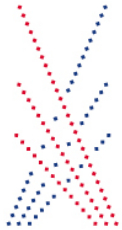

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Managerial Perception of Supply Chain Quality Risk: An Examination of the Risky-Decision Making Model

Due to increased supply chain complexity, ensuring the quality of supply materials or products from upstream suppliers has become a challenge for firms. A great deal has been written on possible solutions and strategies to deal with supply chain quality risk (SCQR) in recent years. However, the manager's decision-making process in relation to SCQR has not been fully researched. To close this gap, the aims of this study were to scrutinise managers' perceptions of SCQR, as well as the antecedents of and decision-making related to perceived SCQR. The resource dependence theory was drawn on to identify factors related to the supply chain relationship that might have effects on three of the representations of SCQR. With a sample of 316 Chinese manufacturers, a theoretical framework of the managerial decision-making process in relation to perceived SCQR was assessed.

Track 17: Operations, Logistics and Supply Chain Management

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1. INTRODUCTION

The recent large-scale recall of Samsung Electronic Co.'s Galaxy Note 7 smartphone has once again shone a spotlight on the quality control of electronics production (BBC, 2016). The recall of the Note 7 smartphone is also raising questions about the ability of today's electronics companies to manage product quality in complex supply networks. Not only this case, but an increasing number of product recalls, reveal that manufacturing firms are particularly vulnerable with regard to product quality and safety where goods and materials have been sourced globally; in other words, they incur supply chain quality risk (SCQR). The horsemeat scandal outbroke in 2013 when the Food Safety Authority of Ireland announced the presence of horse meat in' burgers produced by the famous brands, such as Tesco, Iceland, Aldi and Lidl. The suspected horsemeat was found in extensive ready meal in the European Market and the scandal severely dented consumer trust in the food industry (Tse et al., 2016a). Indeed, product recall could be a 'nightmare' for a company. Recent cases worldwide reveal that SCQR is one of the major reasons for product recall. In general, a buyer involved in a complex supply chain is more likely to encounter trouble than is a buyer involved in a relatively simple supply chain. In such cases, a defective component provided by a supplier might result in the buyer incurring significant losses. For example, in 2017, the transportation and manufacturing industries faced threats from supply chain quality issues. The products of Kobe Steel, a major Japanese steel manufacturer, were found to have false documentation regarding the thickness of steel. Around 3,793 tons of steel plates had been shipped to customers with potentially fake measurement data. Toyota, Honda and Nissan, the major customers of Kobe Steel, launched a large-scale investigation to determine whether the companies should recall those products that contained the affected materials. After the scandal was exposed, the market share of Kobe Steel was plummeted (Terazono, 2017).

Most operations management (OM) researches have regarded the issue of poor product quality as a production quality problem (Karim et al., 2008, Hales and Chakravorty, 2006, Tannock and Balogun, 2007). However, nowadays the product quality problem is located not within individual firms, but within supply chains. According to Tse and Tan (2011), SCQR can be regarded as supply quality problems, which are associated with raw materials, ingredients, production or packaging and which have cascading effects in the supply chain.

Given the increased challenge of managing uncertainties that extend beyond the internal organization boundary, practitioners and researchers have shown growing interest in determining the optimal supply chain management (SCM) practices (Robinson and Malhotra, 2005, Tse and Zhang, 2017, Zu and Kaynak, 2012). Consequently, the last decade has seen the rapid development of research dedicated to supply chain risk management (SCRM), which combines the topics of risk management (RM) and supply chain management (SCM) and focuses on understanding how to reduce the negative outcomes of supply chain risk (SCR) (Finch, 2004, Jüttner et al., 2003, Norrman and Jansson, 2004). Specifically, SCRM can be regarded as the management practices for SCR through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity (Tang, 2006). In particular, the practical issues related to the SCQR provide the operations management (OM) researcher with a great opportunity to further extend the knowledge system of SCRM and quality management (QM). The majority of SCRM studies are concerned with (1) exploring the most appropriate management practices in an SCRM framework (Norrman and Jansson, 2004, Manuj and Mentzer, 2008); (2) examining the antecedents and performance outcomes of the SCRM practices (Grötsch et al., 2013, Li et al., 2015) and (3) SCRs assessment (Wang et al., 2012, Tummala and Schoenherr, 2011). However, there is a gap in the SCRM literature with regard to understanding the nature of SCQR from a behavioural standpoint. Although risk

perception is a particularly important factor influencing how top managers react to risk, the research in this area is still in the embryonic stage. This motivates the author to investigate how a manager's view of SCQR is developed, and how the perceived SCQR may affect the implementation of particular QM practices with different orientation.

In order to fill the research gaps, this study seeks to answer the following research questions:

RQ1: *What are the antecedents of perceived SCQR?*

RQ2: *What are the relationships between perceived SCQR and managers' intention to adopt QELM and QERM practices?*

In this study, the Yates and Stone (1992) risky decision-making model is adopted to investigate the decision-making process for SCQR. The theoretical framework includes three groups of factors, i.e. the representation of SCQR, antecedents of risk factors, and intention to adopt QM. To further extend the previous risk perception research in OM, this study conceptualizes and operationalizes four factors in representations of SCQR, namely risk probability, risk magnitude, psychological factor and overall risk perception. Drawing on the resource dependency theory (RDT), the causal relationships between the situation factors (i.e. buyer dependence, supplier dependence, inability to trace and inability to test) and representation of SCQR are examined. From a contingency theory perspective, no one management practice or theory can work in all instances. Regarding the adoption of QM, this study follows Zhang et al. (2012) to distinguish the traditional quality management practices into quality exploration and quality exploitation. The motivation for classifying the quality management is based on the notion of Sitkin et al. (1994) that using a single unique set of practices cannot allow for the customization that is critical to the success of adopting management practices (Westphal et al., 1997). Exploration and exploitation represent different orientations of decision makers in applying the QM practices. Specifically, quality exploration is aimed at exploring the unknown and identifying novel solutions (Zhang et al., 2012, Garvin, 1985), while quality exploitation aims at cybernetic control, which refers to the use of feedback loops in the form of standards of performance and budgets to evaluate the performance of the business, plan and make changes to correct any deviations (Green and Welsh, 1988).

