Examining supply chain quality management in Chinese automobile market

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Abstract
The paper focuses on Supply Chain Quality Management (SCQM) in the Chinese automobile industry. Through a comparative study of seven leading OEMs, we elaborate on the major inhibitors that impede Chinese Self-Owned brands in successfully competing with Chinese-Japanese Joint Ventures, and propose a framework for effective SCQM in China.

Keywords: SCQM, Chinese automobile industry, comparative study

Introduction

The supply chain of automobile industry grows longer and complicated due to the involvement of large number of components and the high degree of participation of component suppliers and dealers in the business (Womack et al., 2007). Therefore, the way to supervise the product quality plays a key role in automobile industry. A series of high-profile automobile recalls, such as the recent 17,000 sports car recall of Aston Martin caused by the problematic accelerator pedals (Cauchi, 2014), have revealed that quality problems in the supply chain can create tremendous implications for consumer confidence and brand identity. Facing this critical phenomenon, there is now growing awareness of the importance of supply chain quality management (SCQM) in addressing issues that impact automobile quality. However, the quality problem in automobile supply chain operations has barely featured in developing countries (Foster, 2008). Therefore, China is selected as the research target for this research. In order to identify the current SCQM conditions in Chinese Self-owned Brands (CSBs) and Chinese-Japanese Joint Ventures (CJJVs) and clarify the reasons of current SCQM systems that fail to ensure desirable quality, this paper answers two research questions: 1) what are the differences between CJJVs and CSBs in terms of SCQM practices and SCQM performance? 2) why do such differences occur? This study contributes to our understanding of the differences between CSBs and CJJVs. It can help academics, policy makers, and practitioners to establish an effective SCQM framework and reduce the negative impact of potential quality crisis in practice.

Literature Review

Since 2009, China has become the world's biggest automobile market and producer. In 2013, its production and sales volumes have reached 22.12 million units and 21.98 million units respectively (CAAM, 2014). There would be 700 million more automobiles running on Chinese roads, if the level of automobile ownership in China catches up with the USA

(Schuman, 2014). The vast inflows of foreign direct investment in the form of joint ventures make huge contributions to the rapid development of the industry. Several famous Japanese brands, for instance, Toyota, Nissan, Honda, have cooperated with Chinese companies to build plants in China as well as exported finished automobiles to China from Japan. The sales volume of Japanese automobiles in China increased a lot in 2013. For instance, Nissan sold 1.27 million cars in China, an increase of 17.2% compared to that of 2012 (CAAM, 2014). CSBs have also made huge contributions to the industry. However, Mitchell (2014) reported that the market share of CSBs decreased from 31% to 23% in the first two months of 2014. This shows that low price, which used to be the competitive advantage of the CSBs, no longer dominates customers' decisions. Quality, safety and design start to play more important roles (JD Power, 2014).

The overall initial quality score (OIQS) indicates that in Chinese market there are 22 brands whose quality are above the industry average level (JD Power, 2014). 8 out of 22 are pure Japanese or CJJVs. Even though the average OIQS of CSBs has improved from 155 to 131 in 2014, only one CSB (e.g. GAC Trumpchi) exceeds the industry average level, compared with the number of three in 2013. This shows that although CSBs are trying to reduce the number of defects and malfunctions, the extent of quality improvement is still lagging behind others, especially the Japanese brands.

Quality performance and supply chain performance have been treated as trade-offs in the past, because companies could speed up the delivery only by sacrificing quality (Chen and Yang, 2002). However, dealing with traditional trade-offs is no longer an appropriate choice open to organisations in the present. The threats from competitors have forced organisations to confront the changes in both supply chain management (SCM) and quality management (QM). Both QM and SCM aim to develop tactical strategies for enhancing customer satisfaction and business performance (Vanichichichai and Igel, 2009). They are broadened to gain synergies through integrating all the internal and external parties. Consequently, SCQM emerges as a new management concept involving both QM and SCM (Sila et al., 2006). SCQM is the formal integration of measuring, analysing and continually improving products, services and processes in all SC members (Robinson and Malhotra, 2005). However, implementing SCQM is not a simple task. It requires the investments of money and intangible knowledge to establish cooperative relations among SC partners and enhance the quality awareness of all SC members. Recent SCQM literature lack studies on emerging countries, the roles of which turn out to be incredibly important in the global market. The lack of comparative studies of SCQM between emerging and developed countries renders SCQM understanding insufficient in explaining the globalised supply chain. Furthermore, the studied SCQM practices and performances are also incomplete because the majority of literature focus on internal company or upstream of supply chain (Zeng et al., 2013). Typically, such literature fails to explain organisations' choices of specific SCQM practices.

