# Managing Quality Risk in Supply Chain to Drive Firm's Quality Performance


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# Managing Quality Risk in Supply Chain to Drive Firm's Quality Performance: The Mediating Role of Supply Chain Quality Integration

**Abstract**

**Purpose** – As quality becomes increasingly prioritized in supply chain management, understanding how supply chain quality risk management (SCQRM) practices impact quality performance (QP) is essential. This study investigates the effects of two SCQRM practices—risk prevention (RP) and proactive product recall (PPR)—on QP, with a particular focus on the mediating role of supply chain quality integration (SCQI).

**Design/methodology/approach** – A structured survey was administered to gather data from 400 Chinese manufacturing firms. Structural equation modeling was employed to evaluate the proposed relationships among SCQRM practices (RP and PPR), SCQI, and QP.

**Findings** – The findings reveal that both RP and PPR significantly and positively influence QP. Specifically, in the structural model, RP exerts a positive effect on SCQI, while PPR also positively impacts SCQI. Additionally, SCQI serves as a mediator between RP and QP, as well as between PPR and QP.

**Originality/value** – This study contributes to the supply chain management literature by elucidating the beneficial effects of RP and PPR on QP and identifying SCQI as a key mediating factor in these relationships. Leveraging Information Processing Theory (IPT), the study provides new theoretical insights into the mechanisms through which SCQRM enhances QP via SCQI.

**Keywords:** Supply chain quality risk management, Risk prevention, Proactive product recall, Supply chain quality integration, Quality performance, Information processing theory

**Paper type:** Research paper

# Managing Quality Risk in Supply Chain to Drive Firm's Quality Performance: The Mediating Role of Supply Chain Quality Integration

## 1. Introduction

In an increasingly complex and competitive environment shaped by globalization and shortened product life cycles, manufacturing supply chains encounter heightened vulnerabilities (Chowdhury *et al.*, 2021). Disruptions such as the COVID-19 pandemic and inter-organizational conflicts further exacerbate supply chain fragility. Consequently, supply chain risk management (SCRM) has become a priority in both scholarly research and industry practice (Sodhi *et al.*, 2012; Tang *et al.*, 2014). Within this framework, supply chain quality risk management (SCQRM)—a specialized area within SCRM—has garnered significant scholarly attention, providing valuable insights (Xie *et al.*, 2011; Foster, 2008; Kaynak and Hartley, 2008; Sato *et al.*, 2020). Supply chain quality risk (SCQR) is defined as "the inherent quality uncertainty of raw materials in supply chain entities, which triggers a cascading effect that permeates a multi-tier supply network" (Tse *et al.*, 2021). SCQR can not only severely impact a company's reputation and financial stability but also lead to substantial market share loss and enduring brand damage (Hora *et al.*, 2011; Ma *et al.*, 2022). Thus, effectively understanding and managing these risks is crucial for firms to sustain competitive advantage and ensure long-term viability. Although SCQRM has been identified as a strategy to enhance supply chain resilience, thereby mitigating the adverse effects of supply-related disruptions (Clemons and Slotnick, 2016), the specific link between SCQRM and quality performance (QP) remains underexplored. This study aims to investigate whether and through which mechanisms SCQRM influences QP.

Previous studies have classified SCQRM practices into preventive and responsive categories (Thun and Hoenig, 2011). These practices aim to address potential quality risks in the upstream supply chain and mitigate the negative impacts of product recalls in the downstream network (Tse *et al.*, 2018). However, prior research has primarily differentiated upstream and downstream SCQRM practices on a theoretical basis. This paper seeks to empirically measure preventive and responsive SCQRM practices and examine their effects on QP. Following definitions from previous studies, we adopt risk prevention (RP) as a representation of preventive quality risk management practices aimed at mitigating risks within the supply chain (Tse and Tan, 2012). Additionally, proactive product recall (PPR) is utilized as a proxy for responsive quality risk management practices, encompassing preemptive strategies and procedures designed to manage recalls (i.e., remediation plans) (Tse *et al.*, 2018).

Consequently, effective SCQRM requires synergy between upstream and downstream practices; that is, supply chain members must interpret signals from SCQRM and respond appropriately to enhance performance (Yu *et al.*, 2019).

To provide a more comprehensive explanation of the relationship between SCQRM and QP and to clarify the underlying mechanisms of influence, we draw on information processing theory (IPT; Galbraith, 1974). This theoretical perspective describes supply chain quality integration (SCQI) as an information-intensive exchange of quality data among supply chain partners (Srinivasan and Swink, 2015). IPT posits that uncertainty necessitates either a reduction in information processing needs or an enhancement in information processing capabilities (Daft and Lengel, 1986). Within the context of supply chain management, IPT elucidates how SCQRM and SCQI can identify and respond to quality-related risks through systematic information acquisition, interpretation, and application (Srinivasan and Swink, 2015; Yu *et al.*, 2019). SCQRM practices, including RP and PPR, depend on robust information processing mechanisms to ensure that quality information is efficiently acquired, interpreted, and applied across all stages of the supply chain, thereby facilitating improved quality risk management (Lu *et al.*, 2023; Tse *et al.*, 2018). SCQI, as an information processing mechanism that enables intensive quality information exchange across the boundaries of suppliers, internal departments, and customers, strengthens firms' ability to respond effectively to quality risks by promoting information fluidity and consistency within the supply chain (Flynn *et al.*, 2010; Huo *et al.*, 2019). Through SCQI, firms can achieve real-time access to quality information, standardized interpretation, and rapid action, thereby mitigating quality management risks and enhancing overall quality performance in uncertain environments. Consequently, SCQI not only serves as a mechanism for information integration but also acts as a critical bridge between SCQRM and QP, enabling organizations to better address the complexities and quality challenges inherent in supply chain operations.

Our objective is to provide empirical insights into the impact of these practices on distinct segments of the supply chain, including upstream suppliers, internal operations, and downstream customer interfaces. SCQI is conceptually defined as the seamless incorporation of quality management across a company's upstream suppliers, downstream customer operations, and internal functions. Viewed as an extension of supply chain integration (SCI) to encompass quality considerations, SCQI is recognized for its positive influence on QP (Huo *et al.*, 2014). Companies with well-developed SCQRM capabilities can effectively integrate quality across their supply chains, offering clear guidelines to supply chain partners for managing products, minimizing recalls, reducing damage, and preventing risks. Accordingly, our study centers on the relationship between SCQRM practices—specifically, RP and PPR—

and QP, with SCQI as a mediating factor. We address two primary questions: (1) How do RP and PPR contribute to SCQI? and (2) Through which pathways within SCQI do RP and PPR influence QP, either directly or indirectly?

The subsequent sections of this paper are organized as follows. Section 2 presents a literature review and outlines the hypotheses regarding the relationships among SCQRM, SCQI, and QP. Section 3 describes the data collection procedures, defines variables, and delineates the study's operational framework. Section 4 applies structural equation modeling to assess the relationships involving RP, PPR, and QP and examines the mediating role of SCQI. Finally, Section 5 summarizes the findings and discusses the study's implications for both scholarly research and practical application.

