

Retracted: The impact of supply chain quality management on firm performance: Empirical evidence from Vietnam

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ABSTRACT

This research is conducted to investigate the impact of supply chain quality management (SCQM) on supply chain performance (SCP). Data are collected by using questionnaire delivered to 120 manufacturing companies listed on Vietnamese stock market. Three proxies are used to measure supply chain quality management include (i) internal quality management, (ii) upstream quality management and (iii) downstream quality management. Supply chain performance is measured by customer satisfaction regarding three aspects consist of quality, cost and time to delivery. The statistical methods approaches are employed to address the research issues including Cronbach's Alpha, Explanatory Factor Analysis (EFA) and Ordinary Least Squares (OLS). The findings show that supply chain quality management had significant positive effect on supply chain performance of manufacturing companies listed on Vietnamese stock market. Based on the research results, some key intuitive recommendations are proposed aiming to improve the supply chain performance at operational level of Vietnamese enterprises.

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1. Introduction

Quality is the key factor help enterprises survive in competitive market. This is a common statement in the quality policy of businesses, especially manufacturing enterprises. Therefore, quality shows great contribution on the success of the organizations, helping businesses survive and thrive in the context of increasingly competition in the market. From a strategic perspective, quality is the source of differentiation, improving quality is one of the pillars that help build competitive advantage of businesses in the market. Quality management has become one of the research topics that many scholars over the world to analyze the relationship between quality and firm performance as well as find the way to apply and implementing quality management in enterprises. However, there is a challenge facing businesses and managers that competition has shifted from competition between businesses to supply chain competition. Therefore, currently quality management is not only at the level of internal management but also to pay attention to external practices, cross the boundaries of organizations, integrate businesses with customers and suppliers. Manufacturing businesses currently spend an average of 50% to 80% of their

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production costs on the purchase of raw materials, fuels, parts, and components from many suppliers around the world. Optimizing production costs requires that producers not only select the right suppliers but also have a good quality management system of the entire supply chain to minimize risks and quality issues of products. Weak supply chain quality management (SCQM) capacity will lead to product quality problems, slow delivery, deterioration of customer reliability and satisfaction. Especially in the context of manufacturing industry, about 50% of the causes of product recall are originated from part suppliers and contract manufacturing.

The objective of this paper is to measure and assess the current status of practices of supply chain quality management in the context of Vietnam. Then, we investigate the impact of supply chain quality management on supply chain performance of Vietnamese manufacturing enterprises. This research develops and verifies an analytical measurement framework for supply chain quality management in manufacturing enterprises of developing countries in general and Vietnam in particular and includes three main components: internal quality management, upstream quality management, downstream quality management. The results provide empirical evidence on the positive impact of supply chain quality management on supply chain performance in terms of quality, cost, and delivery time. The remainder of the paper is structured as follows: In Section 2, Literature Review; the next section demonstrates Research Hypotheses; Section 4, presents the Research Methodology; Results and Discussion about the impact of supply chain quality management on performance are presented in Section 5. Finally, the conclusion and recommendations are explained in Section 6.

2. Literature Review

The concept of supply chain management (SCM) was introduced in 1980s. It was originally involved with purchasing management, inventory management, and shipping operations within the supply chain. After that, this concept was expanded to include the management of all functions in a supply chain. According to Chopra and Meindl (2001), "Supply chain management involves managing flows between processes in the supply chain to maximize total profit". Sila et al. (2006) show that SCM is related to the management of product, information and financial flows in both directions: downstream (towards customers) and upstream (towards suppliers) in the supply chain. SCM also entails making decisions about site location, product selection and production capacity, how to produce, and ultimately, how to distribute the products to customers and related services before, during and after sales. Empirical research on quality management has developed over the past 20 years. It has helped supplement the knowledge of quality management theory and practice. Some empirical studies such as Flynn et al. (1994), Saraph et al. (1989), Sila and Ebrahimpour (2005) have defined and evaluated quality management practice activities. Many studies have shown a positive relationship between quality management practices and various aspects of business performance such as production costs, on-time delivery, and production capacity flexibility. Prior to the 2000s, studies showed that quality management efforts were primarily focused on improving product quality at manufacturing processes within the enterprise. However, with the increasing uncertainty of the business environment, the final product quality depends on the entire constant flow in the supply chain. Simchi-Levi et al. (2000) stated that satisfying customer satisfaction can only be achieved when the entire supply chain is committed integrated and closely coordinated to pursue goals, activities and innovation. Traditional comprehensive quality management practices need to be moved to a different approach on the supply chain extending operations with supply chain partners both upstream and downstream to collect all potential benefits of quality improvement to satisfy customers (Robinson & Malhotra, 2005; Sila et al., 2006). Integrating the two concepts of quality management and supply chain management proposed by many scholars, leading to the introduction of quality management concept. Supply Chain Quality Management (SCQM), offers the potential to deal with future supply chain challenges (Flynn & Flynn, 2005; Foster, 2008;

Robinson & Malhotra, 2005; Sila et al., 2006).

Supply chain quality management is the concept of integrating two areas of management science, including quality management and supply chain management, which has been proposed by many scholars since the 2000s. This proposal was formed based on theoretical and empirical results of supply chain management activities of multinational manufacturing and service corporations. In the first stage, SCQM is defined as “the participation of all members of the supply channel, crossing the boundaries between enterprises in the continuous and uniform development process of all processes and products, service and work culture, focusing on creating differentiated, competitive productivity through the promotion of products and service solutions that deliver value and customer satisfaction” (Saraph et al., 1989). Later et al. (2001) gave the definition of SCQM with three basic concepts: Supply chain (SC) is a network of suppliers, manufacturers, and customers; Quality (Q) is to meet accurate market needs and achieve fast, profitable customer satisfaction; and Management (M) is to facilitate, encourage quality processes and activities, increase trust for the quality of supply chains. With this definition, we can see that Kuei and Madu (2001) support the belief that the relationship between buyers and suppliers is a prerequisite for sustainable quality performance across the supply chain. Recently, SCQM has been considered as a synergistic effect between supply chain management and quality management, with quality management (QM) in the business as a key to improving performance across the supply chain. As such, it extends the aspect of QM and SCM to the cooperation between all members, pointing out the close relationship between QM and SCM that helps improve the performance of the supply chain (Flynn & Flynn, 2005). Developing this approach, Robinson and Malhotra (2005) identified “supply chain quality management as the official coordination and integration of business processes involving all partner organizations in the channel providing to measure, analyze and continually improve our products, services and processes to create value and achieve customer satisfaction, and ultimately on the market”. Towards a more efficient supply chain performance, Foster (2008) defines “SCQM as a system-based approach to improving performance using opportunities generated by downstream and upstream with suppliers and customers”. He also pointed out seven topics related to supply chain quality management including: (1) customer-focused, (2) quality practices, (3) supplier relations, (4) leadership, (5) practice of human resource management, (6) business results, and (7) safety.