Research Framework

An automobile is composed of more than 5,000 types of components (He and Bai, 2012). As the assembler is normally in charge of assembling and stamping works (Womack et al., 2007), the supply of components becomes an indispensable process of ensuring desirable quality. Moreover, the dealer takes assembler's job to sell automobile to final customers (Womack et al., 2007). Therefore, this research starts from the perspective of the automobile company to investigate both internal QM and external QM for its whole supply chain. The framework is categorized into four parts: internal SCQM practices, supplier side SCQM practices, customer side SCQM practices, and SCQM performance.

The internal SCQM practices aim to improve the product quality through enhancing the cooperation among every department. Everyone in the company should accept their responsibility for quality improvement in order to achieve the common goals: better quality, higher customer satisfaction, fewer inventories and higher productivity (Kaynak and Hartley, 2008). Even though these practices are done within the company, they are not isolated from the external parties. Only if the internal SCQM has been successfully implemented, the company will recognize the potential to enhance its capabilities through facilitating the resources (Barney and Clark, 2007). In this research, eight internal SCQM practices will be studied. They are top management commitment on quality, strategic quality planning, employee management, process management, training, product development, quality information, and return.

The automobile cannot satisfy customers if its components fail to reach expected standard. Suppliers contribute to product quality through providing qualified materials and being involved in the product design process. Collaboration with suppliers is another key SCQM practice (Robinson and Malhotra, 2005). Successful buyer-seller relationships encourage suppliers to be involved earlier in the quality improvement implementation and product design process of buying firm (Lin et al., 2013). Effective supplier relationship management benefits the organizations in obtaining strategic resources and capabilities, thus increasing their competitive advantages (Prajago et al., 2012). Therefore, this research addresses supplier selection, supplier cooperation, and supplier development to describe supplier side SCQM.

Establishing close relationships with customers requires identifying customers' requirements, collecting customer feedback, and transferring this feedback to the corresponding employees who can then make improvement (Kaynak and Hartley, 2008). By involving customers in quality work, companies can be aware of and meet the changing demands of customers in time. Therefore, cooperation with customer is a prerequisite of achieving supply chain quality. A long-term cooperative relationship could be achieved through conducting systematically interacting activities with customers (i.e. Customer Conference, Company Open Day). In this research, the use of feedback, customer cooperation, and customer development are investigated as the core elements of customer side SCQM practices.

SCQM performance is a subset of the overall concept of organizational effectiveness (Foster, 2008). In this research, it contains both financial and operational performances. The financial performance refers to the outcome-based indicators that reflect the achievement of the firm's economic goals (Venkatraman and Ramanujam, 1986). Sales, profit, market share, and ROI are adapted from the work of Kaynak and Hartley (2008). The operational performance represents the effectiveness of the operation strategy for different stakeholders (Slack and Lewis, 2008). Quality performance, inventory turnovers, productivity, and customer satisfaction are adapted from the works of Kuei et al. (2001) and Sila et al. (2006).

Methodology

As this research is exploratory in nature, case study is selected to ensure that the important contextual variables and relationships are identified (Yin, 2009). The case companies were selected based on two criteria: first, it has an automaker in Chinese automobile industry; second, its ownership is either Chinese or CJJV. Therefore, seven automakers (five CSBs and two CJJVs) were selected to fulfil the goals of this study.

Data was collected from semi-structured interviews, company documents (annual reports, internal SCQM documents), and observations (Press Shop, Welding Shop, Paint Shop, and Assembly Shop) to enhance data triangulation. The interview protocol consisted of

33 interview questions that were developed from literature. These questions were divided into sections about company introduction (two questions), internal SCQM (twelve questions), supplier side SCQM (seven questions), customer side SCQM (six questions), and SCQM performance (six questions). 15 interviews were conducted in August 2014. Two interviews were conducted in companies of A, B, C, and E respectively. One interview was conducted in Company D. Three interviews were conducted in companies F and G respectively. The interviews were audio recorded and the average duration was 80 minutes. The interviewee selection was guided by their roles in quality management.