## 2. Literature review and hypotheses development

### 2.1 Supply chain quality risk management

SCQR is defined as "the inherent quality uncertainty of raw materials in supply chain entities, which triggers a cascading effect that permeates a multi-tier supply network" (Tse *et al.*, 2021). As supply chains become increasingly complex and quality demands rise (Tse and Tan, 2012), quality risk has emerged as a pervasive challenge for manufacturing companies (Sato *et al.*, 2020). SCQR can adversely impact a company's reputation, market share, and brand; thus, understanding and managing SCQR is essential for business survival and growth (Hora *et al.*, 2011; Ma *et al.*, 2022). Consequently, SCQRM has become a critical area of research (Van Heerde *et al.*, 2007). SCQRM is specifically designed to address risks associated with unsafe products that can create cascading effects throughout the entire supply network (Zsidisin and Ellram, 2003; Tse and Tan, 2011; Tse and Tan, 2012). Although prior studies have shown that SCQRM can improve flexibility and reduce the adverse impacts of supply chain security incidents, few have investigated its relationship with QP or the mechanisms driving this impact (Clemons and Slotnick, 2016).

SCQRM involves not only the identification of potential risks but also the assessment of their likelihood, along with the formulation and implementation of proactive and reactive response strategies (Thun and Hoenig, 2011). Additionally, both ex-ante and ex-post mechanisms are essential in operational risk management (Lewis, 2003). In this context, theoretically linked to both upstream and downstream segments of the supply chain, Tse *et al.* (2018) provide valuable insights by examining how preventive and responsive quality risk management practices affect firm performance. However, this positive expectation largely stems from theoretical frameworks, while empirical research on the direct and indirect impacts of preventive and reactive quality risk management practices on QP remains limited.

With global supply chains increasingly emphasizing digitalization and information sharing (Rauniyar *et al.*, 2022; Sanders and Ganeshan, 2018; Vedantam and Iyer, 2021), preventive quality risk management practices may require data inputs from downstream customers (Chakravarty *et al.*, 2022). Similarly, responsive quality risk management practices may involve tracing back to upstream suppliers to identify the root causes of quality issues (He *et al.*, 2020; Steven *et al.*, 2014; Marucheck *et al.*, 2011). Therefore, we highlight the need for more in-depth exploration and empirical evidence to clarify how preventive and responsive quality risk management practices influence QP.

### 2.2 Supply chain quality integration

SCI involves the comprehensive alignment of upstream suppliers, downstream customers, and internal departments within a manufacturing company. The primary goal of SCI is to streamline activities such as research and development (R&D), manufacturing, quality control, and logistics. This optimization enhances the flow of products, services, information, capital, and decision-making, ultimately maximizing customer value (Flynn *et al.*, 2010; Huo *et al.*, 2014; Kang *et al.*, 2018). Research on the relationship between SCI and QP has produced mixed findings. For example, Wong *et al.* (2011) and Rosenzweig *et al.* (2003) identified positive impacts of supplier, internal, and customer integration on QP, including delivery reliability and product quality. In contrast, other studies have reported divergent results. Swink *et al.* (2007) found a negative relationship between supplier integration and QP, while Devaraj *et al.* (2007) observed a positive association with supplier integration but no significant effect of customer integration on QP. These varied outcomes highlight the need for a more nuanced understanding of how SCI influences QP. Addressing this complexity, Quesada *et al.* (2008) differentiated firms based on their quality-focused supplier and customer integration strategies. Expanding on this, Huo *et al.* (2014) extended SCI into the realm of quality management, offering new insights into how SCI impacts QP.

SCQI represents an advanced evolution of SCI, emphasizing both strategic and operational collaboration within an organization and with external partners to manage quality-related aspects effectively (Flynn *et al.*, 2010). SCQI comprises three core sub-dimensions: supplier quality integration (SQI), internal quality integration (IQI), and customer quality integration (CQI). SQI and CQI, collectively referred to as external quality integration, involve aligning inter-organizational strategies and practices with external supply chain partners to ensure the synchronization of quality standards and the fulfillment of customer quality requirements (Flynn *et al.*, 2010; Huo *et al.*, 2019). SQI focuses on integrating suppliers' core quality competencies into the organization's processes, while CQI emphasizes aligning these competencies with customer expectations. In contrast, IQI is an internally focused dimension that represents an organization's commitment to synchronizing its internal strategies, practices, and procedures to meet quality requirements. This dimension includes the implementation of cross-functional quality management and teamwork, which are critical for managing activities and addressing quality-related issues within the organization (Flynn *et al.*, 2010; Huo *et al.*, 2019). The strategic emphasis on SQI, IQI, and CQI positions SCQI as a comprehensive approach to strengthening overall quality management within the supply chain context.

Compared to general SCI, SCQI has a more profound impact on the overall performance of the supply chain. SCQI not only enhances the quality level of the supply chain through information processing mechanisms but also optimizes the cost structure by reducing rework, minimizing quality complaints, and improving customer satisfaction (Alkalha *et al.*, 2019; Foster, 2008). Additionally, the application of SCQI enables companies to cultivate a quality-driven culture throughout the supply chain, allowing each link in the chain to operate at elevated standards. This quality-oriented integration enhances firms' market competitiveness and strengthens customer trust in the brand (Lakhal *et al.*, 2006; Lawson *et al.*, 2019). For instance, Toyota's 'Lean Manufacturing' system exemplifies the practical application of SCQI. Through close collaboration with suppliers and rigorous quality standards, Toyota has achieved efficient integration of production and quality management, securing a competitive advantage in product quality (Kumar and Schmitz, 2011; Samson and Swink, 2023). This example illustrates how SCQI enables companies to maintain stringent quality control within highly uncertain supply chain environments, thereby minimizing quality risks and optimizing customer experience.

Recognizing the critical role of SCQI in supply chain management, our study leverages this concept to examine its role in the relationship between SCQRM and QP. While previous studies have underscored the importance of collaboration between focal firms and supply chain partners, these studies have primarily relied on the resource-based view and relational perspectives (Flynn *et al.*, 2010; Yu *et al.*, 2013). Here, we employ IPT as a theoretical lens to conceptualize SCQI as a quality information-intensive exchange between supply chain partners (Srinivasan and Swink, 2015). IPT provides a framework to better understand SCQI's role in facilitating quality information sharing and reducing quality uncertainty. Consequently, we propose that SCQI can function as a quality information processing agent that links SCQRM practices to QP by mitigating uncertainty and enhancing information flow.

Numerous studies have categorized SCI into various dimensions, such as technology integration and activity integration (Wu *et al.*, 2006), or internal and external integration (Yu *et al.*, 2019), with external integration further divided into supplier integration and customer integration (Flynn *et al.*, 2010). However, the objective of this study is not to address the differential impacts of SCQI's multiple dimensions but rather to understand SCQI's role as a quality information processing agent in the influence of SCQRM on QP. Accordingly, we conceptualize SCQI as a second-order aggregated construct composed of three first-order sub-dimensions: SCQI—SQI, IQI, and CQI.

## 2.3 Information processing theory

The central premise of IPT is that as the uncertainty and complexity faced by firms increase, their information needs also rise. To make effective decisions in this environment, organizations must alleviate the stress generated by these elevated information needs by enhancing their information processing capabilities (Daft and Lengel, 1986; Srinivasan and Swink, 2018; Li *et al.*, 2022; Lu *et al.*, 2024).