Most recently, researchers considered SCQM as a multidirectional concept including internal quality management (IQM) consists of process management, product design, process, quality training, quality management activities at the supply chain level (cooperation with customers and suppliers, quality training at the supply chain level, participation of members in the product design process (Hong et al., 2018). As can be seen, there exists a number of different definitions for SCQM. These definitions reflect differences in theory, experimentation and more importantly, the focus and scope of scholars' research. To study how SCQM affects performance, scholars have developed the aspect of SCQM, also known as SCQM practice activities. The practice of SCQM is defined as a set of daily activities carried out by organizations to achieve the goals of SCQM (Quang et al., 2016). SCQM practice activities have been studied by many scholars in order to develop structures, demonstrate the characteristics of SCQM, as well as assess the impact of each of these practices on performance. Soares et al. (2017); Kuei et al. (2001) proposed eleven structures for measuring SCQM, based on internal quality management practices and the company's relationship with customers and suppliers. Meanwhile, Kaynak and Hartley (2008) developed eight SCQM practices with an internal focus and supplier quality management: leadership, training, staff relations, customer focus, reporting, and quality data, supplier quality management, product or service design and process management. Later, Zeng et al. (2013) proposed the practice of SCQM divided into three groups: internal quality management, upstream quality management, and downstream quality management. Recently, SCQM practices related to information sharing and knowledge management among businesses,

suppliers and customers (Hong et al., 2018; Zeng et al., 2013) as well as the application of information systems such as the latest internet technology improve quality results throughout the supply chain (Robinson & Malhotra 2005). The impact of SCQM on performance has also extensively been studied by many scholars to better understand how SCQM practices work on quality results and satisfaction customers (Hong et al., 2018; Kuei et al., 2001; Quang et al., 2016; Sila et al., 2006; Soares et al., 2017; Zeng et al., 2013). The results obtained are quite diverse due to different contexts, research samples as well as not having a uniform and complete scale of SCQM practice activities. Specifically, Zeng et al. (2013) showed that there was no evidence of the impact of upstream quality management on quality conformity, while Soares et al. (2017) focused on suppliers and integrating suppliers to improve quality results. Vanichchinchai (2011) showed that quality management activities had direct and indirect effects through SCM practices on firm performance. However, the study of Lin et al., (2005) provides evidence that quality management activities had no direct impact on performance. The findings of Hong et al. (2018) showed that internal quality practices at the supply chain level could affect performance through intermediaries of transfer knowledge.

3. Research Hypotheses

3.1. Internal Quality Management

Internal quality management (IQM) is a collection of quality activities within the enterprise aimed at directing and controlling a quality organization on the basis of integrated departments and internal processes. Integrating internal quality is an organization's effort to create the core quality of the organization, facilitating quality improvement in the supply chain by integrating internal departments and processes. The support from top management plays a driving force for quality efforts. When management commitment is transformed into specific strategies, staff involvement in the decision-making process is carried out through training and capacity building. This can assist in transforming design quality into products and services. Quality assurance process through the use of quality information, results in higher quality results. Improving product quality helps reduce rework, less scrap and improves productivity and reduces the organization's cost structure. Practice activities of internal quality management within the organization and the cooperation between marketing, planning, production, inventory and logistics activities increase delivery speed for customers (Sroufe & Curkovic, 2008). Internal quality management allows everyone in the organization to be responsible for quality management and promotes collaborative functions within the same quality standard that helps to reduce wastes due to waiting, poor coordination, and reduces the costs. The positive relationship between internal quality management practices and performance is supported by numerous empirical studies (e.g. Flynn, 1995; Kaynak, 2003; Tan et al., 1998). Therefore, this paper proposes the following hypothesis:

H1a: Internal quality management has a positive impact on product quality.

H1b: Internal quality management has a positive impact on delivery time.

H1c: Internal quality management has a positive impact on costs.

3.2. Upstream Quality Management

Upstream quality management (UQM) is a collection of communication activities, information sharing, coordination with suppliers to consider quality, product design, etc. based on technology linking platform to quality assurance from supplier. Tan et al. (1998) found that supplier evaluation and facility management led to better performance, while Shin et al. (2000) found that long-term relationships with suppliers, product development process with supplier participation, vendor selection significantly improves quality. Lo et al. (2007) found that supplier integration,

supplier selection and supplier development were positively related to quality. Previous studies on the topic of supply chain management have shown a positive relationship between supplier management and performance (Kaynak & Hartley, 2008). Extending their findings to quality in the supply chain, this paper argues that integrating supplier quality is related to quality performance. Integrating supplier quality reduces supply chain risk and enhances supply chain member understanding of quality specifications and requirements. A close relationship and communication with suppliers facilitate the company's delivery process and product design resulting in higher product quality and lower costs. The company's involvement in suppliers' quality improvement efforts helps suppliers reduce quality costs and improves delivery performance, thereby reducing quality costs and improving product quality and speed up delivery. The involvement of suppliers in product development helps to improve the defect rate of the post-production stage, helping the company to improve the quality (Carter & Ellram, 1994). Therefore, the author proposes the following hypothesis:

H2a: Upstream quality management has a positive impact on product quality.

H2b: Upstream quality management has a positive impact on delivery time.

H2c: Upstream quality management has a positive impact on costs.

