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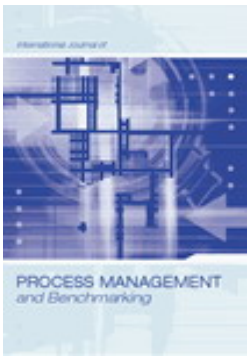

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Strategic framework for successful implementation of synergistic approach SCQM (TQM-SCM)

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Abstract: Nowadays customers are very concerned about product and service quality, delivery and flexibility. Therefore, emphasis is given to improve the quality, flexibility and timely delivery of products through synergistic implementation of quality principles with supply chain management. However, the majority of the manufacturing firms hesitate to implement all parameters of TQM-SCM simultaneously because of some constraints. Therefore, the aim of this study is to purpose a phase wise approach to successfully implement TQM-SCM. For this, survey of 116 Indian manufacturing organisations has been carried out. Responses of this survey are utilised in identify various options, profiles and weights of multiple regression utilised in OFM, OPM, and FST. Afterwards, Academic experts and industry experts were consulted through specially drafted comparison scale questionnaire to obtain the weights of objectives with the help of AHP. Finally, results of this integrated OFM, OPM, AHP, FST are utilised to propose a strategic framework.

Keywords: synergistic approach; a phase wise approach; Indian manufacturing industries; competitive dimensions.

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1 Introduction

Globalisation of markets, the changing demands of consumers (more variety, better quality, and greater service in terms of reliability and response time (Doshi, 2019) and competitive economy had forced organisations to satisfy the needs and expectations of their trade partners and ultimately the end customer (Rebelo et al., 2016; Carvalho et al., 2018). As a result of this scenario, manufacturing organisations have started collaboratively working on to improve the quality of whole supply chain (Foster and Ogden, 2008; Ni et al., 2015). As quality management within supply chain results in the betterment of customer satisfaction in terms of quality, delivery and availability of goods and ultimately the business performance (Sharma and Modgil, 2015; Bastas and Liyanage, 2018; Sidhu et al., 2019).

Further, total quality management (TQM) and supply chain management (SCM) are such an innovative improvement approaches to achieve competitive advantage (Ahmed and Ferdousi, 2020) by addressing issues related to customer satisfaction (Vanichchinchai and Igel, 2009). But to serve the customers, their focus is different. Like, TQM approach which is considered as the most important trigger for Indian manufacturing firms to achieve success, focuses on quality throughout all phases of an organisational system Sahoo (2020), while main motive of SCM isto ensure on timely delivery of products, minimising total cost(Marino et al., 2018) through the management of supplier relationship (Vanichchinchai and Igel, 2009). Moreover, the literature reveals

that a firm's quality management practices and SCM practices complement each other and hence demands implementation in an integrated manner to achieve better organisational performance (Terziovski and Hermel, 2011). Therefore, application of quality management practices along with supply chain management is proving helping hand for industry.

Based on insights of research on SCQM practices conducted by previous researchers such as Flynn et al. (1995), Lin et al. (2013), Quang et al. (2016), Fernandes et al. (2017) and Apornak and Hezaveh (2019), current study explores the area of supply chain quality management with the proposal of the model in context of Indian manufacturing companies.

In addition, One of the important decision-making problems that are practicing managers always encounter is how to select the best set of practices/measures to be competitive with their competitors (Sivakumar et al., 2020). It is therefore important to thoroughly investigate the sequence of steps in the acquisition and to develop a set of guidelines for the implementation of the proposed guidelines in the Indian manner so that industry managers can be directed to the successful adoption of quality practices in the supply chain.

Therefore, this study focuses the research questions like:

1 What are the measures required for the synergistic implementation of quality principles along with supply chain management in Indian manufacturing firms?

2 There are several measures that ensure the effective implementation of a synergistic approach but all measures cannot be performed simultaneously due to various problems such as cost, time and so on. Therefore, it is important to determine the order of acquisition of these measures.

In addition to the research questions the following objectives are addressed:

a To identify prominent measures required for successful implementation of synergistic approach.

b Develop a strategic framework for the phase wise synergistic implementation of TQM-SCM.