IPT provides a vital framework for understanding organizational decision-making and problem-solving through processes of information acquisition, interpretation, and application (Galbraith, 1974; Yu *et al.*, 2019). Information acquisition refers to the continuous collection of quality-related information from various nodes of the supply chain to address quality risks and management requirements (Srinivasan and Swink, 2015). Information interpretation involves analyzing and processing this collected information to identify and understand potential risks and quality issues (Yu *et al.*, 2019). Information application is the process of translating acquired and interpreted information into specific management decisions and operational practices (Yu *et al.*, 2019). The relevance of IPT is particularly pronounced in supply chain environments, where effective management requires collaboration among multiple parties and extensive information exchange across organizational boundaries (Srinivasan and Swink, 2015; Wei *et al.*, 2020; Yu *et al.*, 2019).

### *2.3.1 Information processing theory in Supply chain quality risk management*

In the context of SCQRM, IPT provides an analytical framework to guide organizations in addressing quality-related risks by enhancing their information processing capabilities (Srinivasan and Swink, 2015; Yu *et al.*, 2019). For SCQRM, the nature of quality risks determines the critical need for risk information processing, as these risks often involve multiple links upstream and downstream in the supply chain, with each link's response directly influencing the overall QP of the supply chain (Qu and Raff, 2021; Srinivasan and Swink, 2018).

In SCQRM, information acquisition serves as the initial step in identifying and predicting potential quality risks. Organizations with advanced information processing capabilities can more effectively acquire quality-related data from suppliers, internal processes, and customer feedback, enabling them to detect risk signals promptly and implement preventive measures

(Bode *et al.*, 2011). For RP practices, information acquisition allows firms to identify potential quality hazards; for instance, by regularly reviewing supplier qualifications and analyzing raw material data, firms can take proactive steps to prevent quality issues before they arise (Tse *et al.*, 2018). Additionally, in PPR practices, it is equally crucial to obtain timely feedback from downstream customers to promptly identify and address defective products. The quality and timeliness of information acquisition underpin a firm's capacity to execute SCQRM effectively (Yu *et al.*, 2019).

IPT posits that when faced with a substantial amount of uncertain information, organizations must employ effective interpretation mechanisms to integrate and simplify complex information, aiding managers in comprehending the nature and potential impact of risks (Daft and Lengel, 1986). In SCQRM, organizations need to establish linkages between diverse information sources (e.g., supplier data, production process records, and customer complaints) to assess risks comprehensively (Mehrotra and Schmidt, 2021). For example, by analyzing quality data provided by suppliers in conjunction with customer feedback, firms can more accurately determine the likelihood of risk occurrence and the extent of its potential impact (Deiva *et al.*, 2022). Information interpretation goes beyond merely categorizing and storing data; it involves deriving deeper insights from the information, thereby forming the foundation for more targeted quality management strategies (Lu *et al.*, 2023).

In the information application phase, IPT emphasizes the organization's ability to act swiftly based on interpreted information (Yu *et al.*, 2019). RP and PPR are quintessential examples of information applications. Through effective RP measures, companies can implement preventive actions before risks materialize, such as enhancing supplier screening or refining production quality control processes (Tse and Tan, 2012). When PPR is required, firms can recall defective products more rapidly through efficient information transfer and analysis, minimizing the risk of customer dissatisfaction and brand damage (Hosseini-Motlagh *et al.*, 2020). The efficiency of information applications directly influences the effectiveness of SCQRM, determining the speed and precision of a firm's response to quality issues (Schoenherr and Swink, 2012).

### *2.3.2 Information processing theory in supply chain quality integration*

IPT provides theoretical support for understanding the significance of SCQI in quality management (Wei *et al.*, 2020). SCQI involves not only the acquisition and sharing of information but also the in-depth interpretation of information and coordinated execution across departments (Alkalha *et al.*, 2019; Huo *et al.*, 2014). Regarding information acquisition, SCQI ensures that all supply chain partners have timely access to high-quality, quality-related information (Fan *et al.*, 2022). For instance, firms can identify potential quality issues by sharing data with suppliers or assessing the actual quality performance of products through customer feedback (Flynn *et al.*, 2010). This real-time access provides supply chain members with critical insights into product and service quality, enabling proactive intervention before issues arise.

In terms of information interpretation, SCQI streamlines the interpretation process across departments by developing standardized quality metrics and processes. Through data and process standardization, companies enable supply chain members to achieve a unified understanding of quality data, thereby reducing misunderstandings and communication costs (Devaraj *et al.*, 2007). Standardized information interpretation not only enhances collaborative efficiency across the supply chain but also improves the accuracy of decision-making, allowing each link in the supply chain to accurately interpret quality information and take timely action (Danese and Romano, 2011; Schoenherr and Swink, 2012).

For information application, SCQI further enables cross-functional collaboration, ensuring that quality issues can be resolved swiftly and effectively. Through seamless information flow and cross-functional coordination, SCQI empowers organizations to take preventive or corrective actions on quality issues promptly (Deiva *et al.*, 2022; Yu *et al.*, 2019). This rapid response capability makes SCQI particularly valuable in quality risk management.

Thus, applying IPT to SCQRM and SCQI helps organizations identify and manage quality risks across the supply chain while improving overall quality performance by enhancing information flow. By positioning SCQI as a crucial link between SCQRM practices and QP, IPT provides a theoretical foundation for explaining the central role of information processing in quality management. The application of IPT in SCQRM and SCQI indicates that strengthening information processing capabilities can help firms achieve higher-quality performance, especially in uncertain environments.

## 2.4 Supply chain quality risk management and quality performance

### *2.4.1 Risk prevention and quality performance*

Informed by IPT, we conceptualize RP as a strategic approach that involves the acquisition, interpretation, and application of quality-related information to prevent the distribution of hazardous materials to consumers. RP encompasses three primary practices: (1) implementing a comprehensive supplier evaluation system, (2) employing risk management tools to identify and assess quality risks, and (3) developing tailored quality inspection strategies for various product categories. This approach ensures that purchased products meet accepted quality standards, supported by regular supplier audits and on-site visits to maintain supplier QP (Krause, 1999; Kaynak, 2003).

In uncertain environments, clarifying responsibilities among supply chain partners can be challenging (Li *et al.*, 2015). However, by predefining quality responsibilities, partners can collaboratively mitigate supply chain risks (Tse *et al.*, 2018). IPT plays an essential role here, aiding firms in analyzing the supply chain and devising strategies for risk mitigation (Lemke and Petersen, 2013). We propose that enhancing information processing capabilities through RP strengthens risk response, improves quality control, reduces quality risks, and subsequently enhances QP. Consequently, our hypothesis is:

**Hypothesis 1.** Risk prevention has a positive effect on a firm's quality performance.

*2.4.2 Proactive product recall and quality performance*

High-profile cases, such as Samsung's Galaxy Note7 and Toyota's automotive recalls, underscore the importance of proactive product recalls (PPR) as a critical response to quality issues in products offered or sold to customers, with significant potential impacts on a firm's reputation and financial position (Kumar and Budin, 2006). In response to such incidents, PPR strategies are essential for sustaining long-term customer satisfaction and trust (Liu *et al.*, 2016). Guided by IPT, we conceptualize PPR as a firm's predefined strategies and procedures for effectively managing unexpected product recalls, involving extensive information gathering and application to address quality issues and prevent widespread recalls.