3.3. Downstream Quality Management

Downstream quality management (DQM) is a collection of interactive activities, communication, information sharing with customers about quality considerations, product design based on technology linking platform to identify customers' requirements, ensure supply chain quality from customers. Customer engagement is an important component of traditional quality management (Flynn et al., 1994), whereby a company should listen to customers' voices and build relationships with customers. In an effective supply chain network, members maintain and develop a customer-oriented culture, providing the right products, the right customers, the right place, on time and reasonable cost (Kuei et al., 2001). Collaborative and integrated activities with customers allow customers to be more satisfied. Similar to UQM, the ultimate goal of customer engagement is to learn from them. Learning from customers is not only related to customer participation in product design and development, but also receives instruction in the manufacturing process and information from customers about the quality. Customer development is a company's effort to enhance the capabilities of its customers for the long-term mutual benefit of both parties. This is shown by providing customers with suggestions on how to improve, provide information about products and quality issues, or educate customers on how to store products. A company with a good understanding of customer requirements is an important premise for them to be able to deliver high quality products and deliver goods reliably and quickly in a cost-effective manner. Receiving feedback from customers and related to product design and quality improvement helps companies prevent quality problems and avoids delays in delivery. Customer feedback also facilitates corrective action for the product or process faster and thus leads to increased performance. By understanding customer requirements and incorporating them, the company can reduce defects, rework and reduce quality costs. Therefore, the paper proposes the following hypothesis:

H3a: Downstream quality management has a positive impact on product quality.

H3b: Downstream quality management has a positive impact on delivery time.

H3c: Downstream quality management has a positive impact on costs.

4. Research Methodology

This paper is employed both qualitative and quantitative research methods as follows:

Qualitative research method: consultations (group discussions and interviews) of quality management, supply chain management and storage, procurement, customer relationship, and product management managers, the quality of production and management to confirm the correlation between potential concepts proposed in the analysis framework, the clarity and coherence of the questionnaire. The result of qualitative method used to adjust and supplement analytical framework, original survey form. Quantitative research method: Official survey forms were sent to purchasing managers, inventory managers, production managers, quality control managers, customer relationship managers at manufacturing enterprises to collect additional primary data for testing the proposed analytical framework. The data after the survey was cleaned, coded, entered and analyzed on statistical software name SPSS version 23. The research implementation process goes through three main stages: desk research, preliminary research and large-scale research. The first phase of the research process focused on desk research in order to study theoretical based, develop analytical frameworks and build scale sets for questionnaire.

The scales were developed based on the literature review process and have been revised to ensure compatibility with the research context in Vietnam using the 7-level Likert scale (1 - strongly disagree, 4 - normal, 7 - strongly agree).

(1) Internal Quality Management Scale

Internal quality management (IQM) is a set of quality practices within the organization that focus on directing and controlling a quality of organization on the basis of integrating departments and internal processes. According to Flynn et al. (1994), quality management practices in an organization can be divided into two groups as follows: (i) quality management infrastructure practices include: top management support, strategic planning for quality, quality training, rewards; (ii) core practices include: process management, data and quality reports, feedback, quality design, continuous improvement, problem solving. Inheriting the results of this research, the practices of internal quality management are evaluated and measured through 10 components.

(i) Scale of support from top management

The highest level of leadership support consists of 6 observed variables, measured using a 7-level Likert scale, developed based on studies by Flynn et al. (1994) and Kaynak (2003). Top management support demonstrates top management involvement and commitment in all functions of quality and quality improvement that enables the conditions for implementing quality operations at the organization. Support from top management scale includes six items: (1) all head of departments in the company acknowledge responsibility for quality, (2) company leaders directly direct the quality and quality improvement, (3) the top criterion for evaluating corporate governance is quality performance, (4) company leaders strongly encourage employees to participate in the production process, (5) company leaders establish and communicate a vision focused on quality improvement, and (6) company leaders are directly involved in quality improvement projects.

(ii) Scale of quality strategy planning

Based on studies of Flynn et al. (1994), Samson and Terziovski (1999), quality strategic planning will have a positive impact on the organization's long-term quality of products and services that help drive activities and plan resources and innovate quality. Strategic quality planning is the activity of identifying and documenting visions, long-term plans, policies and quality objectives. These documents need to be disseminated and understood throughout the organization as well as periodically reviewed and updated. It measured using a 7-level Likert scale that indicates the extent to which an internal functional design organization reflects its mission of quality. The quality strategic planning scale consists of three items: (1) the company has a formal quality planning process that results in a documented text, mission, long-term goals and quality strategy,

(2) the company has a written quality strategy plan, and (3) company leaders regularly review and update long-term strategic plans for product/service quality.

(iii) Scale of process management

Process management refers to the techniques and tools applied in a process to implement and improve the process efficiency, maintain the achieved results and ensure the integrity of the process of customer's request. Process management reduces process variability, leading to reduced scrap and rework. This scale consists of 5 questions based on the 7-point Likert scale developed based on research by Flynn et al. (1994) and Kaynak (2003): (1) the processes in the company are clearly designed, (2) most manufacturing processes and services are now controlled by statistical techniques, (3) the company makes extensive use of statistical techniques to reduce fluctuations in its manufacturing and service processes, (4) the company uses charts to determine whether the manufacturing processes are in control or not, and (5) The company keeps track of processes through statistical process control tools.

(iv) Scale of data and quality report

The scale of data and quality report consists of 4 question items in which questions from 1 to 3 are developed based on research by Saraph et al. (1989) and question 4 is developed based on Black and Porter (1996). This scale shows the availability of quality data/reports for analysis, improvement and quality management, measured on a 7-level Likert scale. The items include (1) quality data (defect rate, defect rate, types of defects, defective products, etc.) are always available for analysis, (2) quality data is updated in real time, (3) quality data (quality cost, errors, defects, defective products, etc.) is used as a tool for quality management, and (4) the company has a process to ensure the reliability and increasing accuracy of the data collection process.

(v) Scale of feedback

Feedback is the availability of quality performance information of individuals and units that are publicly available to all employees. The feedback scale was developed based on research by Flynn et al. (1994) and Kaynak (2003) including 5 question items and measured using a 7-level Likert scale: (1) tracking sheets/error rate charts are located at the workplace, (2) work performance charts are located at the workplace, (3) the monitoring sheet/frequency chart of machinery stop is located at the workplace, (4) information about product quality results is available to all employees, and (5) information on productivity and output is available to all employees.

(vi) Scale of quality design

Quality design is a measurement scale of the quality of product design activities. It is reflected through the process of screening ideas, participation and cooperation of all relevant departments and the entire staff. Members in design emphasis on production ability, clarity of specifications, emphasis on quality, do not run on schedule and avoid frequent redesign. This scale was developed based on the research of Saraph et al. (1989), Flynn et al. (1994), Kaynak (2003), including 6 questions using the 7-level Likert scale: (1) the design of new products was thoroughly reviewed before they are manufactured and marketed, (2) the departments work closely in the process of developing new products, (3) the quality of the new product is always emphasized while designing the product, in relation to comparison with other goals such as cost or progress, (4) specifications of new products and technological processes for new products are clearly defined, (5) production capacity of the company is always considered in the process of designing new products, and (6) sales staff, customer service, marketing, and public relations emphasize the quality of new products.