The data analysis process of Miles and Huberman (1994) (i.e. data reduction, data display, and conclusion drawing) was employed in this paper. The transcripts were generated through translating all the interviewees' answers into English. By listing key codes, "supplier selection", "quality training", and "customer feedback", etc. the necessary data was drawn from the original database. After reducing the data, the within case analysis was conducted in the first place to categorize SCQM practice and performance for each company. Second, the cross case analysis was conducted to compare the differences between CSBs and CJJVs. Through investigating the reasons of conducting SCQM practices in their specific way, the factors that block the SCQM implementation and cause undesirable SCQM performances were summarized.

Case Analysis

During the interviews, we found that only sales and profit are used as financial performance indicators in the target companies. ROI and market share were not mentioned by interviewees. The related financial data were retrieved from companies' annual reports. Moreover, instead of using levels of scrap and parts per million (PPM), interviewees used first time through (FTT) of finished automobile to describe their quality performance.

Within case analysis is a process of data reduction and every case has been summarised to identify key findings. The subheadings of the interview protocol (company introduction, supplier side SCQM, internal side SCQM, customer side SCQM, and performances) were used in building categories. The interview transcripts, information from site visits and archival data were then clustered into these categories. The detailed descriptions of each case are listed in Table I.

During the cross-case analysis, data was reduced further in order to derive commonalities and differences among the seven cases. Data shows that each company implements SCQM in their specific way which leads to different SCQM performances. CJJVs (Company E and G) perform better than CSBs in FTT and customer satisfaction with aids of strong quality awareness, intimate upstreamand downstream quality cooperation, and well implemented internal quality system. On the other hand, CSBs focus more on upstream and internal SCQM. The downstream SCQM doesn't attract enough attention because of the insufficient understanding of "customer concept". This is reflected in the small number of customer quality related staffs and the insufficient quality support to dealers. Moreover, the low quality awareness, the lack of quality knowledge, the laggard equipment, and inactive learning attitude of CSBs impedes their upstream and internal SCQM implementation.

Through conducting the second round cross case analysis, the reasons that hide behind these specific SCQM practices are clarified.

Table I : SCQM Conditions of Case Companies

Introduction	Internal SCQM	Supplier side SCQM	Customer side SCQM	Performance
A **Location: TianJin** **Ownership: SOE** **Employee: 7700**	Change quality system 3 times in 6 years; Run "Quality Battle" for quality training; Only implement 7 quality tools in work.	Stable production is the key factor of supplier selection. Hold "New Model Conference" every year to work with suppliers.	Use MIS to collect market quality data.	FFT: 63%; P:6000/month; I: High; S: 48% decline; Profit: -600%; CS: Low
B **Location: ZiBo** **Ownership: POE** **Employee: 1500**	Implement "Double-Check Point" for core producing procedure; No motivation of using professional SPC tools. Run "Speak out" activity for quality improvement.	Cost is the key concern of supplier selection; Arrange daily, monthly, and annual meeting with suppliers.	Do not think customer can directly influence product quality. Normally discuss market information with customer.	FFT: 80%; P: 8000/month; I:5days; S: 70000; CS: Better than benchmark target
C **Location:DingZhou** **Ownership: SOE** **Employee:1500**	Implement TS16949, but can't strictly follow the guidance; Send managers to developed city for quality training.	Require TS16949 certification for Level A supplier; Have very limited budget to work with supplier.	Implement DMS to collect customer feedback (doesn't work well).	FTT: 65%; P: 160000/ year; S: 150000; I: 3Days; CS: Better than benchmark target.
D **Location: XingTai** **Ownership: POE** **Employee:1000**	Quality is ranked below production; Only has workshop-level quality goal; No quality trainings in the company.	Cost and delivery are the key concerns of supplier selection.	Divide the feedback into 4 levels. However very few of feedback will send to the workshop.	FTT: 70%; P:100000/year; I: High; S: 50000; Profit: 150 Million RMB; CS: High in market.
E **Location: Tianjin** **Ownership: CJJV** **Employee:12000**	Strictly follow TPS; Implement Andon system; Hold QCC conference twice per year; Run "Creative Kongfu" 14 years for continue improvement.	Joint problem solving; Establish long term relationship through treating suppliers as its employees.	Establish Dealer Support Department; Provide quality training and financial support to dealers.	FTT: 99%; P:450000/year; I:5 Days; S: 450000/year; CS: Model C received the highest score in Compact Car section.
F **Location: BaoDing** **Ownership: POE** **Employee:60000**	Follow TS16949; High requirements of 5s; Run military-style management; Hold the zero defects forum in recent year.	Build laboratory with supplier to improve quality; Establish "Component Park" to locate majority of suppliers.	Provide maintenance sessions and one-stop financial services for dealers.	FTT: 96% (Model A is extremely low); P:730800; I: 5 Days; S: 730600; CS: Above average.
G **Location: Guangzhou** **Ownership: CJJV** **Employee: 8000**	Operate under ANPQP system. Run "Quality Adoption Plan" to allocate quality responsibility. Provide specific code for every component.	Jointly set up quality target with suppliers; Implement QCDD to cooperate with suppliers; Provide quality training to suppliers.	TCS department use QIS to handle feedback and provide formal solution to customers based on Q-Speed system.	FTT:99.58%; P:1100000/year; I: 8-10 Days; S:954000; CS: 1st in Sales Satisfaction Index