The rest of this paper comprise five sections. Section 2 develops the hypotheses and proposes the research model. Section 3 discuss the data collection and measurement scale for each construct. Section 4 presents the data analysis results. Section 5 concludes this paper through providing the implications and suggesting the future research directions.

2. THEORETICAL BACKGROUND

2.1. The Representation of Risk

In this paper, the probability of SCQR is defined as the *perceived likelihood that the key supply material/product from a key supplier will have quality problems*. Moreover, the "magnitude of SCQR" is defined as the perceived severity/significance of the impact that the key supply material/product from a key supplier has quality problems. It is clear that a significant body of evidence supports the binary structure of the perceptual risk, including two stable components—risk probability and risk magnitude. Yet, based on the views of risk analysts in sociological and psychometric domains, many other potential factors can also facilitate the constructions of risk perception (Slovic, 1987, Jia et al., 2015). For example, Loewenstein et al. (2001) revealed that changes in affective factors (or mood) will influence the perception of riskiness. In the field of sociology, the psychometric paradigm has become a

widely-accepted scale in measuring risk perception (Slovic et al., 1982, Gaskell et al., 2017). It is surprising that few works in OM or even general business study have looked into applying such recognised instruments. By doing this, this study contributes to the literature the operationalisation of the psychological factor by adopting the Slovic team's method. Some empirical research has started to investigate the psychologic factor for testing the OM theory, such as Hill et al. (2009), but very few studies have examined the psychological factors in assessing risk perception, let alone the investigation of SCQR.

Some early staged research argues that experts only have the simple judgement of the risk (Yates and Stone, 1992). However, this study questions whether a supply chain manager or even a CEO of a company is really an "expert" in risk assessment. The recent risk perception research overthrows the assertion of experts' simple judgement of risk. Dobbie and Brown (2014) indicated the cognitive structure of the risk perception is the same for both experts and laypeople. Hence, the inclusion of psychologic factor for measuring the managerial risk perception is reasonable.

One of the objectives of this paper is to conceptualise and operationalise the SCQR framework to deepen understanding of the decision-making of the practitioners. But it is worth asking if the decision-making is directly impacted by the various risk elements discussed in the last several sections. Figure 1 illustrates how various risk factors influence decision-making. Therefore, it is a decentralised risk perception framework. Nevertheless, Shapira (1995) argued that the executive decision is based on the perception of "overall risk". Adapting from the risky decision model of Yates and Stone (1992), Ellis et al. (2010) and Tse et al. (2016a) remarkably developed a risk appraisal model that shows that the risk factors, i.e., risk probability and risk magnitude, are synthesised into an overall risk appraisal. The model emphasises that the risk factors play a formative role in the perception of the overall risk. In the context of supply disruption risk, Ellis et al. (2010) and Tse et al. (2016a) empirically tested the overall risk perception framework. Specifically, they find significant and positive linkages between risk probability, risk magnitude and overall risk.

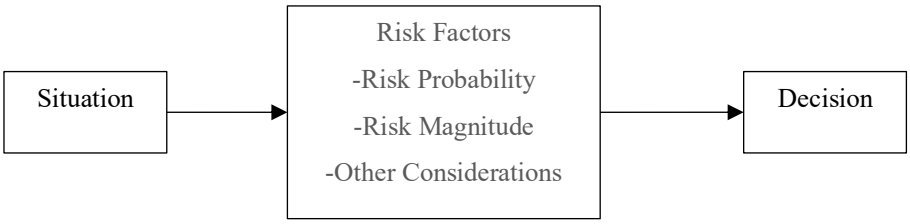

Figure 1. Risk Perception Scenario 1

Based on the previous works, this study conceptualised the risk perception framework that consists of two representations, the risk factors (including risk probability, risk magnitude and psychological factor) and the overall SCQR perception. Ellis et al. (2010, P.37) stated, *"a key difference between these successive stages of assessment is the distinction between judgement and decisions"*. The *"decisions"* in Ellis' statement are not the decision-making, but rather the result/evaluation of the judgement. Given the findings of Thun and Hoenig (2011), managers view the supplier quality problem as a high probability event with great negative impact. Then, managers might evaluate the judgement of the risk constructs and perceive the greater level of supplier quality risk. The prescription of Yates and Stone (1992) is also helpful to overcome the issue in traditional risk assessment. For instance, it is hard to simply equate the risks with high probability but low impact and the risks with high magnitude with low probability (Kaplan

and Garrick, 1981). Therefore, this paper argued that the perception of SCQR is a process of managers' evaluating the judgement of various risk elements. In this paper, the perceived overall SCQR is defined as *"individual's perception of the overall level of the riskiness due to the inherent quality problems in the supply of key materials from the key supplier"* (Tse and Tan, 2012, Tse et al., 2011, Ellis et al., 2010). To develop a formative risk perception model, this paper employs a single item for measuring overall SCQR.