The primary objective of PPR is to minimize the impact of defects by preventing the distribution of unsafe or defective products. Effective PPR strategies can limit recalls to earlier stages in the supply chain, thereby significantly reducing the operational costs and resources required for extensive recalls (Kumar and Schmitz, 2011). Moreover, PPR enables firms to quickly identify the source of defects, examine potentially affected products, and formulate well-informed remediation plans. This approach aligns with research by Li *et al.* (2019), which emphasizes the importance of information processing with supply chain partners, as highlighted by IPT.

Fundamentally, IPT provides firms with a framework to minimize the damages associated with recalls, enhance quality management across the product lifecycle, and reduce defect occurrences, thereby improving QP. Therefore, we propose the following hypothesis:

**Hypothesis 2.** Proactive product recall has a positive effect on a firm's quality performance.

**2.5 Supply chain quality risk management practices and supply chain quality integration**

Based on IPT, we propose that SCQRM practices play a pivotal role in facilitating SCQI (Galbraith, 1974). IPT emphasizes that when supply chains integrate across multiple organizational boundaries, effective information sharing and processing are essential to enhance organizational adaptability and responsiveness (Zsidisin *et al.*, 2015). First, the implementation of RP activities signals an organization's commitment to maintaining high-quality standards. This commitment helps foster trust with suppliers, thereby promoting robust, long-term relationships and facilitating SQI (Dyer and Chu, 2000; Nyaga *et al.*, 2010). Second, a culture of strong internal collaboration enables the early detection of supply chain risks (Riley *et al.*, 2016). By emphasizing RP, companies cultivate a quality-focused culture among employees, who prioritize maintaining high standards in their daily work, contributing to IQI (Zsidisin *et al.*, 2005). Additionally, this collaboration ensures a consistent quality management process through information exchange and cooperation across different departments within the organization (Poberschnigg *et al.*, 2020). Finally, by sharing information and data with suppliers and customers, RP activities improve supply chain responsiveness and adaptability, drive CQI, and foster deeper integration across the entire supply chain (Schoenherr and Swink, 2012; Huo *et al.*, 2014).

From an IPT perspective, SCQRM can be viewed as a formative approach to strategic collaboration by establishing quality commitments to external supply chain partners and fostering an internal quality culture, which in turn facilitates cross-organizational information sharing and resource integration (Flynn *et al.*, 2010). This integration enhances the overall information-processing capability of the supply chain. Based on these insights, we propose the following hypothesis:

**Hypothesis 3.** Risk prevention has a positive effect on supply chain quality integration.

PPR aims to reduce the risk of defective products reaching downstream partners (Hosseini-Motlagh *et al.*, 2020). Based on IPT, we suggest that PPR plays a critical role in promoting SCQI. First, the traceability inherent in PPR allows organizations and their suppliers to conduct a comprehensive analysis of the root causes of quality issues. This understanding enables suppliers to implement corrective actions, preventing the recurrence of similar problems in the future (Dai *et al.*, 2015; Marucheck *et al.*, 2011), thereby enhancing SQI. Second, PPR emphasizes continuous improvement (Das, 2011), fostering a quality culture that motivates employees to identify and address potential quality issues. Furthermore, active involvement in recall activities requires collaboration among departments such as quality assurance, operations, and customer service, encouraging communication and cooperation for a unified quality management approach, thereby promoting IQI (Tse *et al.*, 2018). Finally, through PPR, companies can demonstrate their commitment to customer safety and well-being, effectively reducing perceived customer risk and strengthening customer trust and loyalty (Wei *et al.*, 2022). Timely and effective handling of product recalls minimizes customer dissatisfaction and maintains a company's reputation for providing high-quality products (Lawson *et al.*, 2019).

As a result, PPR promotes CQI.

From an IPT perspective, PPR serves as a corrective mechanism to enhance SCQI through cross-functional coordination and information sharing in the supply chain (Flynn *et al.*, 2010). PPR significantly improves the responsiveness and adaptability of the supply chain at the quality level by strengthening coordination and integration with supply chain partners (Koufteros *et al.*, 2012). Therefore, we propose the following hypothesis:

**Hypothesis 4.** Proactive product recall has a positive effect on supply chain quality integration.

### 2.6 The mediating effects of Supply chain quality integration

Grounded in IPT, we examine SCQI as a mediating variable between SCQRM practices and QP. IPT more effectively elucidates the role of SCQI in quality information sharing and reducing quality uncertainty (Yu *et al.*, 2019). We propose that SCQI can function as a quality information processing agent within the supply chain, serving as a crucial link between SCQRM practices, particularly RP and PPR, and QP by reducing uncertainty and facilitating information flow.

SCQI enhances the exchange of quality-related information, streamlining business processes, improving transparency, optimizing resource use, and reducing risks, thereby increasing the effectiveness of RP and PPR practices, which ultimately leads to better QP (Chen *et al.*, 2009; Frohlich and Westbrook, 2001).

Specifically, SQI contributes to QP by fostering collaboration with suppliers on production plans and ensuring adherence to raw material standards (Chen *et al.*, 2018; Zhang *et al.*, 2019). IQI focuses on aligning internal functions, breaking down departmental barriers, integrating data systems, and fostering cross-functional collaboration to enhance QP (Zhao *et al.*, 2021; Huo *et al.*, 2014). Meanwhile, CQI enables timely responses to customer quality requirements, product adjustments, and new product development, indirectly boosting product quality (Quang *et al.*, 2016; Elvers and Song, 2016).

From an IPT perspective, the effectiveness of organizational decision-making depends on the quality and timeliness of information (Yu *et al.*, 2019). By integrating quality processes among suppliers, internal functions, and customers, SCQI optimizes information quality within the supply chain and ensures its timely distribution. This optimization enhances decision-making within RP strategies, positively impacting QP. Thus, SCQI acts as a critical mediator that amplifies the impact of RP on QP. Accordingly, we propose the following hypothesis:

**Hypothesis 5.** Supply chain quality integration mediates the relationship between risk prevention and quality performance.

Additionally, by establishing close relationships with suppliers, SQI can effectively reduce inventory waste while enhancing information exchange and integration (Yeung, 2008). Through close collaboration and integration with suppliers, firms can improve the reliability and stability of supply chain quality, thereby contributing to better product quality, waste reduction, increased productivity, enhanced firm credibility, and optimized supply chain management practices (Luo *et al.*, 2023). By collaborating with suppliers, companies can construct a comprehensive manufacturing map, facilitating the efficient identification of defective product sources.

IQI reflects a company's capacity to seamlessly integrate its functions and practices to meet customer needs (Zhao *et al.*, 2011). Within the IPT framework, IQI enables companies to respond promptly to market changes and quality issues by facilitating cross-functional information sharing and collaboration (Srinivasan and Swink, 2015). This improved internal information processing capability allows companies to identify and address quality risks more quickly, optimize product recall strategies, and thus enhance overall QP. CQI involves the exchange of products and data between customers and suppliers. Within IPT, CQI is not merely a process of product delivery but also a critical node for processing quality information. By understanding customer needs, the organization can effectively integrate external information and adjust production and supply chain strategies to deliver high-quality products (Lakhal *et al.*, 2006). This information processing function of CQI strengthens collaboration between the organization and the customer, supports the smooth execution of the PPR process, and ultimately improves QP.