P: Production; I: Inventory; S: Sale; CS: Customer Satisfaction

Motivation of Quality Improvement

All of the interviewees claimed that quality is their first concern. However, this claim is just a symbolic slogan in CSBs. All the interviewees of CSBs emphasized *specific market condition* when introducing quality policy. For instance, the quality chief of Company D mentioned:

"We know that our product quality is not good and we receive a large number of customer complaints. However, if we can still earn desirable revenue by selling the existing products, why should we improve quality? A large amount of CSBs have the same condition with us, we will never sacrifice the order and production to exchange the misty quality."

Similarly, the quality chief of Company B indicated:

"Our high-end product does not sell well because customers do not think our products are worth the price. Therefore, we set low prices for our models. The low price means we can only buy low cost components that in low quality… Even though our quality has bad reputation in the world, our models still sell well. Therefore, investing more on quality is not that attractive."

Overlooking the importance of quality commonly exists in CSBs. It is true that improving quality will increase the investment, and the benefit may not be achieved in short-term. However, the underestimate of quality will significantly strike the brand recognition, and it is not easy to rebuild customer confidence. Furthermore, if the foreign competitors decrease prices, their models will quickly dominate CSBs' market share due to their better quality and higher customer satisfaction.

Capability of Company

During the field works, the researchers found clear gaps in the fields of production equipment, quality knowledge of staffs, and technology investment and ability between CJJVs and CSBs. The newly designed stamping dies, the imported painting machine from Daiki Sha (famous Japanese brand), the 277 full-automatic welding machines, the high-tech AGVs (Automated Guide Vehicle), and the mobile hybrid assembly line together show Company G's high technology ability and advanced automation. This can directly guarantee the desirable quality. Moreover, besides mastering the fundamental 7 quality tools, the quality managers could operate SPC software and conduct FMEA work. The frontline workers also had the awareness of reading the posted quality data and had the ability to understand it. These were the results of the various quality training sessions and the high recruitment requirement of the company. The quality manager WHG of Company G claimed:

"For the frontline workers, the minimum education requirement is the bachelor degree…… We will train new employees three months on quality assurance and corresponding production procedures…….Because we are associated with Company N in Japan, we send our quality managers to Japan to visit and work with Company N. This really improves their understanding of quality and how to use tools to supervise quality work."

A similar claim was also made by quality manager ZJE of Company E:

"We design a comprehensive training path for our employees to enhance their working ability and quality knowledge. It includes the internal quality sessions, quality control circle competitions, and Creative Kongfu presentations. Moreover, we will select some managers and core workers and send them to Company T in Japan to work with our parent company and experience their warm atmosphere of quality work."

On the other hand, the CSBs didn't perform well in these fields. Company D only had two stamping machines. Both of them were made in the 1980s. Nearly half of the moulds were gathering rust. Except the overhead transmission chains in Assembly Workshop, there were no other computer numerical control systems. Moreover, the quality chief of Company

D claimed:

"We also want to use the five tools of TS 16949 to manage our quality, but I don't think these tools are suitable for the automobile company. It is very hard to identify and numerically represent the related parameters."

