

Supply chain risk management: approaches and tools for continuous improvement

The “Total Quality Management” (TQM) revolution in the second half of the 20th century had a dramatic impact on the way in which companies defined and understood both product and service quality. There was a growing recognition that quality management was ultimately about process management along with creating a culture within the organization that acknowledged that quality was the concern of everyone who worked there. This recognition triggered a focus on process improvement and control, using tools like Failure Mode and Effect Analysis (FMEA), Fault Tree Analysis, Cause and Effect Analysis, Statistical Process Control and later the adoption of “Six Sigma” thinking with its emphasis on reducing the variability of process performance.

At first most quality improvement programmes were internally oriented. The concern was “to get it right first time” with a particular emphasis on improving the quality of manufacturing output. Later there came a growing realisation that because the business had out-sourced many of the activities that it used to perform itself, it was no longer a stand-alone entity. Instead it was part of a wider supply/demand network with many interdependencies and multiple nodes and links where things could go wrong. As a result it now became necessary to look at quality through a much wider lens – a lens which should encompass the whole of the supply chain.

Because the purpose of any supply chain is to serve a customer and because at present the “customer experience” is a major determinant of loyalty it is critical that TQM should prioritise the improvement and consistency of that experience. Since the reputation of the business is so closely linked to the quality of the customer experience it follows that the antecedents of that experience, i.e. the actions of supply chain partners, should be carefully managed. From this perspective, a new challenge is to recognise the key role of the “4 Ps” of TQM (Planning, Process, Performance, People) in the holistic perspective of supply chain management (SCM).

To enable a closer working relationship with partners in the supply chain with the aim of enhancing supply chain performance and hence the customers’ experience, the practice of “Supplier Relationship Management” (SRM) has been widely adopted. SRM stands in contrast to the traditional “arms length” approach to working with suppliers. Here the philosophy is that by establishing closer working relationships with key partners in the supply chain the opportunities for creating seamless and more efficient process connectivity can be identified and exploited. Thus quality management migrates from primarily having an internal focus to one which looks for improvement possibilities across the entire supply chain.

Ultimately the requirement for quality improvement can be linked to the need for risk reduction and mitigation by the organization and its supply chain, from a supply chain risk management (SCRM) perspective. Since quality failures, whatever their source, have potential consequences for the reputation of the business it makes sense to take a risk management perspective when considering quality improvement initiatives.

So, the eight steps of the “problem solving” philosophy in the TQM framework (the Plan-Do-Check-Act (PDCA) cycle) – problem definition, collect data, define target, cause analysis, define countermeasure, apply countermeasure, verify countermeasure effectiveness, standardize and prevention – become a common mindset for managing quality and risk within the company and along the supply chain.



In this regard it is encouraging to see that in recent years SCRM has become a priority for many businesses. Because of the growing complexity of present day's extended – and often global – supply chains the potential for disruption in the network has inevitably increased. The situation is often exacerbated because simultaneously those same businesses were possibly in the process of “going lean” i.e. focussing on improving efficiencies, cutting out “waste” in the form of additional inventory and capacity and hence reducing their resilience to supply chain disturbances.

The paradox is that many businesses, having spent decades on improving the performance of their own internal processes using the classic TQM tools, are now discovering that the real threat to reputational risk is from the wider supply chain. A striking case in point is provided by Mattel, the toymaker, who in 2007 were forced to recall more than 21 million toys. In the USA – Mattel's biggest market – sales slumped and their profits and market valuation nose-dived. The cause of this recall was a quality problem arising from their out-sourced supply arrangements. It transpired that the cause of this problem was not with the first tier supplier, or even the second tier but with an obscure third tier supplier well out of view of Mattel. The lesson to be learnt from this example, and others like it, is that the connection between SCM and the potential for business disruption and the likely subsequent reputational risk is very real.

TQM theories focus on two main themes that have been differently addressed in the papers of this Special Issue: management system and techniques. The TQM management system deals with the philosophy, the leadership vision and the PDCA cycle involving human resources. TQM tools and techniques aim to guide the quality improvement process (Tarí and Sabater, 2004). These papers explore both these TQM themes in the field of SCM and SCRM, in order to support a continuous improvement. Different perspectives, including continuous learning theories (Garvin, 1994; Teece, 2009), agency theories (Ahire and Dreyfus, 2000) and contingency theories (McAdam *et al.*, 2019) have been adopted in the papers.