The paper starts with a review of the literature pertinent to SCQM practices followed by adopted quantitative methodology. Next section represents an analysis of the data by using integrated OFM, OPM, AHP and FST approach. Further, on the basis of results provided by this integrated approach, strategic framework for phase wise implementation of TQM-SCM is developed. Conclusion is presented in final section.

2 Practices of integrated approach (SCQM): a review

The synergy of TQM and SCM is called supply chain quality management (SCQM) (Lin and Gibson, 2011). According to researchers, SCQM is defined in many ways. Robinson and Malhotra (2005) considered SCQM to be 'integration between different business nodes, that is, among all partner trading partners in the supply chain to measure, and analyse then further develop products, processes and services to create value based on customer satisfaction'. Furthermore, Kuei et al. (2008) define SCQM as 'an extension of supply chain management, designed to provide a supply chain that becomes competitive

through the use of quality management practices'. SCQM deals with the fulfillment of requirements of supply chain, i.e., Production at low cost with minimum time to meet customers need with effort of all nodes of supply chain (Apornak and Hezaveh, 2019). As, it improves the quality across whole supply chain through leadership, strategic design, up-stream and down-stream process integration and product recall strategy (Cogollo-orez and Correa-Espinal, 2019).

Table 1 Major practices for supply chain quality management (SCQM)

SCQM practices	*Supporting references*
Supplier management (includes Supplier selection and Supplier participation, supplier assessment and supplier quality management, supplier relationship management)	Flynn et al. (1995), Kuei and Madu (2001), Lin et al. (2005), Yeung (2008), Sroufe and Curkovic (2008), Kaynak and Hartley (2008), Rashid and Aslam (2012), Lin et al. (2013), Quang et.al. (2016), Hu and Zhao (2018), Nosratpour et al. (2018), Doshi (2019), Kaur et al. (2019, 2020)
Customer focus	Flynn et al. (1995), Flynn and Flynn (2005) Yeung (2008), Sroufe and Curkovic (2008), Kaynak and Hartley (2008), Kuei et al. (2010), Rashid and Aslam (2012), Hu and Zhao (2018), Nosratpour and Soofifard (2018), Kaur et al. (2019, 2020), Kumar et al. (2020)
Product/service design	Flynn et al. (1995), Rashid and Aslam (2012), Quang et al. (2016), Hu and Zhao (2018)
Process management	Flynn et al. (1995), Flynn and Flynn (2005), Malhotra et al. (2005), Kaynak and Hartley (2008), Kuei et al. (2010), Rashid and Aslam (2012), Lin et al. (2013), Paras (2013), Quang et.al. (2016), Kaur et al. (2020)
Information sharing	Flynn and Flynn (2005), Sroufe and Curkovic (2008), Kaynak and Hartley (2008), Kuei et al. (2010), Lin et al. (2013), Paras (2013), Zhou et al. (2014), Qrunfleh and Tarafdar (2014), Quang et.al. (2016), Fernandes et al. (2017), Nosratpour and Soofifard (2018), Kaur et al. (2019)
Leadership and strategic quality planning	Flynn and Flynn (2005), Malhotra et al. (2005), Kaynak and Hartley (2008), Kuei et al. (2011), Rashid and Aslam (2012), Lin et al. (2013), Fernandes et al. (2017), Hu and Zhao (2018), Nosratpour and Soofifard (2018), Kaur et al. (2019), Kumar et al (2020)
Human resource management	Flynn and Flynn (2005), Sroufe and Curkovic (2008), Kaynak and Hartley (2008), Kuei et al. (2011), Rashid and Aslam (2012), Lin et al. (2013), Kaur et al. (2019), (Singh et al., 2020), Kumar et al.(2020)
Communication and partnership	Malhotra et al. (2005), Yeung (2008), Sroufe and Curkovic (2008), Kuei et al. (2010)
Trust	Paras (2013), Cai et al. (2010), Fawcett et al. (2012)

Another important area of concern in the SCQM literature is the collection of practices that support the importance of SCQM in terms of business performance. Numerous studies as shown in Table 1 (Flynn et al., 1995; Sroufe and Curkovic, 2008; Kaynak and Hartley 2008; Kuei et al., 2010; Quang et.al., 2016; Fernandes et al., 2017; Kaur et al., 2019) have explored significant practices that ensure the successful implementation of SCQM.