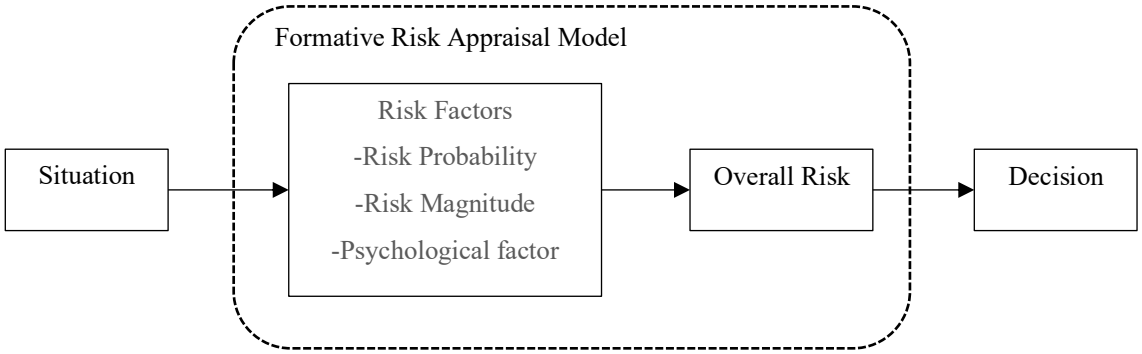

Figure 2. Risk Perception Scenario 2

H1: Probability of SCQR is positively associated with overall SCQR.

H2: Magnitude of SCQR is positively associated with overall SCQR.

H3: Psychological factor of SCQR is positively associated with overall SCQR.

2.2. Supply Chain Dependencies

Taking a RDT perspective, this study investigates the factors of supply chain dependencies (SCD). Emerson (1962) defines dependence in the organizational context as the need to rely on a partner's contribution in pursuing one's goal. According to Zhang and Huo (2013 , P.546), *"the dependence in SCM can be defined as a firm's need to maintain its business relationship with supply chain partners to achieve its goals"* (p. 546). Here, the RDT is a relevant lens to investigate the mechanism of supply chain dependence, i.e. Buyer Dependence (BD) and Supplier Dependence (SD). From the perspective of RDT, the bargaining power of a focal company in an exchange relationship, such as a buyer-supplier relationship or strategic alliance, is greatly reliant on the resource held by the focal company (Elking et al., 2017). Hillman et al. (2009) suggest that the power relations formed from the resource exchange will create dependency from the weaker party. Hence, RDT suggests that when a firm can minimize its dependence on its external parties (such as its supplier) and maximize the dependence of other parties on itself, it will be more successful (Pfeffer and Salancik, 1978). In the context of SD, typical techniques of buying firms, such as multi-sourcing and promise of large purchase volume, will be more effective, because they have more power over their suppliers (Kull and Ellis, 2016; Berger and Zeng, 2006). Conversely, if the level of BD is higher, buying firms' ability to effectively capture value in the exchange relationship will be reduced (Kull and Ellis, 2016). According to Provan and Gassenheimer (1994), higher dependencies on external parties will result in decreased resource security and increased vulnerability and uncertainty.

This paper hypothesizes that SD and BD have different effects on three SCQR components, namely psychological factor, probability and magnitude.

If a buyer-supplier relationship is characterized as "high BD", the situation whereby the "supplier is more powerful" might be perceived by purchasing decision makers as a worrying

signal with regard to quality problems. This is because where there is supplier dominance (i.e. high BD), the supplier has high information asymmetry advantages over the buyer (Cox, 2001). According to Webster Jr and Wind (1972), purchasing decision makers have similar psychological responses to those of consumers, because of the combined effect of information filtered through the external environment. Marketing studies into consumer decisions explain that lack of information pre-processing might increase the risk perception (Ha, 2002). Accordingly, this study suggests that the presence of high BD will positively affect the psychological factor in the perceived SCQR of purchasing decision makers, for example with regard to non-preventability and non-controllability, due to the information asymmetry disadvantage. In a setting of SD, the situation will be completely reversed. In order to improve the activities and ability of suppliers to satisfy the organization's quality requirements, a company will usually implement process-oriented quality management programs (Choi and Liker, 1995). However, such SCQM programs might be determined by the commitments of the business partners. If the supplier is highly dependent on the buyer (i.e. high SD), a high supplier commitment can be expected (Carr et al., 2008). In this case, the purchasing decision maker should find the QM programs are easier to implement and the quality problems are perceived as more controllable. Consequently, the present study suggests that managers' perceptions of SCQR may be negatively affected by SD.

H4: BD is positively associated with the psychological factor of SCQR.

H5: SD is negatively associated with the psychological factor of SCQR.

A key argument in RDT is that the success of an organization is determined by its ability to access resources (Pfeffer and Salancik, 2003). The accessibility of quality information could be regarded as a kind of intangible resource. Imbalance between the information required and the information actually processed within the organization is a key reason why a company seeks information beyond the intra-organization boundary, moving instead to an inter-organization model (Sander de Leeuw et al., 2015; Pfeffer and Salancik, 1978). The product quality improvement programs of the buyer may be dependent on suppliers for their technical expertise. In the context of QM, collecting quality information outside rather than inside the organization would be more difficult and costly. According to Sousa and Voss (2002), quality information comprises two aspects, namely product quality and process quality. Product quality information is usually available for the purchasing decision makers, while process quality information related to suppliers' process variability is not always obtainable, especially when there are no explicit agreements between the business partners (Sousa and Voss, 2002, Zu and Kaynak, 2012). This study argues that BD makes it more difficult for buyers to assess the quality information from suppliers, especially the process quality information. The RDT supports the argument that reliance on external parties can raise uncertainties in obtaining external information (Kulangara et al., 2016). By reducing purchasing decision makers' ability to process the quality information, BD increases the likelihood of SCQR. Conversely, when the supplier is dependent on the buyer, there is less likelihood of quality problems being raised in the supply chain, because of the greater commitment to the buyer-supplier relationship, and closer collaboration. According to Hallen et al. (1991), suppliers that are highly dependent on other companies are more likely to satisfy the buyer's needs in terms of product processes, product specification and inventory. It can be expected that buyers' requirements with regard to quality improvement will receive more positive responses and results from dependent suppliers.

