

users to perform secure online data collection. It has been well documented in the management literature that electronic surveys are effective research data collection methods that typically overcome the time and cost constraints of traditional mail surveys (Williams, 2012; Croteau *et al.*, 2010; Smith, 2002; MacElroy, 2000).

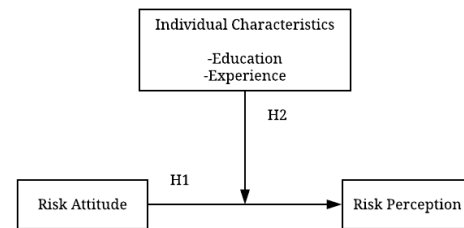


Figure 1. Theoretical model

The sample frame of this study consisted of current or previous SCM professionals, who were informed that the study was for academic research purpose only and that research participant would remain anonymous. A total of 1,406 surveys were electronically distributed online. There were 10.1% of respondents who opened the survey but did not start the survey. Another 59.1% of respondents were disqualified because they either lived outside the United States or were not SCM professionals. After deleting another 4.5% of responses with missing and unmatched data, a total of 307 responses were selected as the sample for this study, which represents an estimated response rate of 26.3%. The descriptive statistics of the sample is presented in **Table 1**.

Table 1. Descriptive statistics of sample

		Number	Percentage
Gender	Men	202	54.6%
	Women	168	45.5%
Age	18 to 29	73	19.7%
	30 to 39	129	34.9%
	40 to 49	121	32.7%
	50 to 59	33	8.9%
	60+	14	3.8%
Education	Supply Chain Related	243	65.7%
	Other	127	34.3%
Experience	≤ 5 years	116	31.4%
	5 < years ≤ 10	138	37.3%
	10 < years ≤ 15	75	20.3%
	15 < years ≤ 20	24	6.5%
	20 < years	17	4.6%

3.2 Measures

3.2.1 Control variables

Control variables considered in this study were gender and age. The two demographic traits could have an influence on risk attitude and/or risk perception. The impact of gender on risk perception has been shown to be important in various fields (Petraakis, 2005; Chua, 2012). The risk perception literature has consistently found that females perceive higher risk compared to males (Barke *et al.*, 1997; Slovic, 1999).

Regarding age, studies have shown that as people age, they become less flexible and resistant to change. Therefore, as employees age, they tend to avoid risky decision-making or become more risk-averse (Carlson and Karlsson, 1970; Vroom and Pahl, 1971; Nicholson *et al.*, 2005).

3.2.2 Education

Education measurement was based on whether or not the participants received formal education in a supply chain

management related field. The participants answered the following question: “Is your college degree (if any) supply chain oriented (logistics, operations, etc)?” If a participant received formal education in supply chain management through a 2-year, 4-year, or post-graduate college education, the response was “yes.” If not, the response was “no.”

3.2.3 Experience

The experience measurement was grouped into categories. In the first category, the participants were asked the following question: “How long have you worked in the supply chain management field (amount of experience)?” In the second category, the participant selected one of five options depending on the number of years working in the supply chain management field. The options were as follows: 1) 5 or fewer years, 2) 10 or fewer years, 3) 15 or fewer years, 4) 20 or fewer years, and 5) more than 20 years.

3.2.4 Risk attitude

Individual risk attitude scales have been developed for different contexts; four scales include the Choice Dilemma Questionnaire (Kogan and Wallach, 1964), the Risk Style Scale (Forlani and Mullins, 2000), the Domain-specific Risk-Taking scale (Weber *et al.*, 2002), the Six-Domain Scale (Nicholson *et al.*, 2005). Zhang *et al.* (2018) developed a scale to measure risk attitudes of decision-makers across broad settings: The General Risk Propensity (GRP) scale. The instrument uses eight items; two items include: 1) “I would take a risk even if it meant I might get hurt” and 2) “I am attracted, rather than scared, by risk.” Each item was measured on a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree.

3.2.5 Risk perception

Risk perception can be quantified by socio-psychological scaling and survey techniques (denoted as the “psychometric”) (Rohrmann, 2003). In this research, the level of perceived risk in a supply chain disruption is defined as risk perception. Two means to measure perceived risk have been proposed by researchers: first, a direct measurement of whole risk perception, and second, the expected utility-based measurement of assessing the probability of occurrence and impact of risk.