In the context of IPT, SCQI acts as a vital information processing mechanism that enhances the impact of PPR on QP by improving information processing capabilities across each link in the supply chain, especially in information exchange and collaboration during PPR implementation. Therefore, we propose the following hypothesis:

**Hypothesis 6.** Supply chain quality integration mediates the relationship between proactive product recall and quality performance.

Based on the above hypotheses, a conceptual model is formulated as in the following figure.

*Insert Figure 1 here.*

## 3. Methodology

### 3.1 Questionnaire design

The conceptual model was empirically tested using survey data collected through a questionnaire. Following an extensive literature review designed by scholars specializing in survey research on supply chain management and quality management, the questionnaire was initially developed in English. Two scholars translated the English version into Chinese, after which two research assistants back-translated it into English. Any discrepancies were carefully examined, and adjustments were made to ensure equivalence between the Chinese and English versions. Pilot tests were conducted during a quality management meeting with managers from eight manufacturing firms, yielding valuable suggestions on item wording, all of which were incorporated. The final questionnaire comprised four sections: respondent personal information, company background information, measurement items for SCQRM practices and SCQI, and measurement items for QP.

### 3.2 Sampling and data collection

The questionnaire design for our study utilized a robust dataset initially gathered in 2017, focusing on quality issues in the Chinese supply chain. The motivation for using this dataset stems from the critical role of Chinese manufacturers in the global supply chain and the relatively high frequency of product recalls in China. This dataset was established by Professor Zhao's research association, which supports research in China's operations management and graciously shares this data for broader scholarly use. We acknowledge and appreciate their contribution.

The sample was randomly drawn from three major economic zones in China: the Bohai Bay Economic Zone, the Pearl River Delta, and the Yangtze River Delta. These regions are known for hosting numerous manufacturing companies and serve as hubs for knowledge and innovation in China. Four industries (automotive, food, toys, and pharmaceuticals) were selected due to their relatively high incidence of quality issues and increasing rates of product recalls.

After controlling for region and industry using the China Industrial Classification codes, our sample was derived from the 1,623 manufacturing companies listed in the China Statistical Yearbook. Invitations were initially extended to all 1,623 companies, targeting key informants such as general managers, presidents, directors, quality managers, and purchasing managers. The survey was administered via email, resulting in 400 fully completed responses and yielding a response rate of 24.6% (Zhang *et al.*, 2020), as detailed in Table I.

*Insert Table I here.*

To assess potential non-response bias, follow-up calls were made to randomly selected contacts at non-participating companies. The most common reasons for non-participation were cited as lack of time or interest, suggesting that non-response bias is likely not a significant concern (Liu *et al.*, 2016). We compared key demographic characteristics, such as ownership, number of employees, and total sales, between responding and non-responding companies. The t-statistics revealed no significant differences (Zhang *et al.*, 2020). To address possible common method bias arising from the single-respondent questionnaire, two steps were taken. First, researchers provided explicit instructions indicating that the questionnaire should be completed by individuals with a comprehensive understanding of their organization's supply chain and quality management practices, such as senior managers responsible for supply chain or quality management. If respondents felt they were not the best individuals to answer certain questions, they were encouraged to consult with or delegate those questions to the most knowledgeable individuals within their organization. This multi-respondent approach helps to ensure that responses are informed by appropriate expertise, thereby reducing the risk of common method bias. Secondly, Harman's one-factor test, utilizing exploratory factor analysis (Podsakoff *et al.*, 2003), was conducted to assess common method bias. The analysis extracted five main component factors, with the maximum variance explained by a single factor at 28.64% (Zhang *et al.*, 2020), indicating that a single-factor model is unacceptable. Thus, common method bias is not considered a significant issue.

### 3.3 Variables and measures

#### *3.3.1 Dependent variable*

***Quality performance (QP)***. QP was assessed using items derived from Luo *et al.* (2023), selected based on the perspectives of Kaynak (2003), Koufteros *et al.* (2007), Huo *et al.* (2014), Yu and Huo (2019), and Luo *et al.* (2023). The questionnaire included five items evaluating key performance indicators such as product reliability, compliance with design standards, safety, and customer-perceived quality. All items were measured on a seven-point Likert scale, where 1 = significantly worse than the competition and 7 = significantly better than the competition.

#### *3.3.2 Independent variables*

***Risk prevention (RP)***. RP was measured based on the traditional concept outlined by Kaynak and Hartley (2008) and Tang (2008), with additional considerations from studies emphasizing the benefits of defined responsibilities (Cucchiella and Gastaldi, 2006; Lemke and Petersen, 2013; Li *et al.*, 2015; Tse *et al.*, 2018). The questionnaire included five items capturing both traditional and contemporary perspectives on RP. Responses were recorded on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

***Proactive Product Recall (PPR).*** PPR was evaluated through a newly created scale, addressing the limited direct literature on the subject. Primary references were drawn from Tse *et al.* (2018), with additional insights from a comprehensive review of relevant literature assessing proactive product recall strategies. The questionnaire included six items measuring top management's attitude and the existence of company standards or guidelines for recalls. Responses were recorded on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

*3.3.3 Mediating variables*

***Supply Chain Quality Integration (SCQI).*** SCQI was adapted from studies by Huo *et al.* (2014), Yu and Huo (2019), and Huo *et al.* (2019). SCQI was assessed as a second-order latent variable comprising three first-order latent variables: ***Supplier Quality Integration (SQI), Internal Quality Integration (IQI), and Customer Quality Integration (CQI)***. SQI, consisting of four items, evaluated how firms engage with suppliers in quality improvement. IQI, represented by five items, measured the ability of cross-functional quality management teams to coordinate and resolve quality-related issues. CQI, assessed through four items, captured the interaction between firms and their customers in quality improvement initiatives. Responses were recorded on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

*3.3.4 Control variables*

This study included ***the firm listing status (listed)*** and ***firm size (Size)*** as control variables. Listing status was measured with a dummy variable, assigning a value of 1 for listed firms and 0 for non-listed firms. Firm size was measured on a five-point Likert scale, where a higher score indicated a larger number of employees.

### 3.4 Measurement model

Table II presents the measurement model results for each construct. The Cronbach's alphas (ranging from 0.763 to 0.856) and composite reliability values (ranging from 0.784 to 0.858) for each construct exceeded the established thresholds, affirming the reliability of the construct measures. Similarly, the standardized factor loadings (ranging from 0.583 to 0.814) indicate that the items within each construct effectively measured the same underlying construct, further supporting reliability (Chau, 1997; Chin, 1998).

*Insert Table II here.*

Table III displays the descriptive statistics, correlations, and discriminant validity of the variables, including means and standard deviations. Descriptive statistics for the core variables are shown in the table, while those for the control variables (Listing status with a mean of 0.02 and SD of 0.122, and Size with a mean of 3.690 and SD of 1.276) are summarized separately. The average variance extracted (AVE) values in the table are above or close to the critical threshold, initially supporting the convergent validity of the framework measures. Convergent validity was further supported by the results of confirmatory factor analysis (CFA) shown in Table III. The model fit indices (CMIN/DF = 1.976, $p < 0.001$, RMSEA = 0.049, GFI = 0.894, IFI = 0.929, TFI = 0.918, CFI = 0.929) exceeded acceptable values as recommended by Hair *et al.* (2006). Additionally, the chi-square difference between the restricted and unrestricted models was significant at $p < 0.01$, supporting discriminant validity. Furthermore, the table shows that the square root of each AVE exceeds its corresponding correlation values, further affirming discriminant validity. In summary, the results from the measurement model analysis confirm the reliability and validity of the framework measures.