H6: BD is positively associated with the probability of SCQR.

H7: SD is negatively associated with the probability of SCQR.

"Substitutability" is a key economic concept that describes the resource dependence (Jacobs, 1974). Specifically, this concept views a party as dependent when other sources are not available (Caniels and Gelderman, 2005). From the perspective of RDT, substitutability can be determined by two elements, namely the "availability of alternative sources" and the "costs that are associated with switching suppliers" (Caniels and Gelderman, 2005). Accordingly, high SD means that there are fewer alternative sources for the buyers to obtain the resources, and the costs of switching suppliers are high. The negative effects of supply chain quality problems can be magnified by a lack of alternative suppliers. For example, if there are few alternative suppliers, buyers are only able to ask their original supplier to remake or resupply the materials or components. Moreover, the high switching costs mean that the buyers will bear a more serious brunt of the costs related to the supply quality problems. For example, the investments in the supply relationship and in tangible resources such as dedicated equipment might turn out to be sunk costs (i.e. costs that cannot be recovered) when switching suppliers. Therefore, this study argues that the magnitude of SCQR will be enlarged with increased BD. According to Casciaro and Piskorski (2005), power imbalance in an inter-organizational relationship is due to resource dependence. Specifically, power in the context of the buyer-supplier relationship can be regarded as the function of *"(1) dependence on the other party, and (2) the use of dependence to leverage change in accord with the intentions of the less dependent firm"* (Hart and Saunders, 1997, P.26). With increased SD, buyers have greater power in the transactions with their suppliers, which enables them to influence the suppliers to act in the desired ways. When SCQR occurs, the more powerful buyers ensure that the suppliers help to solve the problems by exerting coercive power through threats of various punishments that are detrimental to the suppliers, such as reduced order volume or withdrawal of business (Zhao et al., 2008). Moreover, with SD, the high proportion of sales volume makes the suppliers keen to continue the relationship with their existing customers. To secure future transactions, suppliers should be more willing to share the loss of SCQR. Therefore, from a power relationship perspective, when buyers have more power over their suppliers (i.e. SD), those buyers will suffer less impact of SCQR:

H8: BD is positively associated with the magnitude of SCQR.

H9: SD is negatively associated with the magnitude of SCQR.

2.3. Intention to Adopt Quality Management Practice

The empirical study of and related measurement scales for quality management have been well developed over the last two decades, thus providing practitioners and academics with fundamental understanding of the related concepts (Kaynak, 2003, de Sousa Jabbour et al., 2014, Flynn et al., 1995, Nair, 2006). However, scholars widely criticize the measurement of QM as a single construct, which could be one of the reasons why there are inconclusive results in the performance outcomes when applying the QM practices (Zhang et al., 2014, Zhang et al., 2012). To fill this gap, OM researchers advocate the need to customize the QM in order to fit with the contextual factors and reflect the decision maker's strategic orientations (Sitkin et al., 1994, Westphal et al., 1997, Zhang et al., 2012). Here, the aforementioned exploration-exploitation concept can provide a conceptual framework to customize and classify the QM practices based on the decision-maker's strategic orientation (Zhang et al., 2014). In this study, the two different forms of QM are classified based on the conceptual framework of exploitation-exploration, i.e. QELM and QERM. QELM refers to the management practices that aim at refining and improving the existing process to improve firms' quality performance. For example, QELM includes activities such as the practices for ISO9000 certification through

managing the stable and familiar process (Wu and Zhang, 2013). However, firms can also improve their quality performance through innovating the production process and exploring the unknown. Therefore, reflecting another orientation, QERM refers to the practices that aim to *"explore unknown and to identify and pursue novel solutions"* (Zhang et al., 2014, P.84). More specifically, QERM includes experimenting and searching for innovative process (Sitkin et al., 1994).

To be noted, study measures the adoption of QM by adoption intention (Liu et al., 2010). The reasons for using this measurement are two-fold. First, focusing on the adoption intention allows the researcher to measure both dependent and independent variables at the same point in time, which therefore avoids methodological concerns, such as endogeneity. Second, according to Liu et al. (2010), a critical challenge when making the adoption decision is that many other factors that are unobservable, such as resource constraints, could be playing a role in the process and the results would be unclear. Furthermore, it has been widely accepted that the actual behaviour is highly correlated with the behaviour intention (Liu et al., 2010). Thus, the adoption intention should be reliable to predict the actual behaviour. This notion is supported by Ajzen and Fishbein (1980, P.41), who argue that, *"intention is the immediate determinant of behavior, and when an appropriate measure of intention is obtained, it will provide the most accurate prediction of behavior"*. In line with this argument, this paper proposes that the actual adoption of a particular QM orientation (i.e. QELM and QERM), can be predicted by the decision-maker's adoption intention.