However, TS 16949 is specifically designed for the automobile industry. This reply shows the low quality awareness and insufficient quality knowledge in Company D. Furthermore, the frontline workers hired by Company D were from a nearby village. The education level of them was very low. The workers even spent time on socializing during the production. The quality chief claimed:

"Our frontline workers only watch the working procedures on the Kanban. They do not pay attention to the listed quality data and do not want to take the quality training. "

Similarly, the quality manager LSC in Company C complained:

"The quality goal will be successfully achieved by the support of sufficient quality knowledge and experience. However, in my company, how can we clearly know our quality situation through using EXCEL as the only statistical tool? How can we build a fruitful FMEA database by only three young staff without knowledge to identify the occurrence and severity of quality problems?"

Adoption of Advanced Practices and Techniques

Only paying attention to the appearance of modification, but not continually seeking the nature of quality improvement is inadvisable (Andersen and Pettersen, 1995). It will only cost more money and time, but bring nothing to quality improvement. The senior quality manager of Company A said:

"After 30 years' learning from foreign company, we still stop at the superficial level of their advanced management……Not just us, some CSBs are also saying that they are following Toyota's way of QM. However, what have we learned? Yes, we have changed the title of workers from "Gong Ren" (Chinese translation of worker) to "Staff". But so what? The so called "learning and modification" is entirely symbolic."

The quality manager CZA in Company A further claimed:

"For example, they (Company T in Japan) may have 20 or 50 records about minor door problem in their FMEA database. This is due to their accumulation of quality records and knowledge, year after year. But look at us, we have already changed our quality system 3 times after reorganisation for the so called "learning" purpose. How can we build up our own quality database?"

The "symbolic adoption" is not a random case that only happened in Company A. The quality manager LQC in Company C claimed:

"In order to improve the quality work by integrating information technology, we have implemented Dealership Management System (DMS) since several years ago. However, this system was designed by our IT staffs that lack the quality knowledge (in production). Frankly speaking, this system contributes very little to our work."

During the site visit in Company F, the systematic 5S in workshops, the good maintenance of melting and assembly machines, and the strict production procedures show its efforts of adopting advanced management practices. However, the "beautiful appearance" cannot guarantee the desirable level of quality. The release of its flagship model had been delayed twice because of the bad quality of retarder and serious mismatching problems among several essential components. This showed that transform quality investment into "visible" quality performance is still a serious concern to CSBs.

However, Company G set a good example for CSBs. It co-developed the AGV with Tsinghua University, which reduces workers' unnecessary movement and distraction. After

the invention, Company G kept learning the technique of AGV and finally mastered all the principles. At present, Company G has upgraded the AGV and reduced almost 60% of its production cost. This shows how the right attitude and spirit of adoption of advanced practices and tools benefit the company.

Key Findings

Within and cross case analyses clearly suggest that there is a quality gap between CJJVs and CSBs. CJJVs are strictly implementing their designed SCQM principles within the company, conducting quality supervision and providing quality support to suppliers, and systematically collecting customer feedback and taking action. However, CSBs focus more on supplier side and internal SCQM but underrate customer side SCQM. Moreover, CSBs also are facing several problems, for example, the loose quality requirements for suppliers, the relatively laggard equipment, and the insufficient quality awareness and knowledge, in upstream and internal SCQM implementation. Through continually comparing the replies of interviewees and the notes of observations, three factors that lead to the different SCQM implementation have been identified: motivation of quality improvement, capability of company, adoption of advanced practice and techniques. Figure I illustrates that the extent of SCQM implementation in CJJVs is superior to CSBs. The CJJVs prevail CSBs in all the three determining factors. However, the gaps between CJJVs and CSBs are narrowing down because the CSBs (e.g. Company F) have already started investing more resources on upgrading equipment and building R&D centre.