*Insert Table III here.*

## 4. Analysis and results

### 4.1 Hypothesis testing

The results of the structural model analysis are presented in Figure 2 and detailed in Table IV. The path model for the direct effect of RP on QP demonstrated a positive relationship ($\beta$ = 0.367, $p < 0.001$), with the model fit considered adequate (CMIN/DF = 2.691, $p < 0.001$, RMSEA = 0.065, GFI = 0.950, IFI = 0.956, TFI = 0.942, CFI = 0.956). A one-unit increase in RP was associated with a 0.367-unit increase in QP. Similarly, the path model for the direct effect of PPR on QP showed a positive association ($\beta$ = 0.263, $p < 0.001$), with an acceptable model fit (CMIN/DF = 2.559, $p < 0.001$, RMSEA = 0.063, GFI = 0.949, IFI = 0.956, TFI = 0.943, CFI = 0.956). A one-unit increase in PPR was associated with a 0.263-unit increase in QP. Thus, hypotheses *H1* and *H2* were supported.

The path model for the indirect effect of the mediators demonstrated acceptable fit (CMIN/DF = 2.038, $p < 0.001$, RMSEA = 0.051, GFI = 0.878, IFI = 0.911, TLI = 0.901, CFI = 0.910). The path coefficient between RP and SCQI was positively significant at the $p < 0.001$ level ($\beta$ = 0.550), supporting *H3*. Similarly, the path coefficient between PPR and SCQI was positively significant at the $p < 0.001$ level ($\beta$ = 0.303), supporting *H4*. Additionally, the analysis of the relationship between SCQI and QP showed a significant positive correlation ($\beta$ = 0.563) at $p < 0.001$, providing preliminary evidence for our mediation effect test.

*Insert Table IV here.*

*Insert Figure 2 here.*

Building on the methodology employed in previous studies (Yolal *et al.*, 2017; Zhai *et al.*, 2020), we rigorously examined the mediating effect of the SCQI using the bootstrap methodology and conducted robustness tests. Based on the skewed distribution of indirect effects, we generated a sample of 5000 bootstrap samples using 90% bias-corrected confidence intervals to assess the indirect and total effects between RP PPR and QP via the SCQI, following the procedure outlined by Preacher and Hayes (2008). Table V summarizes the results of the mediation tests, which indicate that the SCQI mediates a mediation effect of 0.310 between RP and QP with a confidence interval of (0.129, 0.547). For PPR and QP, the mediation effect of the SCQI was 0.171 with a confidence interval of (0.075, 0.320).

All confidence intervals were non-zero, and these results confirmed that the effects of RP and PPR on QP were mediated by SCQI, and thus *H5* and *H6* were supported. Further analysis reveals that in the path from RP to QP, the indirect effect of SCQI is 0.192 (0.375*0.511) (calculated from the standardized coefficients). Meanwhile, in the pathway from PPR to QP, the indirect effect of SCQI was 0.201 (0.393*0.511).

*Insert Table V here.*

## 4.2 Robustness checks

### *4.2.1 Removing Items with Low Factor Loadings*

Following Chin's (1998) recommendation, we conducted a robustness check by removing items with factor loadings below 0.6. Specifically, we removed two items: RP3 and CQI1. The overall reliability and validity of RP and CQI improved after the removal of RP3 and CQI1, with RP (Cronbach's alpha = 0.799, Composite Reliability = 0.792, AVE = 0.491) and CQI (Cronbach's alpha = 0.771, Composite Reliability = 0.777, AVE = 0.540). The mediation model fit indices (CMIN/DF = 1.961, $p < 0.001$, RMSEA = 0.049, GFI = 0.885, IFI = 0.920, TLI = 0.911, CFI = 0.919) exceeded the acceptable values recommended by Hair *et al.* (2006). The results of the structural model and the bootstrapping method, as presented in Tables VI and VII, remained consistent with the initial findings.

*Insert Table VI here.*

*Insert Table VII here.*

### *4.2.2 Removing the "Customer Satisfaction" Item*

Given the potential difficulty for managers in accurately assessing "customers' perceived quality," we conducted an additional robustness check by removing the item QP5. The mediation model fit indices (CMIN/DF = 2.038, $p < 0.001$, RMSEA = 0.051, GFI = 0.882, IFI = 0.913, TLI = 0.903, CFI = 0.912) exceeded the acceptable thresholds recommended by Hair *et al.* (2006). The results of the structural model and bootstrapping method, shown in Tables VIII and IX, also remained consistent with the original findings.

*Insert Table VIII here.*

*Insert Table IX here.*

## 5. Discussion and conclusion

### 5.1 Summary of findings

Our study, guided by IPT, uncovers several critical insights into quality risk management. First, our findings establish a significant positive correlation between RP and QP, as well as between PPR and QP. This highlights the foundational role of RP and PPR in driving QP and sets the stage for further exploration of the underlying mechanisms. Second, we find a positive correlation between RP and SCQI and, similarly, between PPR and SCQI. This suggests that RP and PPR contribute to SCQI by committing to quality externally and fostering a quality-focused culture internally. Third, our study demonstrates that SCQI significantly enhances QP, positioning SCQI as a critical antecedent to QP. Finally, our bootstrapping analysis shows that SCQI is an essential mediator of the positive effects of RP and PPR on QP. Based on IPT, SCQI, as an information processing mechanism, plays a significant mediating role in SCQRM practices; specifically, this study empirically demonstrates that these two SCQRM practices (RP and PPR) improve QP by enhancing supply chain quality information processing, thus contributing to the SCQRM literature.

### 5.2 Theoretical implications

This research has several important theoretical implications. First, we reveal how two key practices of SCQRM (RP and PPR) improve QP through information acquisition, interpretation, and application by introducing an IPT perspective. Unlike previous studies that focus on broader supply chain risks, such as market turbulence (Srinivasan and Swink, 2018) or sudden disruptions (Lu *et al.*, 2023), few studies have examined the impact of SCQRM on QP, with most only theoretically differentiating between the upstream and downstream practices of SCQRM and their impact on QP (Tse *et al.*, 2018). This study enriches the SCQRM and IPT literature by introducing RP and PPR as preventive and responsive SCQRM practices and empirically examining the mechanisms by which these practices impact QP.

Second, this study extends the application of IPT in SCQRM by demonstrating the mediating role of SCQI as an information processing mechanism. SCQI serves not only as a gateway for information integration but also as a crucial mechanism that facilitates information flow, enabling supply chain parties to efficiently manage uncertainty in quality risk management (Wei *et al.*, 2020; Yu *et al.*, 2019). The capability to interact and collaborate within SCQI across different supply chain nodes (suppliers, internal operations, and customers) allows organizations to enhance overall quality levels by integrating information from various sources and implementing appropriate measures swiftly.