Three key topics recently emerged and seem to represent relevant areas of investigations at the intersection between TQM and SCRM, as described in the next sections: (1) a further exploration of the supply chain quality concept, integrating the strategic concepts of supplier relationships, process sustainability, recovery and continuous improvement; (2) the investigation of specific risks and the *ad-hoc* risk management strategies, using the TQM lens; (3) the continuous development of decision-making and risk-analysis tools using the TQM lens.

1. Towards a supply chain quality concept

Recent studies stressed the importance of adopting ad-hoc guidelines, metrics and standards (for example, ISO 31.000, ISO 9.001, ISO 14.001, OHSAS 18.001) for integrating the perspectives of TQM and SCM in order to support a holistic corporate strategy development (Bastas and Liyanage, 2018). This requires the capability to coordinate supply chain processes, using continuous and synchronised measures (Robinson and Malhotra, 2005). Three papers of this Special Issue focussed particularly on the key themes of supplier quality management for sustainability and mitigation of disruptions.

In particular, the paper of Juettner *et al.* (2020) suggests a focus on supplier quality management, highlighting several intercepts between TQM and SCM (Vanichchinchai and Igel, 2009), using the lens of sustainability. In fact, both TQM and SCM theories stress the role of participation and partnership, however, while TQM focusses more on internal participation, SCM traditionally places stronger emphasis on external partnerships. With regards to sustainability, Waddock and Bodwell (2002) emphasized the role of philosophy, people and processes in meeting sustainability targets and avoiding risk. However, only a few papers (e.g. Huo *et al.*, 2016) have acknowledged the importance of HR and people

management from these perspectives. The paper of Juettner *et al.* (2020), in particular, stresses the importance of the identification of sustainability quality requirements as specification-based performance. Quality could be basically defined as the degree to which a set of inherent characteristics fulfils requirements (Robinson and Malhotra, 2005; Waddock and Bodwell, 2002). In a broader perspective, quality requirements represent stakeholder specification-based performance indicators. It is therefore essential to take a stakeholders' perspective in order to identify sustainability and quality risks and hence to define more holistic quality requirements, which consider not only customer demands. This holistic view may guide a better definition of process improvement measures along all phases of the supplier relationship. Such a process quality management can positively effect "external" or "final" quality in the value strategy of the organization. In this context, the agency theory has been interestingly applied to TQM theory, providing a dynamic view on the overlapping relationships (e.g. Ahire and Dreyfus, 2000).

The paper of Riley (2020) seeks to understand if organizations can leverage recovery/continuous improvement capabilities and two competencies to mitigate manifest supply chain disruptions. Specifically, the author analysed the competences that supply chain managers should have to cope with highly uncertain environments, and how these competencies allow them to develop recovery/continuous improvement, according to TQM theories. In addition, the author examines how learning from previous experience and supply chain disruption-orientation affects organizations' capability to recover continuously and improve once a supply chain disruption has manifest itself. In addition, knowing that organizational inertia likely exists during disruptions, the paper examines the mediating effects of routine rigidity on proposed relationships.

The exploratory study of Pellegrino *et al.* (2020) investigates the key role of SRM in achieving company's quality and continuous improvement. The paper analyses in particular how purchasing organizations perceive and manage supply risks. According to Jiang *et al.* (2008) and Rao and Goldsby (2009), the upstream market uncertainty leads to higher levels of uncertainty in both quality and reliability, generating a detrimental effect on final product quality and higher risk exposure downstream along the supply chain. According to TQM theories, organizations need to develop a supply risk management strategy devoted to the prevention and mitigation of supply risk, as a process-oriented philosophy of enhancing customer satisfaction through the quality optimization. Hence, quality practices evolved from quality control to quality management (Mehra *et al.*, 2001). From this perspective, SRMs, like information sharing, establishment of long-term and trusting relationships with suppliers, mutual dependence and commitment represent a key driver for both TQM and SCRM theories (Theodorakioglou *et al.*, 2006).

2. Improving the management of specific risks using the TQM lens

In this Special Issue, there are two papers that addressed the benefits of integrating TQM theories and SCRM theories in order to improve the management of specific risks, such as counterfeit risk and cargo theft risk.