The explorative organizational activities have the characteristics of risk-taking, and can be seen as a form of risky decision (March, 1991, Zhang et al., 2012). According to Geroski et al. (1993), exploration activities that create novel competencies that motivate the ongoing innovation within an organization can generally promote superior long-term returns. However, such benefits might come with high costs and uncertainties. Gupta et al. (2006) argue that the benefits brought by the exploration activities are balanced by the higher level of risk inherent in the related activities, which require significant investment in opportunities that are characterized as highly uncertain payoffs. This paper proposes that the QERM, which involves risk-taking activities such as exploring improvement of new products and processes, identifying new customers and exploring new needs for customers (Zhang et al., 2012), might be negatively associated with the overall perception of SCQR. In other words, when decision makers perceive a relatively high level of SCQR, they should be less likely to engage in proactive QM activities.

The previous literature widely considers the risk perception factor as a significant determinant in the decision-making process. According to Sitkin and Weingart (1995), the degree to which individuals make risky decisions will be negatively associated with their level of perceived risk in the situation. In the field of entrepreneurship research, Simon et al. (2000) find that managers' risk perception is negatively associated with the decision to start a venture, which means that individuals start ventures because they do not perceive the risk involved, rather than that they accept a high level of risk. Most recently, using large-scale survey data, Nguyen et al. (2017) empirically show that investors' financial risk perception is negatively associated with their risky-asset allocation decision. However, the prospect theorists hold another view. According to Kahneman and Tversky (1979), when firms are under threat, they are more likely to embrace more risks. Abebe and Angriawan (2014) provide empirical support for this notion that firms that face intensive market uncertainties will be engaged in more exploratory activities.

H10: Overall SCQR is negatively associated with the intention to adopt quality exploration management.

According to Gatignon et al. (2002), successful exploitation provides a buffer from the shocks of exploration and entails less risk than the exploration activities. When firms' resources become scarce and firms' external environment becomes unstable, organizations are more likely to focus on the existing product competencies, adjusting the product quality with minimal improvements and incremental repositioning (Levinthal and March, 1993). Representing the firms' exploitation orientation, the QELM can be regarded as a reactive management practice. This study argues that the intention to adopt QELM will be motivated particularly by a decision maker's perception of greater SCQR. This argument is consistent with Voss et al. (2008, P.151) assertion that *"in the face of sure losses, decision makers prefer alternatives that curtail losses over those promising further gains"*. The economic psychologist views this situation as a *"reverse sunk cost effect"* (Zeelenberg and Van Dijk, 1997). In such a situation, managers prefer financial options that promise smaller but certain returns rather than those financial options with greater but uncertain financial returns (Thaler and Johnson, 1990).

The proposition of the positive relationship between perceived SCQR and QELM is also supported by the threat-rigidity perspective (Sitkin and Pablo, 1992, Staw et al., 1981). A situation of looming losses and a loss of control over operating decisions and outcomes could promote decision makers' risk aversion and commitment to protect an organization's current status (Dutton and Jackson, 1987). According to Voss et al. (2008), an organization that faces a threatening environment will aim at the tried and tested competencies with more predictable outcomes to limit the potential loss. Extending this logic, we argue that high perception of SCQR leads to risk aversion and intention to adopt QELM, which focuses on controlling the stable and familiar processes rather than seeking innovative approaches for improving quality performance (Wu and Zhang, 2013).

H11: Overall SCQR is positively associated with the intention to adopt quality exploitation management.

3. METHODOLOGY

3.1. Data Collection

To collect information about how managers perceived SCQR and related factors in the theoretical framework, a large scale of questionnaires were sent to the potential respondents. Managers who were at the decision-making level were the target informants of this study. To facilitate the research purpose, the unit of analysis was the buyer's transaction with the supplier (Ellis et al., 2010). The survey data were collected through a large online survey platform in China, namely Sojump.com (SJ). The service of the SJ Company is reliable, because many empirical business studies in China that have been published in top-ranked journals have successfully employed this platform (Jin et al., 2013, Ye et al., 2016, Zhou et al., 2013).

To approach the potential respondents, three email contact lists were made, and emails were sent to the contacts that included the information sheet, the covering letter and the Web link to the online survey. A merged contact list containing contact information that was provided by GISTI and obtained from the Zero2IPO database was used as the sample for this study. Zero2IPO is a leading research institute in China that has a large amount of company information (Gu and Lu, 2014). Overall, the contact list included 1,384 manufacturing firms that deal with furniture, metal, computer equipment, pharmaceuticals and medical devices. Excluding the replicated information, 1,021 emails were sent. However, 356 contacts either returned the email or the email address was no longer valid. A total of 483 responses were

eventually received, but 127 were incomplete responses. Therefore, 316 valid responses were received. The effective response rate was thus 30.95% (i.e. 316/1021).

In accordance with the method suggested by Armstrong and Overton (1977), a *t*-test was conducted to assess whether the respondents and non-respondents were significantly different ($p<0.05$) in the related demographic information. No significant results were identified in the *t*-test of respondent and non-respondent difference on number of employees (p=0.283) and annual sales revenue (p=0.764). According to Swafford et al. (2006), the non-response bias can also be used to assess the significance of the difference between the early and late returned surveys. Regarding the company size (i.e. annual sales revenue and number of employees), the results of the *t*-test indicated that the difference between early respondents (n=212, received within the first four weeks) and late respondents (n=104, received within the fifth week and later) was insignificant. Therefore, it was concluded that non-response bias did not threaten the research outcome (Armstrong and Overton, 1977).