Finally, we find that each of the three dimensions of SCQI—SQI, IQI, and CQI—plays a specific role in information processing, including the accuracy of information acquisition in supplier management, the consistency of information interpretation within cross-functional teams, and the timeliness of information application in response to customer feedback (Huo *et al.*, 2014; Yu *et al.*, 2019). These findings offer insights into optimizing supply chain quality management through information flow, thus further extending the applicability of IPT in quality management.

### 5.3 Practical implications

Based on IPT, our findings illustrate the pivotal role of SCQI as a mediator in the relationship between SCQRM practices and QP. This insight informs practical recommendations for firms, emphasizing the strategic importance of enhancing internal and cross-supply chain sharing of quality-related information.

To effectively implement SCQRM practices such as RP and PPR, companies must prioritize developing robust information-handling capabilities within their supply chains. This includes fostering closer collaboration and communication with suppliers, internal teams, and customers to ensure that quality-related information is effectively shared across the supply chain network. By doing so, companies can significantly improve their overall QP. Honda's success in China exemplifies this point. Honda's effective integration of quality management processes with suppliers and distributors is a key factor in maintaining its competitive edge in the highly competitive automotive market. This success highlights the importance of a high level of information processing capability—i.e., SCQI—in achieving superior QP, especially in complex and dynamic supply chains.

In summary, organizations aiming to enhance QP should consider strengthening SCQI as a core strategic initiative. By ensuring that quality-related information flows smoothly through all levels of the supply chain, organizations can not only mitigate risk more effectively but also create a more resilient and responsive supply chain, ultimately enhancing their competitive advantage.

### 5.4 Limitations and future research

While this study offers significant contributions to both academic theory and industrial practice, it is essential to acknowledge certain limitations when interpreting the findings.

First, despite our efforts to incorporate the explicit responsibility of top management for RP and attitudes toward PPR, the measurement of these concepts remains underdeveloped in the areas of RP and PPR. Future research could deepen our understanding by employing more comprehensive surveys to measure these critical aspects. Aligned with IPT, there is also room for developing more refined measures that account for information processing mechanisms, particularly within the contexts of RP and PPR.

Second, our focus was limited to preventive and responsive quality risk management practices. Future research could explore a broader range of quality risk management practices and investigate their impact on a firm's QP throughout the supply chain.

Third, although the reliability and validity of this study met acceptable standards, as indicated by previous research, further improvement is possible (Chau, 1997; Chin, 1998). Future studies could construct more robust measurement items through exploratory factor analysis to enhance the reliability and validity of the study.

Finally, although our data was drawn from four industries with a high likelihood of implementing SCRM, the exclusion of other industries, such as electronics, leaves room for further exploration. Future research could expand its scope to include additional industries, providing insights into the generalizability of our results across a broader array of sectors.

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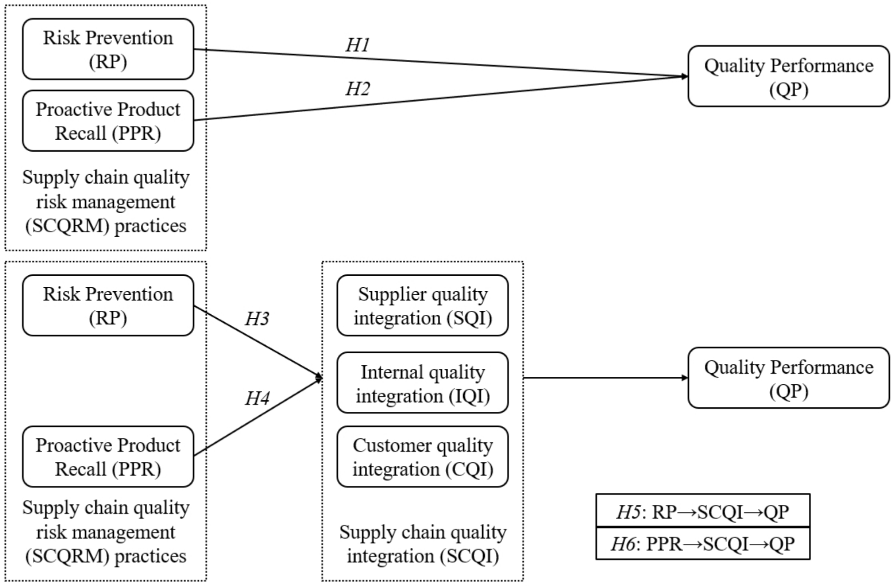


Figure 1 Conceptual model (Notes: The figure shows standardized estimates, * p< 0.05; ** p< 0.01: *** p< 0.001)

444x262mm (72 x 72 DPI)

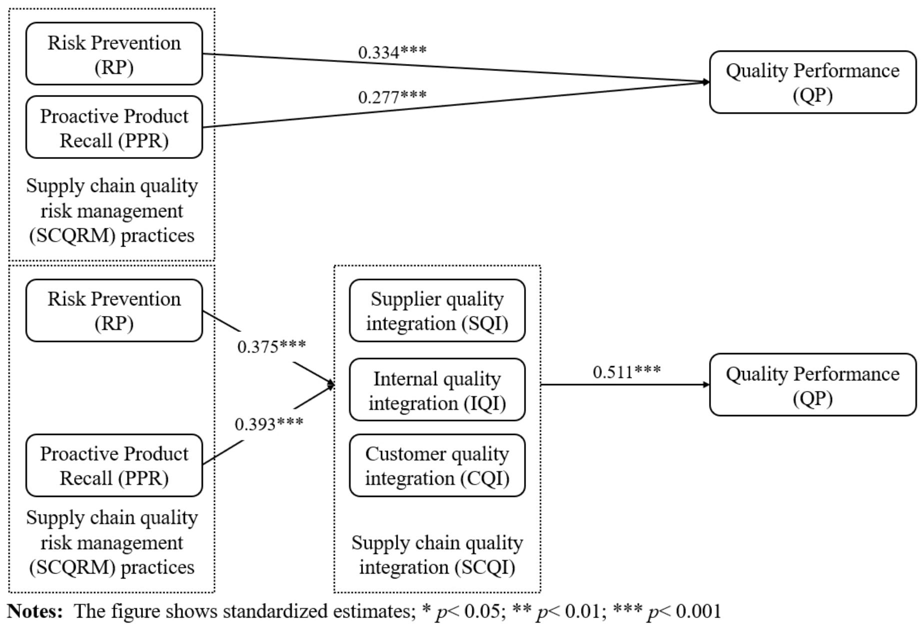


Figure 2 Estimated structural equation model

432x268mm (72 x 72 DPI)

**Table I** Profile of Firms

| Characteristics | Categories | samples | Percent (%) |
|---|---|---|---|
| **Location** | Yangzi River Delta | 138 | 34.50 |
| | Bohai Bay Economic Rim | 124 | 31.00 |
| | Pearl River Delta | 138 | 34.50 |
| **Ownership types** | State-owned | 23 | 5.75 |
| | Private | 160 | 40.00 |
| | Joint venture | 60 | 15.00 |
| | Foreign | 139 | 34.75 |
| | Others | 18 | 4.50 |
| **Number of employees** | Less than 100 | 75 | 18.75 |
| | 100-199 | 100 | 25.00 |
| | 200-499 | 130 | 32.50 |
| | 500-999 | 54 | 13.50 |
| | More than or equal to 1000 | 41 | 10.25 |
| **Industry** | Automobile | 100 | 25.00 |
| | Food | 100 | 25.00 |
| | Toy manufacturing | 100 | 25.00 |
| | Pharmaceutical | 100 | 25.00 |