We adopted the direct measurement for perceived risk using a vignette adapted by Thompson (2015): Albert Standin scenario. This scenario was a modification of a Pat

Carter vignette employed by Sitkin and Weingart (1995). The Pat Carter vignette was an adaptation of a National Aeronautics and Space (NASA) Carter Racing decision-making case study (Brittain and Sitkin, 1989). The two-item scale includes: 1) “How would you characterize the decision faced by the production manager?” and 2) “What is the likelihood the supplier will obtain the critical supplies in time to avoid a supply chain disruption?” The items were written in the negative form. A seven-point Likert scale was used in the measurement of the two items. For the first item, 1 means a significant threat, and 7 means a significant opportunity. For the second item, 1 means very unlikely, and 7 means very likely.

3.3 Common Method Variance

Factorial analysis was performed on the self-reported data for risk attitude scales; we concluded the common method variance was an insignificant concern (Podsakoff *et al.*, 2003). To evaluate non-response bias, we compare respondents’ overtime on key variables of the study (Armstrong and Overton, 1977). We found no significant differences in key variables of this study between respondents.

4. RESEARCH FINDINGS

Table 2 shows the mean values, standard deviations, and correlations for all the measured variables. Inspection of the table shows no sign of multicollinearity (correlation coefficient < 0.70). The mean risk attitude and mean risk perception levels were moderate at 3.01 and 3.49, respectively. The intercorrelations show that the relationship between education and risk attitude was strongly significant and in the positive direction with a correlation coefficient of $r = 0.20$ ($p < 0.001$). The intercorrelations also show that the relationship between education and risk perception was strongly significant and in the positive direction with a correlation coefficient of $r = 0.24$. However, the intercorrelations show that the relationship between risk attitude and risk perception was negative and strongly significant with a correlation coefficient of $r = -0.54$ ($p < 0.001$). The mean age of the sample was equal to $\bar{x} = 2.42$, implying that the mean age was in the range of 30 to 39, and the mean experience was equal to $\bar{x} = 2.16$, implying that the mean experience was in the range of five to ten years.

Table 2. Means, Standard Deviations, and Correlations

Variable (n = 370)	Mean	s.d.	1	2	3	4	5
1 Age	2.42	1.02					
2 Gender	0.45	0.50	-0.14**				
3 Experience	2.16	1.08	0.38***	-0.14**			
4 Education	0.66	0.48	-0.09+	-0.06	0.14**		
Table 2. Means, Standard Deviations, and Correlations (Con't)							
5 Risk Attitude	3.01	1.22	-0.07	-0.21***	0.04	0.20***	
6 Risk Perception	3.49	1.35	-0.09+	0.08	-0.01	0.24***	-0.54***

Note: Correlations are shown below the diagonal. s.d. = standard deviation. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ (two tailed).

A factor analysis was used to confirm the underlying structure of risk attitude, and principal component factor analysis was used to extract the factor. We rotated the factor matrix using the orthogonal Varimax rotation and obtained the solutions by rotating factors with eigenvalues greater

than one. Cronbach’s alpha was used to perform the reliability test for the factor (Cronbach, 1951).

Only one eigenvalue greater than one was observed, and the loading for all items was greater than 0.40. These items formed the construct of risk attitude with 67.2% of the

variance extracted from the data (see **Table 3**). The Cronbach alpha reliability estimate was used to test the internal consistency of the scale items; the factor was high as 0.92 (Hair *et al.*, 2006, p. 137).

To test the hypotheses, hierarchical multiple regression analysis and moderated multiple regression analysis were used (see **Table 4**). The table shows the standardized beta coefficients. First, to test the linear relationships between

risk attitude and risk perception, risk perception was regressed on the control variables (age and gender) in Model 1 and estimated the parameters for the risk attitude main effect in Model 2. Residual plot analysis indicated no issues related to heteroskedasticity or error term distribution. Our variance inflation factor (VIF) analysis indicated no issues of multicollinearity (i.e., all VIFs were below 1.5).

Table 3. Factor analysis

Risk Attitude		Mean	s.d.	Factor Loading
Item				
1	Taking risks makes life more fun	2.87	1.49	0.83
2	My friends would say that I'm a risk taker	2.86	1.59	0.83
3	I enjoy taking risks in most aspect of my life	2.91	1.57	0.84
4	I would take a risk even if it meant I might get hurt	2.69	1.56	0.86
5	Taking risks is an important part of my life	3.20	1.49	0.78
6	I commonly make risky decisions	3.35	1.39	0.79
7	I am a believer of taking chances	2.82	1.55	0.84
8	I am attracted, rather than scared, by risk	2.77	1.54	0.79
Bartlett's test		2004.54***		
KMO		0.93		
Eigenvalue		5.37		
%Variance		67.2%		
Cronbach alpha		0.92		
Risk Perception		Mean	s.d.	Factor Loading
Item				
1	How would you characterize the decision faced by the production manager?	4.62	1.93	0.87
2	What is the likelihood the supplier will obtain the critical supplies in time to avoid a supply chain disruption?	5.21	1.61	0.90
Bartlett's test		115.15**		
KMO		0.50		
Eigenvalue		1.52		
%Variance		75.9%		
Cronbach alpha		0.71		

Note: All items are measured on a five-point Likert scale, where 1 = totally disagree and 7 = totally agree. s.d. = standard deviation.