Table 1. Profile of respondents

	Number of firms	Percentages (%)
Company Size (Number of employees)		
≤50	10	3.2
51-300	116	36.7
301-2000	144	45.6
>2000	46	14.5
Annual Sales Revenue (CNY ¥)		
≤10 Million	15	4.7
10 Million – 30 Million	44	13.9
30 Million – 50 Million	81	25.6
50 Million – 200 Million	98	31.0
>200 Million	78	24.7
Company's ownership		
Local Enterprise	231	73.1
Sino-Foreign Joint Venture	61	19.3
Foreign-Owned Enterprise	24	7.6
Industry Sectors		
Computing machinery	43	13.6
Radio, television & communication equipment	146	46.2
Automotive	76	24.1
Chemicals and Pharmaceutical	26	8.2
Other manufacturing	25	7.9

3.2. Common Method Bias

A CFA approach was adopted to perform the Harmon's one-factor model (Cao and Zhang, 2011, Flynn et al., 2010). Specifically, a latent variable comprising forty selected items was created to assess the uni-dimentionality, i.e. model fitness. The results indicate that the model fit indices, with RMSEA=0.173, NFI=0.189, NNFI=0.154, CFI=0.201 and Normed X^2=10.379, are far worse than the acceptable values. Thus, as the model fit of the single-factor model is not acceptable, the threat of CMB in this study is small (Cao and Zhang, 2011, Flynn et al., 2010). Following Paulraj et al. (2008) and Widaman (1985), a two-step CFA comparison method was conducted to reinforce the result. Firstly, a CFA model including nine proposed factors was established. Then, the compared model was created by adding a method factor into the CFA model. The inclusion of the method variable did not make a significant difference to the original measurement model. Specifically, the factor loadings in the compared model and the CFA model were almost the same, and the t-value for the factor loadings all remained significant with the inclusion of a method factor. In addition, the method factor accounted for only 15.1% of the total variance, and only marginally improved the model fit indices of the measurement model (RMSEA by -0.005, NFI by 0.018 NNFI by 0.014, CFI by 0.015 and Normed X^2 by -0.155). Thus, according to Widaman (1985), the CMB is not a serious problem in this study, because the results of the measurement model did not change significantly when including a method factor.

3.3. Reliability and Validity of Indicators

The reliability coefficient of the indicators[1] with their corresponding latent variables range from 0.601 to 0.924, which are all greater than 0.50. The t-values of the factor loadings range from 10.509 to 27.491 and are thus all greater than the threshold value of 2.0 (see Appendix A). Moreover, the composite reliabilities and the AVE are all greater than 0.801 and 0.525 respectively. The model fit indices of the measurement model indicate good model fit: RMSEA=0.045, NNFI=0.942, CFI=0.948 and Normed X^2=1.648. Therefore, the indicators used for measuring the proposed factors have acceptable convergent validity (O'Leary-Kelly and Vokuraka, 1998, Flynn et al., 2010). Our analysis also supports the discriminant validity, because the values of inter-correlation are all below 0.70 (Mackenzie et al., 2005). The discriminant validity was assessed through comparing the square root of the AVE with the inter-correlation (Hair et al., 2009). The square root of the AVE value are all greater than other inter-correlation values. This result provides good evidence that the criteria for discriminant validity have been met.

4. RESULTS

Before examining the hypotheses through assessing the path coefficient, it is necessary to evaluate the model fit indices of the structural model (Fullerton et al., 2014). The goodness-of-fit statistics indicate a good model fit for the structural model. Specifically, the model fit indices, such as NNFI at 0.877, IFI at 0.889 and CFI at 0.888, exceed the threshold value for a reasonable fit of 0.80 (Cao and Zhang, 2011). The RMSEA is below the acceptable maximum level of 0.08 and the SRMR, at 0.072, is also below the acceptable level of 0.10 (Browne and Cudeck, 2003). Although the normed X^2 index of 2.217 is slightly greater than the rule-of

[1] Given the measurement scales of risk factors of SCQR were newly developed, we have conducted a robust scale development process to confirm the validity and reliability or the items. The results of the scale development are available fro the authors as a supplement document.

thumb of two (Kline, 2011), it is still below the acceptable level of five (Schumacker and Lomax, 2004). In summary, the structural model has a good model fit for the data. The results of the hypotheses testing are summarized in Table 2.

First, because the effects of risk probability (β=0.354; t=6.247; p<0.001), risk magnitude (β=0.187; t=3.380; p<0.001) and psychological factor (β=0.195; t=3.508; p<0.001) on overall risk perception are positive and significant, H1, H2 and H3 are all supported. Second, as expected, all antecedent factors significantly impact on the psychological factor. Specifically, the standardized coefficients of paths from BD (β=0.256; t=3.019; p<0.001) to psychological factor are positive and significant. Thus, H4 is supported. Given that the negative relationship between SD and psychological factor is significant (β=-0.431; t=5.488; p<0.001), H5 is also supported. Regarding the antecedents of risk probability, this study confirms H7, because the negative relationship between SD and risk probability (β=-0.276; t=-3.887; p<0.001) and risk probability is significant. Interestingly, given that the standardized coefficient of path from BD to risk probability (β=0.110; p=0.159>0.05) is not significant, H6 is rejected. BD (β=0.502; t=5.768; p<0.001) show significant relationships with risk magnitude and therefore provide support for H8. However, no significant relationship is found between supplier dependence and magnitude of SCQR (β=0.053; t=0.746; p=0.460>0.05). Thus, the empirical results fail to support H6. The structural model finds significant relationships between the overall perception of SCQR and the intention to adopt QERM (β=-0.389; t=-6.703; p<0.001) and QELM (β=0.330; t=5.662; p<0.001). The overall perception of risk accounts for 15% and 11% of the variance in QERM and QELM respectively.