(vii) Scale of problem solving

This scale shows the level of problem solving through gathering all views and ideas of everyone, encouraging people to solve problems themselves, forming problem-solving teams on the Likert 7 level. The problem-solving scale includes 5 question items developed based on Flynn et al. (1994): (1) in problem-solving meetings, we always try to gather the views and ideas of team members before making a decision, (2) our company has formed teams/groups to solve problems related to the quality of products and services, (3) over the past three years, many issues have been resolved through small group meetings, (4) the problem-solving groups have helped improve the production process at the unit, and (5) team members are always encouraged to try to solve their problems as much as possible.

(viii) Scale of continuous improvement

Continuous improvement reflects a sense of importance, the level of implementation of continuous improvement activities, and learning within the organization. This scale was developed based on the research of Saraph et al. (1989), Flynn et al. (1994), Kaynak (2003), consists of 5 questions and is measured on a 7-level likert scale: (1) the company strives to continually improve all aspects of the product, the process rather than just solving problems when something goes wrong, (2) if we do not improve continuously and learn, the operation results will suffer many losses and long-term losses, (3) continuous improvement helps improve the company's competitive advantage, (4) process improvement is a continuous, non-stop activity at the company, and (5) our organization is not a static entity, but it actively changes itself to better serve our customers.

(ix) Scale of quality training

This scale measures the level of training of working skills, statistical techniques, problem-solving techniques for employees and managers throughout the organization as a prerequisite for improving quality. The scale of quality training was developed based on research of Saraph et al. (1989); Samson and Terziovski (1999) consisted of 5 questions, measured using a 7-level Likert scale: (1) training of specific work skills (technical and occupational) is organized for employees throughout the company, (2) quality training is organized for employees in the company, (3) quality training is organized for executives in the company, (4) statistical technical training is organized for employees in the company, and (5) training on problem-solving techniques is organized for employees in the company.

(x) Scale of rewards

Rewards are defined as material and spiritual incentives for employees and management in the formation and implementation of improvement activities. This scale was developed based on the research of Flynn et al. (1994), consisting of three questions, measured using a 7-level Likert scale: (1) employees receive rewards for quality improvement activities, (2) managers are rewarded for implementing quality improvement activities, and (3) managers are rewarded for implementing quality improvement activities.

(2) Upstream Quality Management Scale

Upstream quality management (UQM) is a collection of communication practices, information sharing, and coordination with suppliers on quality considerations, product design, etc. based on technology linkage to ensure quality assurance from the supplier. The UQM system includes evaluation, selection, development, supplier learning based on technology linkage and information sharing with suppliers. Upstream quality management is assessed and measured through six components including (i) supplier quality management; (ii) technology linking with suppliers; (iii) information sharing with suppliers; (iv) supplier participation provided in product design; (v) supplier involvement in quality improvement; (vi) strategic partnership with

suppliers.

(i) Scale of supplier quality management

Supplier quality management emphasizes selection of suppliers based on quality not on price or schedule, but increasing supplier quality through expanding long-term relationships with suppliers, reducing release number provided. Supplier quality management scale was developed based on research of Saraph et al. (1989); Kaynak (2003), consists of 4 questions and is measured on a 7-level Likert scale: (1) the company always prioritizes expanding long-term relationships with suppliers, (2) the company reduces the number of suppliers when it comes to making timely purchases and/or comprehensive quality management, (3) suppliers are assessed according to quality, delivery, and price criteria, and (4) suppliers are chosen based on quality rather than price or delivery deadline.

(ii) Scale of technology linking with suppliers

This scale reflects the way organizations organize contacting and sharing information with suppliers: connecting with main suppliers by electronic systems, using information technology to contact with suppliers and requirements purchases, invoices, payments are transferred online, etc. The scale of technology linking with suppliers was developed based on the research of Li and Lin (2006), Lin et al. (2005), including 4 question items, measured using a 7-level Likert scale: (1) the company has electronic communication system with major suppliers, (2) the company uses information technology to deal with major suppliers, (3) the company uses electronic delivery of purchases, invoices, and budgets to major suppliers, and (4) the company uses information technology (RFID, PIDT) to track and speed up shipments to major suppliers.

(iii) Scale of information sharing with suppliers

Sharing information with suppliers reflects the level of sharing of information between the company and suppliers such as price information, delivery, demand changes, demand forecasts, inventory, capacity. production, productivity, quality, production schedules and other sensitive information such as finance or proprietary processes. The Information sharing with supplier scale was developed based on research by Li and Lin (2006); Lin et al. (2005) including 6 items using the 7-level likert scale: (1) the company notifies suppliers in advance of changes in demand, demand forecasts, inventories, (2) company and its suppliers share sensitive information such as price, financial, and proprietary processes together, (3) the company and its suppliers exchange information about production capacity, productivity, quality, schedule for business and production planning, (4) the company and its suppliers are always informing each other of events that may affect the other party, (5) sharing information between the company and suppliers takes place regularly, and (6) the company and its suppliers regularly exchange feedback on performance.

(iv) Scale of supplier involvement in product design

This scale reflects the level of suppliers' early and deep involvement in the organization's product design process. Scale of supplier involvement in product design consists of four items, measured using a seven-level Likert scale, developed based on research by Krause et al. (2000) and Carson (2007) as follows: (1) suppliers often engage from the outset in the company's product design efforts, (2) the company works with suppliers in designing new products, (3) suppliers regularly give advice during the design process of new products of the company, and (4) suppliers are an integral part of the Company's new product design efforts.

(v) Scale of supplier engagement in quality improvement

Supplier engagement in quality improvement indicates the degree to which a supplier engages in an organization's quality improvement process by maintaining close relationships, helping

suppliers improve their quality. Amount: This scale was developed based on the research of Kaynak (2003) and Lin et al. (2005), and it was measured based on a 7-level Likert scale and consisted of 3 question items: (1) the company maintains close relationships with suppliers regarding quality considerations and design changes, (2) suppliers are actively involved in the company's quality improvement efforts, and (3) the company helps suppliers improve their quality.