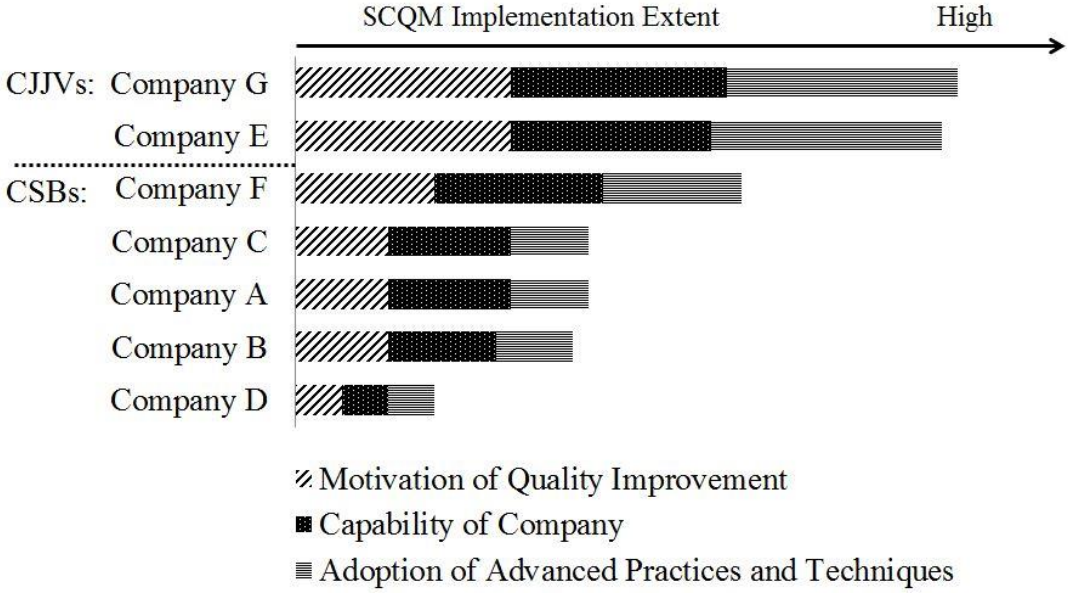

Figure I: Comparison of SCQM Implementation among Cases

Discussion

The findings about the different SCQM conditions in CJJVs and CSBs are consistent with the work of Li et al. (2003) which identified that JVs conduct better quality performances than other types of companies in China. However, they are contrary to the results of Zu et al. (2011) which clarified that the ownership doesn't bring any influence on quality work for Chinese companies. Zu et al. (2011) insisted that Chinese companies have made substantial efforts in upgrading advanced techniques and accepting modern management practices. But adopting advanced quality techniques and practices doesn't equal to their excellent

implementation. The insufficient motivation to improve quality shows the lack of top management support in CSBs. This directly weakens the position of quality when comparing with short-term revenue. It supports the opinion of Zhang (2000) that the lack of top management commitment seriously restricts the quality work in Chinese firms. The inadequate quality intelligence and incorrect learning attitudes impede the SCQM implementation in CSBs. This verifies the works of Zhao et al. (1995), which suggests that the modern quality techniques and knowledge are not well understood by Chinese managers and workers. The notion of customer focus is also belittled in CSBs. It causes the misunderstanding about the real customer requirements. This proves the finding of Lau et al. (2004) that the better quality and higher customer satisfaction can be achieved only when Chinese firms can systematically use customer feedback to improve the design of products and the process of production.

Based on the above discussion, the following managerial suggestions are provided to help CSBs in SCQM implementation. First, facing the problems of insufficient quality awareness and quality knowledge, more advanced training in quality management should be delivered to managers and workers to create a healthy quality culture in CSBs. It is necessary for CSBs to communicate with the international companies frequently about the advanced SCQM systems. They also should participate in academic activities that promote contemporary SCQM practices. Second, in order to enhance the customer side SCQM work, CSBs should hire more customer quality staff to build a comprehensive downstream supply chain. Developing the practicable information system to collect and analyse feedback is also very important. CSBs can enhance their competitiveness through quickly recognising the changing quality requirements and making the prompt response.

Conclusion

This study points out the literature gaps, describes the general situation of Chinese automobile industry, and clarifies the conditions of SCQM in target companies. Through the within and cross-case analyses, the different SCQM in CJJV and CSBs are identified. The root causes of the differences are also analysed. In the end, the managerial suggestions are provided to help the CSBs to make future improvement in SCQM. Because of the importance of the Chinese automobile industry in the world, the SCQM theory cannot claim to be complete without considering the Chinese market. This comparative study makes a valuable empirical contribution to our understanding of relevant factors in Chinese automobile industry. Furthermore, this study also provides practical contribution through clarifying three major factors that impede SCQM implementation in CSBs and providing managerial improvement suggestions. For the future studies, more companies with diverse characteristics will be included into the research. For example, the companies have the backgrounds of America, Germany, and Korea, will be investigated.. Other methodological approaches such as a large survey will also be conducted to test the generalizability of the results found in this work.

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