Amongst the TQM practices, supplier quality management plays a key role (Forker *et al.*, 1997; Talib *et al.*, 2011), and building a "win-win" trustworthy relationship can support the achievement of JIT delivery, TQM and lean goals (Halldorsson, 2007).

The paper of Falasca *et al.* (2020) focusses on counterfeit risks in the relationship with suppliers, addressing how firms with robust SCRM processes need to improve the management of counterfeit risk, using more consistent metrics and getting better performance outcomes in their quality and SCM. This paper highlights how tools such as supply chain FMEA (Kumar *et al.*, 2013) and Fault Tree Analysis (Qazi *et al.*, 2018), can play a key role in achieving effective risk mitigation in a supply chain context. In addition, the paper

shows that formal counterfeit management systems with suppliers have a positive impact on supply chain metrics, including the reduction of variability in product quality.

The paper of Ekwal and Lantz (2020) explores cargo theft risk and security for different product types at different locations along a transport chain stressing the importance of adopting an interdisciplinary approach including TQM, Operations Management, and also Criminology and Decision Sciences, shedding light on the complex relationship between general cargo theft risk and product type and transport chain location.

3. Developing decision-making and risk analysis tools using the TQM lens

As previously highlighted, many TQM-derived studies pay limited attention to the tools and techniques for measuring supply chain performance and associated risk (Huo *et al.*, 2019; Flynn and Flynn, 2005; Huo *et al.*, 2014). To start responding to the need to investigate the application of tools for TQM and SCRM, there are three papers in this Special Issue. These focus in particular on the Lean and Six Sigma philosophy, Fuzzy Analytic Hierarchy Process (FAHP) and grey-based DEMATEL methods.

The paper of Andersson and Pardillo-Baez (2020) investigates how a combined Lean and Six Sigma philosophy can improve the awareness and management of supply chain risk (SCR). In fact, Lean and Six Sigma tools can be very helpful in order to control day-by-day SCRs, and to improve the organization's ability to cope with process variability, uncertainty and risk. Lean Six Sigma tools can also foster the development of a risk-based culture both in the focal company and also with respect to customers and other actors involved in the supply chain. Previously authors have highlighted how the application of Six Sigma ideas has increased in many companies (Andersson *et al.*, 2014) and how Six Sigma projects produce strong financial results (Oprime, 2019), requiring – at the same time – the management of SCRs. Communication, collaboration and integration amongst the members of the supply chain are key drivers, along with integration of processes, both downstream and upstream (Vanichchinda and Igel, 2009).

The paper of Ganguly (2020) developed a FAHP approach, as an extension of one of the multi-attribute decision-making techniques that increase consistency in decision-makers' judgements. The tool represents an assessment methodology for quality-related performance measures linked to SCR using FAHP technique. The proposed risk matrix could allow decision-makers to better measure SCRs and prioritise their decisions, setting the importance of four quality-related performance measures: product quality, delivery, cost of quality and flexibility.

The paper of Prashar and Aggarwal (2020) use a grey-based DEMATEL method to model the key enablers of supply chain quality risk management. This method is based on a hierarchical structure that binds all the factors (Aggarwal *et al.*, 2019; Hsu *et al.*, 2013) in order to support better decisions. Common causal factors emerge from the model, such as involvement of top leaders, inter-firm communication and strategic-level alignment between supply chain members thus highlighting the need for a broader policy at an early stage. This paper provides a structured approach to proactively incorporate supply chain risk management (SCRM) and quality management issues in an integrated manner.

3.1 Future research directions

As the papers brought together in this Special Issue demonstrate, there is significant scope for extending quality management across the wider supply chain. As companies seek to increase their resilience to unexpected shocks and disruption the need for a more systematic approach to SCRM and TQM becomes ever more evident.

Because the field of SCRM is relatively young, scholars and practitioners alike are still exploring opportunities for improving practise. As a result the potential for more detailed

research focussing on this area is considerable. We need to understand more about how risk across the supply/demand network can be identified and mitigated. There are considerable insights to be gained through in-depth qualitative case study research as well as through more classical empirical studies. Hopefully the publication of the papers in this Special Issue will stimulate further work on these important issues.

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Further reading

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