Table 2. Results of the Structural Model

Hypothesized Relationship	Standardized Path Coefficient (p-value)	t-value	Supported or Not Supported
H1: Risk Probability -> Overall Risk	β=0.354 (p<0.001)	6.247	Supported
H2: Risk Magnitude -> Overall Risk	β=0.187 (p<0.001)	3.380	Supported
H3: Psychological Factor -> Overall Risk	β=0.195 (p<0.001)	3.508	Supported
H4: Buyer Dependence -> Psychological Factor (+)	0.256 (p<0.01)	3.019	Supported
H5: Supplier Dependence -> Psychological Factor (-)	-0.431 (p<0.001)	-5.488	Supported
H6: Buyer Dependence -> Risk Probability (+)	0.110 (p=0.159>0.05)	1.408	Not Supported
H7: Supplier Dependence -> Risk Probability (-)	-0.276 (p<0.001)	-3.887	Supported
H8: Buyer Dependence -> Risk Magnitude (+)	0.502 (p<0.001)	5.768	Supported
H9: Supplier Dependence -> Risk Magnitude (-)	0.053 (p=0.456>0.05)	0.746	Not Supported
H10: Overall Risk -> Quality Exploration (-)	-0.389 (p<0.001)	-6.703	Supported
H11: Overall Risk -> Quality Exploitation (+)	0.330 (p<0.001)	5.662	Supported

To demonstrate the need to include the formative risk perception model, a post hoc analysis is conducted, in which the risk factors are omitted from the structural model. First, the psychological factor, probability and magnitude of SCQR are removed from the structural model. Then, the direct relationships between two antecedents and overall perception of SCQR are established. Following Ellis et al. (2010), the R^2 is adopted as a key criterion to compare the proposed model with the alternative model in which the overall perception of SCQR is omitted. Two antecedent factors, i.e. SD and BD, account for only 14% of the variance in overall perception of SCQR. Compared with the theoretical model proposed in this study, the alternative model had a 26.32% of reduction in explaining the variance of overall perception of SCQR. This indicates that the inclusion of the three risk factors enhances the ability to

explain the overall perception of SCQR. In summary, the empirical results provide strong support for the inclusion of the formative risk perception model in the risky decision-making process, as suggested by Yates and Stone (1992) and Ellis et al. (2010).

5. IMPLICATIONS AND CONCLUSION

This study adopts the risky decision-making model (Yates and Stone, 1992) to understand the nature of perceived SCQR. A three-layer theoretical model, which consists of (1) situation, (2) risk appraisal and (3) intention to adopt QM, is examined by a set of rigorous analyses. Sample data from 316 Chinese companies was applied to test the theoretical model. Drawing on RDT, the relationships between the antecedent factors and three risk factors are empirically validated. In addition, the risk appraisal model is empirically verified in a formative factor structure. That is to say, the overall perception of SCQR (i.e. a single item construct) is significantly and simultaneously influenced by three proposed risk factors, namely probability of SCQR, magnitude of SCQR and psychological factor. This study also examines the effect of overall perception of SCQR on the behavioural intention to adopt differently oriented QM practices, i.e. QERM and QELM.

Based on the risky decision-making process model, this study contributes to the body of SCRM by enhancing the investigation of the situational factors that might impact on the supply chain risks. OM researchers pay considerable attention to identifying and verifying the practices or capabilities to deal with the SCR. Although studies among the existing literature have attempted to offer insights on how to manage product quality risk in a supply chain context (Tse and Tan, 2011, 2012; Zhu et al., 2007), the mechanism whereby the factors impact on SCQR has received limited attention. By examining the effects of buyer dependence and supplier dependence, this study contributes to the SCRM study from the perspective of RDT. Although Ellis et al. (2010) also adopt the RDT to propose and examine the antecedents of the risk representation factors, the literature is limited to the perspective of environmental factors of supply markets. In line with the RDT, this study adds to the SCRM literature by directly observing how the dependency between buyer and supplier could impact on the managerial internalization of SCQR. Ketchen and Hult (2007) argue that interdependency between supplier and buyer might be helpful to establish a stable supply chain relationship and therefore help to manage the uncertainties in the supply chain. Given the inconsistent discussion of RDT in previous researches, the investigation of the roles of buyer dependence and supplier dependence in influencing the representation of SCQR can offer valuable insights for the development of RDT in OM research.

Furthermore, the associations between SCQR and customized QM practices (i.e. QELM and QERM) as studied in this research are not investigated in the existing literature. Drawing on the view of ambidexterity, Zhang et al. (2012) categorize the QM as two differently oriented practices. This study extends their research by linking the perception of SCQR with the intention to adopt QERM or QELM. This is also one of the few OM studies to understand the QM practices from a behavioural viewpoint. A key research implication is that managers' preference with regard to the QM strategies could be significantly driven by the risk perception. Specifically, the QERM with risk-taking orientation (Zhang et al., 2012) is negatively associated with the risk perception, while the QELM with risk aversion orientation (Zhang et al., 2014) is positively associated with the risk perception. This study fills the research gap by identifying the drivers of (or barriers to) adopting the QM practices in the decision-making process.

One of the limitations of this study is that the model is observed from the perspective of a single nation, China. Although China is a global manufacturing hub, the results are not necessarily generalizable, and it is therefore suggested that future research could extend the current model to different country contexts. This study also suggests that future research could compare the risk perception of managers from developed and developing countries. Moreover, although questionnaire based research is widely adopted in the OM literature, this research method suffers some limitations with regard to understanding risk perception, such as common method bias and the endogeneity problem. Future research could adopt an experimental research design, such as functional magnetic resonance imaging (fMRI), to more accurately capture the risk perception.