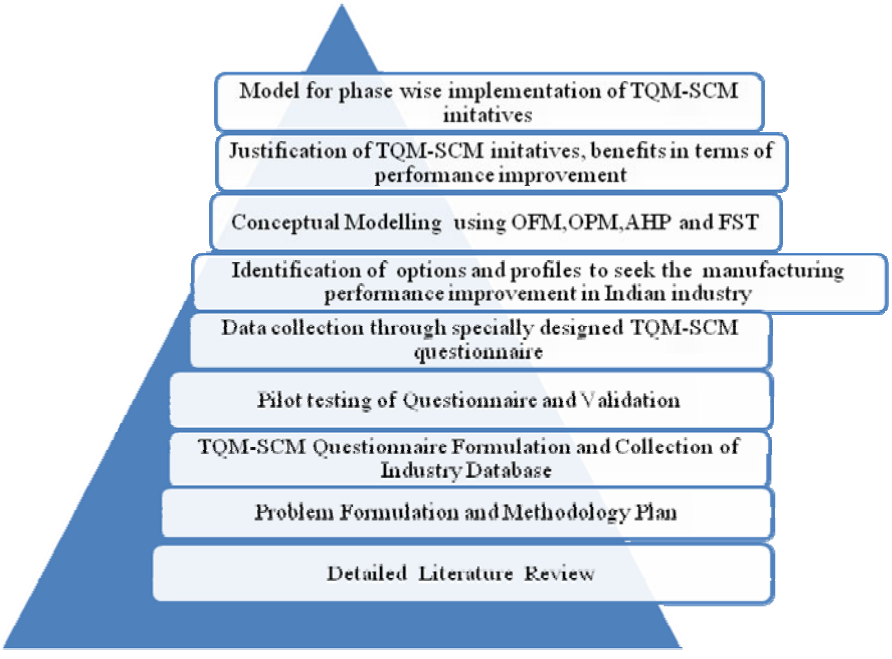
2.1 Research gap

While reviewing literature in the field of synergy of both TQM-SCM, it is found that previous studies reported in the literature tend to take stock of successive structures that focus on critical practices and their impact on business performance. But as per the authors know till now no research has formulated strategic framework addressing phase wise implementation of synergistic approach in context of manufacturing firms of India. That's why, the present study has identified the phase wise measures for this synergistic approach in order to ensure its successful implementation. Thus, this paper addresses the gap in formulation of phase-wise methodology for successfully implementing this synergistic approach by a following two-phase research approach.

3 Methodology

The study has been carried out for investigating various phase wise implementation measures of TQM-SCM, those contributes in the performance improvement of medium and large scale manufacturing Indian industries. Methodology followed for this purpose is represented in Figure 1.

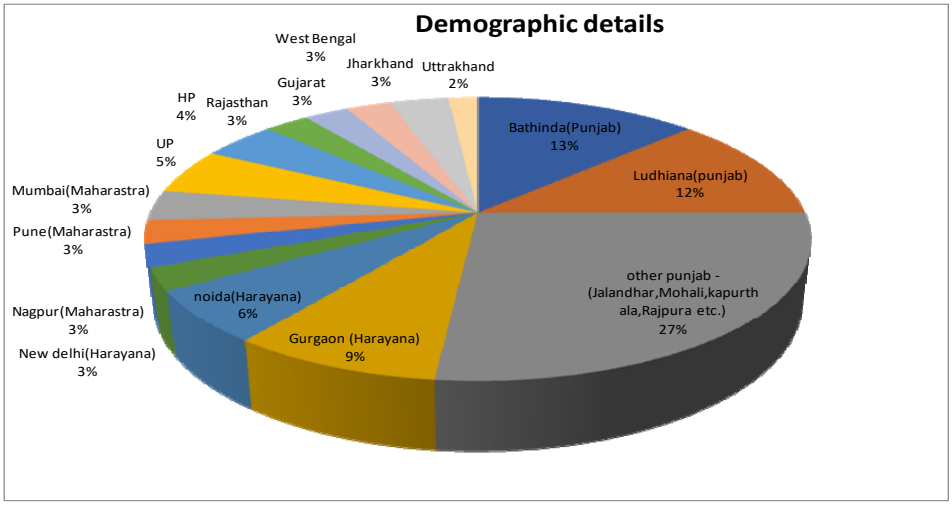
Figure 1 Methodology adopted for the study (see online version for colours)



In order to achieve the above objectives, the proposed method consists of two stages. In the first phase 116 (statistics provided in Figure 2) medium and large scale Indian manufacturing firms has been surveyed (utilised for OFM, OPM and FST), through TQM-SCM questionnaire which has been designed with the help of extensive literature review (Talib et al., 2011; Kaur et al., 2019) and validated by experts. Further, to confirm

the relevance and effectiveness of the questions to manufacturing industry, this questionnaire has been subjected to pilot study.