(vi) Scale of strategic partnership with suppliers

The Supplier Strategic Partnership scale reflects a set of supplier development activities such as adequate technical assistance, regular meetings to exchange ideas, encourage, support suppliers to improve production processes, train, share vision, and supply chain policies. The scale consists of 7 items, measured by a 7-level Likert scale and developed based on research by Tan et al. (2002) and Lin et al. (2005) as follows: (1) the company provides suppliers with full technical assistance, (2) the company holds regular meetings to exchange innovation ideas with suppliers, (3) the company encourages suppliers to continually improve the manufacturing process, (4) if necessary, the company requires suppliers to invest substantially in process improvement, (5) the company provides the necessary training for the supplier, (6) the company shares its vision and supply chain policy with key suppliers, and (7) as the company's suppliers strive to improve their processes, the company will support.

(2) *Downstream Quality Management Scale*

Downstream quality management (DQM) is a collection of interactive practices, communication, information sharing with customers about quality considerations, product design, etc. based on the link platform technology to define customer requirements and ensure the quality of the supply chain from customers. The downstream quality management activity scale consists of 5 components: (i) customer relationship management; (ii) technology linking with customers; (iii) sharing information with customers; (iv) customer engagement in product design; (v) customer engagement in quality improvement.

(i) Customer relationship management scale

The customer relationship management scale reflects the level of relationship development with the company's customers through interaction, measurement, evaluation of regular or unexpected satisfaction, customer support, and anticipation of expectations. In the future of the customer: This scale consists of 5 question items, measured by a 7-level Likert scale and developed based on research by Tan et al. (2002); Lin et al. (2005) as follows: (1) the company frequently interacts with customers to establish trustworthiness, responsiveness, and other standards, (2) the company regularly measures and evaluates customer satisfaction, (3) the company regularly determines customers' future expectations, (4) the Company facilitates its customers with the ability to seek support from the company, and (5) the company periodically assesses the importance of relationships with customers.

(ii) Scale of technology linking with customers

This scale reflects the way organizations organize contact and share information with customers: connecting with main customers by electronic systems, customers using information technology to transact, purchase, and purchase goods, applications and payments are transferred online to businesses, etc. The scale of technology linking with customers was developed based on the research of Li and Lin (2006) and Lin et al. (2005) including 4 questions, measured using a 7-level Likert scale: (1) the company has an electronic communication system with the main customers, (2) customer uses information technology to transact with this company, (3) customers use electronic transfer of orders and money to the company, and (4) customers use information technology to track and accelerate shipments to the company.

(iii) Scale of sharing information with customers

Sharing information with customers reflects the level of sharing information types between the company and customers such as price information, delivery, demand changes, demand forecasts, inventory, production capacity, productivity, quality, production schedules and other sensitive information such as finance or proprietary processes. The Information Sharing scale with customers is developed based on research by Li and Lin (2006) and Lin et al. (2005) including 6 questions, measured using a 7-level Likert scale: (1) customers inform the company about demand changes, demand forecasts, (2) customers and companies share sensitive information such as price, financial, and proprietary processes together, (3) the company and its customers exchange information on inventories, production capacity, productivity, quality, schedule for business and production planning, (4) the company and its customers are always informing each other of events that may affect the other party, (5) information sharing between the Company and customers occurs regularly, and (6) the company and its customers often exchange feedback on product quality and customer satisfaction.

(iv) Scale of customer engagement in product design

This scale reflects the early involvement of customers in product design, the level of cooperation, advising customers on new products, and customers are an integral part of product design efforts. Scale of customer engagement in product design was developed based on research by Saraph et al. (1989); Black and Porter (1996), including 5 questions, use a 7-level Likert scale: (1) the company discussed from the beginning with customers about the draft of new products, (2) the company collaborates with customers to design new products, (3) customers are often asked for ideas about new product designs, (4) customers only participate in the design of new products after the design completion, and (5) customers are an integral part of new product design efforts.

(v) Scale of customer engagement in quality improvement

Customer engagement in quality improvement reflects the level of customer involvement in quality improvement by maintaining close contact with customers and receiving feedback on quality performance, delivery from customer. This scale was developed based on the research of Tan et al. (2002) and Salvador et al. (2001) consists of 5 items that ask and use the 7-level Likert scale: (1) the company maintains close contact with customers, (2) customers give the company feedback on product quality results and delivery status, (3) the company strives to meet the highest needs of its customers, (4) company's customers often visit the factory, and (5) the company regularly surveys customer needs.

(3) Performance scale

Performance is an important parameter for the effective management of any company. The success of a supply chain is basically explained by its performance over a period of time. This paper evaluates performance based on three aspects: (i) quality, (ii) cost and (iii) delivery time, that is widely used in experiments on supply chain quality management practices. Accordingly, the quality aspect reflects the level of meeting customer requirements for quality, the cost aspect refers to the level of meeting customer requirements in terms of price or the ability to cut down product costs. Next to the delivery time, indicates the extent to which a customer's request has been met, in terms of time, schedule or on-time delivery rate. These indicators are developed in a way that allows the organization to self-assess the level of effectiveness in a comparative relationship with competitors.

(i) Quality scale

The quality performance scale reflecting the customer's satisfaction with quality was developed based on the research by Aramyan et al. (2007). This scale consists of 4 items using the 7-level

Likert scale: (1) customers require the company to participate in their quality improvement efforts, (2) customers trust the company for product quality, (3) quality is the most important criteria that customers use in selecting the company as a supplier, and (4) the company was chosen by customers because of its reputation for product quality.

(ii) Cost scale

The cost scale, which reflects the customer's satisfaction with prices, was developed based on the research by Aramyan et al. (2007). This scale consists of 4 items and is measured using a 7-level Likert scale: (1) low price is the most important criterion that customers have used in selecting the company as a supplier, (2) clients require the company to participate in their cost reduction efforts, (3) customers trust the company on low product costs, and (4) the company is chosen by customers for its low-cost reputation.

(iii) Delivery time scale

The delivery time scale reflects customer satisfaction in terms of delivery time developed based on the research by Aramyan et al. (2007). This scale consists of 4 items and uses a 7-level Likert scale: (1) deliver on time is the most important criterion that the customer has used in selecting the company as a supplier, (2) customers choose the company because we deliver on time according to their needs, (3) customers trust the company on delivery on time, and (4) the company is chosen by customers for its reputation for delivery time.