Model 1 shows that the control variables were not statistically significant. However, in Model 2, the standardized regression coefficient for risk attitude is strongly significant with a standardized parameter estimate of $\beta = -0.56$ ($p < 0.001$). This provides support for **H1**. As expected, there is a negative relationship between risk attitude and risk perception, and risk attitude accounts for

19% of the variance in risk perception. Next, the hypothesized interaction effects were tested based on the procedure proposed by Zedeck (1971). The two moderators were entered in Model 3; this model shows education had a strong significant main effect on risk perception with a standardized parameter estimate of $\beta = 0.35$ ($p < 0.000$) and accounted for 12% of the variance in risk perception.

Table 4. Parameter estimates of regression models: risk perception

Variable	Model			
	1	2	3	4
<i>Control variables</i>				
Age	-0.08	-0.13**	-0.11*	-0.10*
Gender	0.07	-0.06	-0.04	-0.04
<i>Main effects</i>				
Risk Attitude		-0.56***	-0.63***	-0.50***
<i>Moderators</i>				
Experience			0.01	-0.02
<i>Interaction effects</i>				
Risk Attitude × Experience				0.05
Risk Attitude × Education				-0.32*
<i>Model summary</i>				
R ²	0.12	0.31	0.43	0.44
ΔR ²		0.19	0.12	0.01
F	2.26	54.41***	54.66***	40.09***

Note: Beta standardized coefficients; +p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001 (two tailed).

Model 4 was estimated to examine the moderator effects of education and experience on the relationship between risk attitude and risk perception for SCM

professionals. A statistically significant increase of variance explained (R^2) upon entering the interaction term indicates the presence of a moderated relationship (Jaccard and

Turrisi, 2003 p. 11-12; Zedeck, 1971). Unfortunately, the model does not support our hypothesis that experience moderates the relationship between risk attitude and risk perception when education is also included as a moderating variable. Hence, **H2a** is not supported. Note in **Table 1**, the intercorrelation between experience and education was very low but statistically significant at $r = 0.14$ ($p < 0.01$). However, Model 4 does support **H2b** that education moderates the relationships between risk attitude and risk perception with a standardized parameter estimate of $\beta = -0.32$ ($p = 0.025$).

The model explains 1% of additional variance upon introducing the interaction terms. Since there is consent in methodological studies on moderator research that significant interaction effects are difficult to detect and that effect sizes are very small (Aguinis *et al.*, 2005; Champoux and Peters, 1987; Chaplin, 1991), this result constitutes an important finding. Consequently, having established the presence of a significant interaction between risk attitude and education, it is warranted to plot the interaction and analyze its specific form following the procedure suggested by Aiken and West (1991, pp. 12-14) and Jaccard and Turrisi (2003, pp. 31-32). The plot is depicted in **Figure 2**. The plot reveals several noteworthy insights that can be seen in the interaction.

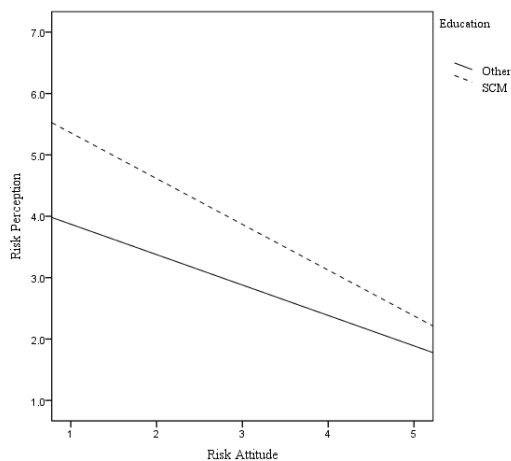


Figure 2. Interaction between risk attitude and education

At each risk attitude level, the risk perception of SCM professionals with formal education of supply chain management tends to assign a higher probability that a supply disruption will occur compared to lower probability of supply disruption given by SCM professionals without formal education in SCM. Contrast participants at the risk-averse level; there is a wide gap in risk perception between participants with formal education in SCM and those without formal education in SCM. On the other hand, compare with participants at the risk-seeking level; there is a narrow gap in risk perception between participants with formal education in SCM and those without formal education in SCM. This means the manipulated independent variable education has different consequences at the extremes of the predictor variable (risk attitude). Further, the plot indicates that as risk attitude moves from low to high, risk perception decreases at a higher rate for those with formal education in supply chain management compared with those without formal education in supply chain management.