**Table II** Construct loading and reliability index

| Construct | Indicator | Item loading | T-value | Cronbach's alpha | Composite reliability | AVE |
|---|---|---|---|---|---|---|
| **RP** | RP1 | 0.680 | - | 0.769 | 0.798 | 0.442 |
| | RP2 | 0.622 | 10.268 | | | |
| | RP3 | 0.589 | 9.274 | | | |
| | RP4 | 0.704 | 16.091 | | | |
| | RP5 | 0.721 | 11.436 | | | |
| **PPR** | PPR1 | 0.627 | - | 0.834 | 0.845 | 0.479 |
| | PPR2 | 0.693 | 12.809 | | | |
| | PPR3 | 0.638 | 10.159 | | | |
| | PPR4 | 0.685 | 10.699 | | | |
| | PPR5 | 0.674 | 10.578 | | | |
| | PPR6 | 0.814 | 10.995 | | | |
| **SQI** | SQI1 | 0.642 | - | 0.763 | 0.784 | 0.479 |
| | SQI2 | 0.785 | 11.204 | | | |
| | SQI3 | 0.605 | 8.784 | | | |
| | SQI4 | 0.721 | 10.836 | | | |
| **IQI** | IQI1 | 0.662 | - | 0.830 | 0.821 | 0.478 |
| | IQI2 | 0.752 | 11.817 | | | |
| | IQI3 | 0.690 | 11.144 | | | |
| | IQI4 | 0.675 | 10.825 | | | |
| | IQI5 | 0.675 | 10.823 | | | |
| **CQI** | CQI1 | 0.583 | - | 0.782 | 0.790 | 0.487 |
| | CQI2 | 0.763 | 10.280 | | | |
| | CQI3 | 0.678 | 11.868 | | | |
| | CQI4 | 0.752 | 12.745 | | | |
| **QP** | QP1 | 0.809 | - | 0.856 | 0.858 | 0.549 |
| | QP2 | 0.805 | 15.633 | | | |
| | QP3 | 0.714 | 14.044 | | | |
| | QP4 | 0.728 | 13.084 | | | |
| | QP5 | 0.635 | 12.269 | | | |

**Note:** All factor loadings are significant at $p < 0.001$ level.

**Table III** Descriptive statistics, correlations and discriminant validity

| Var. | PPR | PRP | SQI | IQI | CQI | QP |
|---|---|---|---|---|---|---|
| **Mean** | 6.288 | 6.016 | 5.263 | 6.250 | 5.914 | 6.300 |
| **SD** | 0.740 | 0.694 | 1.152 | 0.647 | 0.852 | 0.626 |
| **PPR** | ***0.692*** | | | | | |
| **PRP** | 0.622** | ***0.665*** | | | | |
| **SQI** | 0.247** | 0.335** | ***0.698*** | | | |
| **IQI** | 0.454** | 0.489** | 0.305** | ***0.692*** | | |
| **CQI** | 0.378** | 0.387** | 0.455** | 0.416** | ***0.741*** | |
| **QP** | 0.230** | 0.345** | 0.290** | 0.279** | 0.333** | ***0.692*** |

**Notes:** Var. =Variable. The bold italic numbers in diagonal are the square roots of the average variances extracted; ** p< 0.01

**Table IV** Results of structure model

| Path | Estimate | S.E. | T-value |
|---|---|---|---|
| RP→QP | 0.367*** | 0.066 | 5.599 |
| PPR→QP | 0.263*** | 0.049 | 4.495 |
| RP→SCQI | 0.550*** | 0.147 | 3.745 |
| PPR→SCQI | 0.303*** | 0.075 | 4.057 |
| SCQI→QP | 0.563*** | 0.093 | 6.147 |
| listed→QP | 0.613* | 0.266 | 2.302 |
| Sized→QP | -0.042 | 0.025 | -1.638 |

**Notes:** S.E. =Standard error; * $p< 0.05$; ** $p< 0.01$; *** $p< 0.001$

**Table V** Results of bootstrapping method

| Hypo. | Path | Estimate | Lower | Upper | Result |
|---|---|---|---|---|---|
| **H5a** | RP→SCQI→QP | 0.310 | 0.129 | 0.547 | Supported |
| **H5b** | PPR→SCQI→QP | 0.171 | 0.075 | 0.320 | Supported |

**Note:** Hypo. = Hypothesis; If the 90% confidence intervals do not contain zero, the effect is regarded as significant

**Table VI** Results of structure model after removing items with factor loadings below 0.6

| Path | Estimate | S.E. | T-value |
|---|---|---|---|
| RP→QP | 0.369*** | 0.077 | 5.228 |
| PPR→QP | 0.263*** | 0.049 | 4.495 |
| RP→SCQI | 0.543*** | 0.144 | 3.759 |
| PPR→SCQI | 0.305*** | 0.074 | 4.144 |
| SCQI→QP | 0.564*** | 0.094 | 6.000 |
| listed→QP | 0.610* | 0.268 | 2.281 |
| Sized→QP | -0.042 | 0.026 | -1.642 |

**Notes:** S.E. =Standard error; * p< 0.05; ** p< 0.01; *** p< 0.001

**Table VII** Results of bootstrapping method after removing items with factor loadings below 0.6

| **Hypo.** | **Path** | **Estimate** | **Lower** | **Upper** | **Result** |
|---|---|---|---|---|---|
| **H5a** | RP→SCQI→QP | 0.172 | 0.078 | 0.323 | Supported |
| **H5b** | PPR→SCQI→QP | 0.306 | 0.121 | 0.543 | Supported |

**Note:** Hypo. = Hypothesis; If the 90% confidence intervals do not contain zero, the effect is regarded as significant

**Table VIII** Results of structural Model after removing QP5.

| Path | Estimate | S.E. | T-value |
|---|---|---|---|
| RP→QP | 0.626*** | 0.133 | 4.720 |
| PPR→QP | 0.232*** | 0.052 | 4.441 |
| RP→SCQI | 0.550*** | 0.147 | 3.736 |
| PPR→SCQI | 0.303*** | 0.075 | 4.015 |
| SCQI→QP | 0.572*** | 0.093 | 6.132 |
| listed→QP | 0.572* | 0.275 | 2.083 |
| Sized→QP | -0.035 | 0.026 | -1.314 |

**Notes:** S.E. =Standard error; * p< 0.05; ** p< 0.01; *** p< 0.001

**Table IX** Results of bootstrapping method after removing QP5

| Hypo. | Path | Estimate | Lower | Upper | Result |
|---|---|---|---|---|---|
| **H5a** | RP→SCQI→QP | 0.315 | 0.130 | 0.557 | Supported |
| **H5b** | PPR→SCQI→QP | 0.173 | 0.077 | 0.324 | Supported |

**Note:** Hypo. = Hypothesis; If the 90% confidence intervals do not contain zero, the effect is regarded as significant