5. Results and Discussion

5.1. Sample Descriptions

This research was conducted on randomly a sample of 120 manufacturing companies listed on Vietnamese stock exchange. There were 45 companies listed on the Hanoi stock exchange (HNX) and 75 companies listed on the Ho Chi Minh stock exchange (HOSE). The sample can be divided into 11 sectors as follows:

Table 1
Categorize the research sample by sector

No	Sector	Number of enterprises
1	Textile	8
2	Pharmaceuticals, biotechnology	13
3	Civil and industrial consumer goods	24
4	Extractive	5
5	Energy	8
6	Materials	20
7	Food & Beverage	12
8	Grow and feed	4
9	Building materials	11
10	Construct	14
11	Publishing house	1
Total		120

5.2. Results of Testing Scales

To evaluate the reliability and validity of the scales, Cronbach's alpha test and Explanatory Factor Analysis (EFA) were used. Accordingly, the scale achieves reliability if Cronbach's alpha coefficient has value ≥ 0.6 , if value is ≥ 0.7 is good and over 0.8 is very good and correlation coefficient of total variable has value 0.3 and up. Test results of the scales show that the scales have achieved quite high value and reliability. The collected data is highly reliable and can be used to assess the situation, test models and hypotheses.

5.2.1. Testing the Scale of Internal Quality Management

Table 2
Results of testing the scale of internal quality management

Variables observed	Cronbach's Alpha	KMO	P-value (Bartlett's Test)	Initial Eigen values	Cumulative (%)
Support from top management	0.901	.762	.000	4.168	61.955
Quality strategy planning	0.792	.688	.000	2.155	58.282
Process management	0.919	.763	.000	3.728	68.677
Data and quality report	0.861	.726	.000	2.913	64.327
Feedback	0.866	.736	.000	3.368	60.668
Quality design	0.788	.766	.000	2.666	54.442
Problem solving	0.806	.648	.000	2.122	64.136
Continuous improvement	0.717	.719	.000	2.319	46.278
Quality training	0.861	.677	.000	3.226	56.188
Rewards	0.665	.505	.000	1.545	54.138

Test results by Cronbach's alpha coefficient show that all components of IQM have intrinsic consistency values with Cronbach's alpha coefficient ranging from 0.665 to 0.919. However, there are some items in the components that are removed for not meeting requirements such as scale (vi) quality design of IQM: item (6) sales staff, customer service, marketing, and public relations emphasize the quality of new products; scale (viii) continuous improvement of IQM: item (5) our organization is not a static entity, but it actively changes itself to better serve our customers; scale (x) rewards of IQM: item (1) employees receive rewards for quality improvement activities. This reflects quite accurately the current situation in enterprises when practices such as continuous improvement, the participation of parts in product design are still quite new, have not been implemented or received much proper attention from all parts.

5.2.2. Testing the Scale of Upstream Quality Management

Table 3
Results of testing the scale of upstream quality management

Variables observed	Cronbach's Alpha	KMO	P-value (Bartlett's Test)	Initial Eigen values	Cumulative (%)
Supplier quality management	0.626	.612	.000	1.712	57.368
Technology linking with suppliers	0.906	.781	.000	3.201	72.198
Information sharing with suppliers	0.886	.512	.000	5.312	57.099
Supplier participation in product design	0.616	.648	.000	1.919	54.327
Supplier involvement in quality improvement	0.732	.511	.000	1.702	60.688
Strategic partnership with suppliers	0.889	.789	.000	3.968	59.886

The testing results show that all scales of UQM achieve value and reliability with Cronbach's alpha coefficients of all scales are in the range of 0.616 to 0.889, factor load factors of the items are from 0.5 or more. However, there are some items in the component list that are eliminated due to non-compliance such as scale (i) supplier quality management of UQM: item (4) suppliers are selected based on quality rather than price or delivery deadline; scale (iv) supplier involvement in product design of UQM: item (2) the company works with suppliers in designing new products; scale (v) supplier involvement in quality improvement of UQM: item (3) the company helps suppliers improve their quality. This result completely reflects the current general situation of Vietnamese enterprises when the quality and technical capacity is very limited, the main suppliers are commercial enterprises and components equipment produced by itself is very small, the complexity is not high, almost no capacity to give advice, participate in product development. Besides, mostly manufacturing enterprises in the industry are small-scale, so they are not able to support and develop capacity for suppliers.

5.2.2. Testing the Scale of Downstream Quality Management

Table 4

Results of testing the scale of downstream quality management

Variables observed	Cronbach's Alpha	KMO	P-value (Bartlett's Test)	Initial Eigen values	Cumulative (%)
Customer relationship management	$\alpha = 0.856$	.796	.000	3.232	72.102
Technology linking with customers	$\alpha = 0.912$	.756	.000	3.421	71.104
sharing information with customers	$\alpha = 0.868$	.562	.000	5.768	60.216
Customer engagement in product design	$\alpha = 0.756$	.733	.000	2.668	51.119
customer engagement in quality improvement	$\alpha = 0.659$	.515	.000	1.912	58.679

The testing results show that all scales of DQM achieve value and reliability with Cronbach's alpha ranges from 0.659 to 0.912, KMO coefficient from 0.515 to 0.796, Cumulative is from 51.119% to 72.102%.

5.3. Correlation between Internal Quality Management Practices and Performance

As mentioned above, the practices of internal quality management are evaluated and measured through 10 components which include: (1) support from top management, (2) quality strategy planning, (3) process management, (4) data and quality report, (5) feedback, (6) quality design, (7) problem solving, (8) continuous improvement, (9) quality training, (10) rewards, and (11) internal quality management in general. Supply chain performance include three indicators: (12) quality, (13) cost, and (14) delivery time.