5. DISCUSSION AND CONCLUSIONS

5.1 Managerial Implications

This study provides some confirmation, as well as new insights, into how SCM professionals perceive risk based on their risk attitude. We found the relationship between risk attitude and risk perception was negative and strongly significant. SCM professionals who are more risk averse tend to judge certain scenarios to be high risk. The impact on the firm is that because they perceive the risk to be high, they may forego opportunities that may be a significant benefit for the firm. As the risk attitude moved from risk-averse to risk-seeking, SCM professionals given the same scenarios tend to judge the scenario to be less risky. On the other hand, because risk seekers enjoy risk-taking, their risk attitude may lead the organization to take unnecessary risks that may result in a negative consequence on the firm's performance. With about such judgments, management may consider teaming SCM professionals based on their risk attitude when critical decisions under uncertainty are to be made. The goal should be for the team members to converge to a good decision in such an environment.

Another interesting finding is that formal education has an impact on the relationship between risk attitude and risk perception. SCM professionals who had formal education in supply chain management tend to judge the given scenario as a higher risk than does SCM professionals without formal education in supply chain management. The difference in the judgment could be due to formal education tending to focus on case studies whereby students learn about past events of organizations which had supply chain disruptions and the root causes of the disruptions. Formal education broadens the boundaries of their knowledge in the SCM field and prepares these professionals to make improved decisions. Too, formal education enhances the development of critical thinking and problem-solving skills, which prepares SCM professionals to be proactive. Yet, SCM professionals without formal education in supply chain management may gain all or most of their knowledge of supply chain disruptions through on-the-job training. Our study showed that experience did not have a statistically significant impact. Without formal education, SCM professionals may lack the critical-thinking and problem-solving skills, resulting in these professionals being more reactive. Managers should consider creating work teams based on whether or not the SCM professionals have formal education in supply chain management. If the organization has an employee development department, one function should be to provide opportunities for all employees to gain formal education in supply chain management.

5.2 Limitations

Although this study presents adequate literature and data to support the findings, there are a few limitations. First, our sample only included SCM professionals employed in the United States. Organizations outside of the United States can use this study for organizational direction but should keep in mind the results reflected are based on SCM professionals in the U.S. only. The culture of supply chains in the U.S. may in fact be different in other countries as cultures vary. Second, we observed how education

moderates the relationship between risk attitude and risk perception. The survey simply asked if the participant had any form of supply chain education such as logistics, operations, or none. However, the sample did not take into consideration how the different types of education may play a critical role in the surveyor response by only asking if a form of supply chain education was obtained. By this, participants who have logistics or operations form of education may respond differently to risk attitude and risk perception. Participants without formal supply chain management education may also have a dissimilar outlook on risk attitude and risk perception in the supply chain.

Third, the study does not evaluate the different meanings of perception of risk as an SCM professional. It is assumed that SCM professionals may have their perception of risk individually. Although we implemented the direct measurement for perceived risk using the Albert Standin scenario vignette modified by Thompson (2015), we did not take into consideration that SCM professionals may perceive the level of risk inversely, allowing individuals to take higher risks than others.

Last, we did not consider the various types of SCM professionals. We were able to retrieve data on the length of experience each participant obtained but we did not ask the level of experience. For instance, participants may occupy various roles such as entry-level positions to leadership positions. This is significant to ponder as the type of position could also impact how the surveyors answered each question. An entry-level professional may have a significant level of risk attitude than someone in a management position. A manager may be willing to take higher risks because of the knowledge obtained through experience, no matter the level of education.

5.3 Future Research

The scope of this study creates opportunities for future research. Future studies can observe organization characteristics that contribute to supply chain disruptions. While analyzing organization characteristics, examiners can monitor the changes in risk attitude and risk perception within SCM professionals. For example, do risk attitude and risk perception vary with the type of supply chain? The type of supply chain can differ depending on the nature of the material, products, and shelf-life. Do lower shelf-life products cause higher risk than higher shelf-life products? For instance, electronics may have lower shelf life than a supply chain that houses home goods, causing professionals to gauge risk inversely.

Considering the limitations, future research can examine the type of education each participant has, helping to better understand if education moderates risk attitude and risk perception. Knowing the type of education each professional surveyor has will help supply chain hiring professionals know the type of education that should be required within their network to eliminate the risk that leads to higher disruption or risks that worsens the state of disruption.

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