As with other empirical research in the area of SCRM, this study is limited by a relatively small sample size. Although the power analysis conducted in a previous section indicated that the sample size of 316 has sufficient statistical power to explain the structural model, this study suggests that future research should consider a larger sample size to re-examine the theoretical model. Also, this study observes the cross-sectional data, which reflects only the current situation. Future research could design a longitudinal study to comprehensively analyse the dynamic relationships between the concepts proposed in this study.

The use of single respondents is not without limitations, as it might cause the common method bias. However, several well-established statistical tests indicate that the threat of this potential bias is minimal. In addition, further studies could compare the objective assessment of SCQR with the perceived SCQR to understand whether the risk is overestimated or underestimated. It would also be stimulating to scrutinize in what situation the overestimation (or underestimation) of SCQR occurs.

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APPENDIX

Item Name	Scale item	Standardized Item Loading	SE	*t*-value*
Buyer Dependence (Terpend and Krause, 2015; Krause et al., 2007) (Composite Reliability=0.850; Mean=4.829; AVE = 0.587)				
BD1	Switching to a new supplier for our key supply materials/components would take a lot of effort.	0.869	-	-
BD2	We do not have a good alternative to the supplier for our key supply materials/components.	0.911	0.054	16.101
BD3	We are very dependent on the supplier who supplies us with the key supply materials/components.	0.863	0.053	19.174
BD4	There are many competitive suppliers for our key supply materials/components (Reverse Coded).	0.892	0.051	20.199
Supplier Dependence (Terpend and Krause, 2015; Krause et al., 2007) (Composite Reliability=0.870; Mean=4.855; AVE = 0.574)				
SD1	Replacing us would require a lot of effort by the supplier who supplies key materials/components to us.	0.769	-	-
SD2	The supplier who supplies key materials/components to us does not have a good alternative to replace us.	0.797	0.083	14.273
SD3	The supplier who supplies key materials/components to us is very dependent on us.	0.803	0.074	14.399
SD4	The supplier who supplies key materials/components to us will perform poorly if our operations do not perform well.	0.746	0.078	13.288
SD5	If their relationship with our company were terminated, it would not hurt this key supplier's operations (Reverse Coded).	0.665	0.076	11.691
Risk Probability (Newly Developed) (Composite Reliability=0.801; Mean=3.236; AVE = 0.580)				
RP1	There is a high probability that the key supply material from the key supplier cannot meet the quality standards.	0.743	-	-
RP2	There is a high probability that the key supplier will be unable to commit to quality improvement of the key supply material.	0.909	0.096	12.934
RP3	There is a high probability that the key supplier will supply us the key supply material with poor quality packaging.	0.601	0.089	10.147
Risk Magnitude (Newly Developed) (Composite Reliability=0.864; Mean=5.543; AVE = 0.614)				
MA1	A lack of awareness of the usage of defective purchased material in our product would have severe negative financial consequences for our business.	0.802	-	-
MA2	Key suppliers' inability to supply qualified material that conforms to agreed specifications would seriously jeopardize our business performance.	0.773	0.071	14.176
MA3	The quality problem of the key material supply from our key supplier will significantly and negatively impact our production	0.779	0.071	14.314
MA4	The quality problems that occur in the logistics process will cause significant customer loss.	0.779	0.067	14.306
Psychological Factor (Newly Developed) (Composite Reliability=0.845; Mean=3.905; AVE = 0.525)				
PSY1	Please rate to what extent you can avoid the negative impact of the supply chain quality problems happening to your company through your personal knowledge and experience, if exposed to this risk. (1=Controllable; 7=Uncontrollable)	0.644	-	-
PSY2	Do you think the supply chain quality problems can be easily reduced or are they hard to reduce? Please rate the difficulty of this	0.623	0.098	9.446

	risk. (1=Easily; 7=Difficult)			
PSY3	Are the supply chain quality problems ones that you can think about reasonably calmly or are they the risks that you truly dread? Please rate the level of dread potential. (1=Low dread; 7=High dread)	0.795	0.113	11.4
PSY4	Overall, are supply chain quality problems preventable or non-preventable? (1=Preventable; 7=Non-preventable)	0.684	0.105	10.183
PSY5	Are supply chain quality problems the ones that you worry will threaten you personally (e.g. job position, salary etc.) or it does it not matter to you? (1= No Impact; 7 = Great Impact)	0.849	0.112	11.841
Quality Exploration (Zhang et al., 2012; Zhang et al., 2014) (Composite Reliability=0.949; Mean=5.030; AVE = 0.824)				
QERM1	Continually improving all aspects of products and processes, rather than taking a static approach.	0.924	-	-
QERM2	Consulting our customers early in the design efforts for our product.	0.887	0.035	25.486
QERM3	Encouraging the employees of our company to learn how to perform a variety of tasks.	0.912	0.034	27.491
QERM4	Encouraging our manufacturing team members to work interactively with each other for cross-functional cooperation.	0.908	0.038	27.18
Quality Exploitation (Zhang et al., 2012; Zhang et al., 2014) (Composite Reliability=0.903; Mean=5.373; AVE = 0.699)				
QELM1	Monitoring the production processes using statistical process control.	0.804	-	-
QELM2	Regularly surveying our customers' needs.	0.857	0.068	17.04
QELM3	Holding frequent group meetings where our team members can really discuss things together.	0.828	0.064	16.326
QELM4	Providing training and development in existing workspace skills, on a regular basis.	0.855	0.063	17.001
Notes: *: All item loadings are significant $p<0.01$ level a: Fixed parameter				