Table 5

Results of correlation between internal quality management practices and performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)	1	.337**	.456**	.575**	.705**	.378**	.625**	.368**	.386**	.086	.712**	.672**	.235*	.516**
(2)		1	.623**	.335**	.221*	.686**	.535**	.434**	.269**	.226*	.678**	.257*	.123	.383**
(3)			1	.416**	.433**	.657**	.823**	.416**	.266**	.202*	.759**	.456**	.333**	.519**
(4)				1	.556**	.236*	.456**	.568**	.456**	.234*	.715**	.527**	.086	.496**
(5)					1	.232*	.626**	.424**	.319**	.125	.696**	.423**	.069	.426**
(6)						1	.586**	.325**	.185	.202*	.668**	.246*	.315**	.214*
(7)							1	.456**	.346**	.227**	.838**	.629**	.366**	.702**
(8)								1	.635**	.567**	.735**	.445**	.036	.469**
(9)									1	.737**	.626**	.355**	-.266**	.473**
(10)										1	.436**	.124	-.058	.355**
(11)											1	.599**	.168*	.645**
(12)												1	.368**	.768**
(13)													1	.334**
(14)														1

** : P-value <1%

* : P-value <5%

The results of correlation analysis show that internal quality management practices include: support from top management, quality training, data and quality reporting, feedback, problem solving is strongly correlated with all aspects of performance in terms of quality, cost, delivery time with a correlation coefficient of 0.214 to 0.768. Specific results are presented in table 5. Other practical activities such as strategic planning of quality, rewards, process management, quality design only have a positive correlation with quality, delivery time. This result reflects true practices when these practices in the early stages such as rewarding employees for ideas,

quality improvement activities, design of new products are carefully considered before being produced. As a result, production and marketing, the involvement of all departments in the product design process, processes controlled by statistical tools often increase costs. The practice of continual improvement is only correlated with the time of delivery without the correlation with quality and cost, suggesting that improvement efforts at existing businesses are primarily focused to improve production capacity, shorten time to meet customer requirements. One noteworthy result is that the top management support is strongly correlated with all quality management practices within the organization, implying that this is a fundamental, forced implementation, and need to be done before deploying other practices. The set of internal quality management activities is strongly correlated in the range of 0.168 to 0.645 with all aspects of operating results which are most strongly correlated with product quality, then delivery time, and the last is the cost.

5.4. Correlation between Upstream Quality Management Practices and Performance

As mentioned above, the practices of upstream quality management are evaluated and measured through 06 components including (i) supplier quality management; (ii) technology linking with suppliers; (iii) information sharing with suppliers; (iv) supplier participation in product design; (v) supplier involvement in quality improvement; (vi) strategic partnership with suppliers, and (vii) upstream quality management in general. Supply chain performance include three indicators: (viii) quality, (ix) cost, and (x) delivery time.

Table 6

Results of correlation between upstream quality management practices and performance

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)	(x)
(i)	1	.607**	.656**	.415**	.365**	.458**	.765**	.468**	.198	.598**
(ii)		1	.603**	.395**	.345**	.586**	.795**	.384**	.188*	.426*
(iii)			1	.566**	.633**	.697**	.923**	.496**	.269**	.429**
(iv)				1	.205*	.218*	.569**	.408**	.556**	.294*
(v)					1	.868**	.786**	.524**	.068	.449**
(vi)						1	.856**	.425**	.085	.459**
(vii)							1	.563**	.246**	.567**
(viii)								1	.365**	.768**
(ix)									1	.337**
(x)										1

Table 6 shows the correlation coefficients between upstream quality management practices and performance. The results show that all six components of upstream quality management including supplier quality management, technology linking with suppliers, information sharing with suppliers, supplier participation provided in product design, supplier involvement in quality improvement, strategic partnership with suppliers are positively correlated with performance results in terms of quality and delivery time with Pearson correlation coefficient from 0.294 to 0.598. This result is easily explained by reducing the number of suppliers, developing long-term partnerships with suppliers instead of competing ones. Selecting suppliers based on quality, promoting supplier participation in quality improvement, providing technical support, necessary training for suppliers, organizing meetings regularly exchanging ideas for improvement with suppliers, supporting suppliers to improve product quality clearly brings positive improvements in product quality, reliability in delivery, however, these activities initially increase the input costs, so there is no relationship between the above practices and costs. But the analysis also shows that there is a positive relationship between technology linking practices, information sharing with suppliers, supplier involvement in product design and costs. This is explained by the development of technology links with suppliers to help the process of exchange and purchase happen quickly, smoothly, eliminate interruptions; sharing information about forecasts,

inventory, orders or delivery and delivery status to help both businesses and suppliers minimize inventories, more efficiently use human resources, fast delivery, more reliable, integrating suppliers in the process of designing new products helps to have more ideas, suggestions, suggestions to help shorten the time to bring products to market, resulting in operational results on the better cost. The set of upstream quality management practices has a positive relationship with all aspects of performance with a correlation coefficient of 0.567, 0.563, and 0.246, respectively with the delivery time, quality and cost.

5.5. Correlation between Downstream Quality Management Practices and Performance

As mentioned above, the practices of downstream quality management are evaluated and measured through 05 components including (I) customer relationship management; (II) technology linking with customers; (III) sharing information with customers; (IV) customer engagement in product design; (V) customer engagement in quality improvement, and (VI) downstream quality management in general. Supply chain performance includes three indicators: (VII) quality, (VIII) cost, and (IX) delivery time.

Table 7

Results of correlation between downstream quality management practices and performance

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)
(I)	1	.757**	.316**	.585**	.465**	.857**	.465**	.097	.535**
(II)		1	.343**	.695**	.425**	.886**	.495**	.304**	.635**
(III)			1	.596**	-.055	.567**	.569**	.706**	.509**
(IV)				1	.235*	.825**	.459**	.488**	.396**
(V)					1	.568**	.286**	-.264*	.415**
(VI)						1	.606**	.345**	.678**
(VII)							1	.379**	.768**
(VIII)								1	.335**
(IX)									1

Table 7 shows that all downstream quality management practices are studied from customer relationship management, technology linkage, information sharing with customers and customers involved in product development. Quality improvements are strongly positively correlated with quality performance, delivery time with a correlation coefficient of 0.396 to 0.886. Besides, except for interactive practices, measuring, customer satisfaction assessment, customer support; and the involvement of customers in quality improvement, the three practices still have positive cost relationships, especially the practice of sharing information with customers when the correlation coefficient is at 0.706. The set of downstream quality management practices is positively correlated with the performance of which the strongest correlation is with delivery time (0.678), followed by quality (0.606), and finally cost (0.345).

5.6. Regression Analysis of the Relationship between Supply Chain Quality Management Activities and Performance

The results of the correlation analysis of the independent variables that are components of supply chain quality management and the dependent variable are aspects of the performance results including quality, cost, and delivery time. These variables have strong correlations, that is, the higher the value of the independent variables, the higher the dependent variable is the result. This is in line with reality. However, the correlation analysis only points out the relationship between the variables but does not specify the degree of influence of the independent variables that are components of supply chain quality management activities on the dependent variable as a result of quality, cost, and delivery time. Therefore, the author continues to conduct regression analysis. The results obtained are presented in Tables 8 and 9.

ANOVA test of models having sig. = 0.00, which proves that the estimated regression model is consistent with the data set collected with significance level of 5%. The determination coefficient of multiple regression in the models range from 0.192 to 0.556, which means that supply chain quality management practices explain the range of 19.2% to 55.6% of the variation in performance. Specifically explained 55.6% variation of the delivery time, 46.5% variation of quality and 19.2% variation of cost. The univariate regression analysis results show that supply chain quality management activities in general and each of its components such as internal quality management practices, upstream quality management practices, downstream quality management practices have positive impacts on supply chain performance.

However, the results of multiple regression analysis show that except for model (2), all three independent variables are three components of supply chain quality management that have simultaneous effects on the dependent variable, cost; models (1) and (3) show that the only downstream quality management variable affecting the dependent variable is quality and delivery time. The inequality between the results of simple regression analysis and multiple linear regression is explained by the multiple regression model that exists the multi-collinear problem. This is consistent with the fact that it is very difficult to independently separate practices because of the interrelation between them. Results from univariate regression analysis will be used to test research hypotheses.

Table 8
Results of Simple Regression Analysis

Independent variables	Dependent variables: performance		
	Quality Adjusted R ²	Cost Adjusted R ²	Delivery time Adjusted R ²
Model 1: Internal quality management	0.586**	0.186**	0.656*
Model 2: Upstream quality management	0.568**	0.286*	0.566**
Model 3: Downstream quality management	0.626*	0.336**	0.668**

** : P-value <1%

* : P-value <5%

Table 9
Results of Multiple Regression Analysis

Criteria of the model	Dependent variables: performance		
	Quality	Cost	Delivery time
Adjusted R ²	.465	.192	.556
F (ANOVA)	23.615	7.189	32.566
P-value (ANOVA)	0.00	0.00	0.00
Durbin-Watson	2.123	1.324	1.689
Independent variables	Adjusted R ²	Adjusted R ²	Adjusted R ²
Internal quality management (IQM)	0.582	0.586**	0.256
Upstream quality management (UQM)	1.508	0.456*	0.066
Downstream quality management (DQM)	3.268**	0.468**	0.446**

** : P-value <1%

* : P-value <5%

5.7. Analyzing the Hierarchical Relationship between Components of Supply Chain Quality Management Activities

Hierarchical multiple regression is used to determine how the supply chain quality management system is developed in an organization, each variable will be modeled and tested for change in determination of coefficient regression R². Table 10 presents the results of analyzing the hierarchical relationship between supply chain quality management practices. The analysis results show that Model 3 with the interaction between IQM, UQM, DQM has a higher level of explanation than Model 1 has only IQM and Model 2 includes IQM, UQM (the determination of

coefficient of multiples regression R^2 increases from 0.195 up to 0.485). The result shows ΔR^2 Model 2 = 0.182 ($p = 0.004$) and ΔR^2 Model 3 = 0.114 ($p = 0.002$). This result implies that it is necessary to implement internal quality management practices and interacting with supply chain partners (customers, suppliers) practices at the same time will produce higher performance than the implementation of each individual practice due to synergistic effects. This result also implies the path of developing SCQM practices in the enterprise starting from quality management practices within the organization then developing practices with suppliers and customers.

Table 10

Results of analyzing the hierarchical relationship between components of supply chain quality management activities

Model	R	R^2	Adjusted R^2	Standard error of estimation	Statistical change		
					ΔR^2	ΔF	Sig. ΔF
1	.442 ^a	0.195	0.177	0.5465	0.186	7.985	0.003
2	.614 ^b	0.377	0.338	0.4886	0.182	9.263	0.004
3	.694 ^c	0.485	0.430	0.4542	0.114	6.212	0.002

6. Conclusion and Recommendations

Supply chain quality management is a research topic that is receiving the attention of academic scholars and managers. It is the integration between quality management science and supply chain management. It was born in the context of challenges from a growing business environment, and traditional approaches to supply chain management are increasingly ineffective. Supply chain quality management practices have been shown to potentially improve the organization's performance, the entire supply chain in terms of quality, cost, and delivery time. The research results show that the authors' approach to supply chain quality management is like extending the activities of internal quality management practices to the entire supply chain through cooperation, integration, sharing of information with suppliers and customers in the context of Vietnam. The three components of supply chain quality management are upstream quality management, internal quality management, and downstream quality management. These supply chain quality management practices are being implemented at a relatively basic level in Vietnamese manufacturing enterprises, focusing more on internal quality management practices, interactions with supply chain partners are limited. Analysis of survey data obtained from 120 enterprises also shows that supply chain quality management practices have a positive impact on performance. Based on the research results, it can be affirmed that supply chain quality management activities have positive impacts on the performance of manufacturing enterprises. The results of this study are consistent with previous research done by Hong et al. (2018) and Zeng et al. (2013). Improving the quality of supply chains helps improve the competitiveness of businesses and the supply chain. Specifically, the practice of supply chain quality management significantly affects the quality performance of the business. Good practice SCQM will create products of stable quality, bringing quality advantages for businesses such as the number of defective products and returned products is lower than competitors, better customer service, customer satisfaction higher than competitors

Good SCQM practices, especially those that interact with supply chain partners, help create more efficient and affordable problem-solving opportunities that lead to lower production costs and faster delivery times, more flexible or help businesses access valuable experience from partners that have never existed in them before. On that basis, businesses can come up with pricing strategies that appeal to customers more than competitors. Another finding of this study is to find out how to develop a supply chain quality management system in an enterprise. Accordingly, businesses should start by improving the organization's core quality competencies through improved internal quality management practices, which are the foundation for integrating

customers and suppliers. This is supported by phase theory, which shows that internal integration is a prerequisite for external integration to allow external uncertainty to be absorbed into appropriate places within the internal structure of organization. After that, businesses implement supplier quality integration practices that take advantage of their quality performance to deliver raw materials without going through testing. Finally, establish close relationships with customers in improving product quality and customer satisfaction.

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