Figure 2 Demographic details of manufacturing firms considered in the survey (see online version for colours)



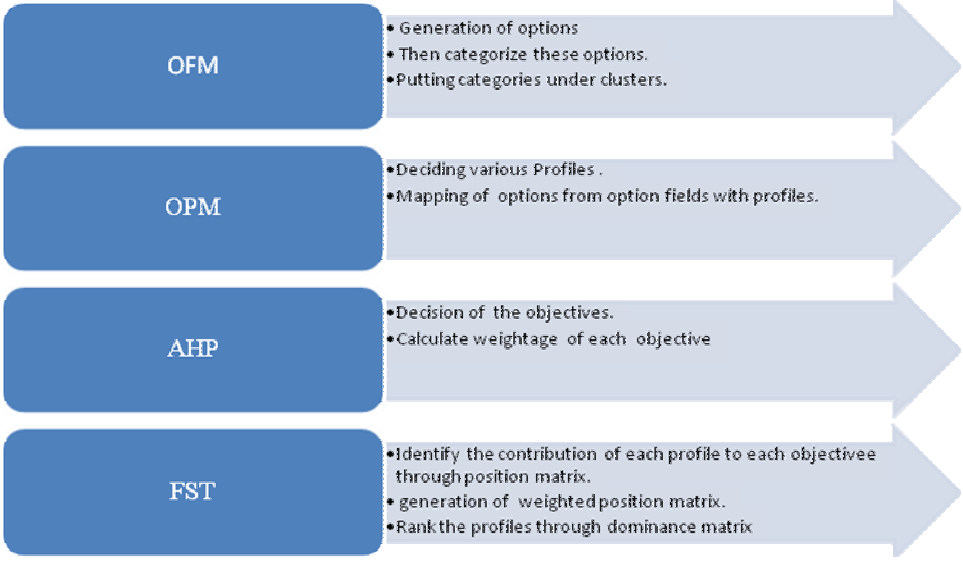
Moving forward, a list of about 500 Indian manufacturing industries following the TQM-SCM approach was compiled with the help of various sources such as MSME and CII. This final questionnaire was sent to these manufacturing industries. Further, to collect responses, different techniques are adopted like mails, personal interviews, postages and telephonic conversation. In response to above total 116 usable questionnaires has been received. So obtained response rate is 23.2%, which is comparable to similar type of studies related to this field (Dellana and Kros, 2014; Soares et al., 2017). The sample size consists of various types of manufacturing industry such as Food and electronic industry, Textile, Automobile, etc. Here, it is relevant to make reference to that the majority of the respondents had a place with the top administration administrators class that incorporates a few vice presidents, heads of quality assurance, quality managers, heads of supply chain, and president operations general managers (GM), chief managers, GM technical, HR manager, etc.

The second stage involves determining weights of objectives through comparison scale questionnaire as shown in Figure 4 by utilising AHP approach. For the purpose, the experts from the company and Academic were asked to pair wise compare the eight objectives on a scale of 1–9 (Saaty, 1980) as represented in Table 3 and accordingly judgment matrices were created of size 8 x 8, where the total number of comparisons was 28. Further, these weights provided by AHP are utilised in FST in order to rank the profiles. Here, it is pertinent to mention that these ranks of profiles are utilised to construct Strategic TQM-SCM model (Figure 5).

4 Conceptual modelling technique adopted for the study

Organisations can enhance their business performance, delivery and quality, etc. by implementing TQM-SCM practices according to the situations. As, the objective of this research is, to develop a strategic framework for Synergistic implementation of total quality management and supply chain management for Indian manufacturing firms. So, to develop this framework, the authors have prepared a modelling technique with the help of the options field methodology, options profile methodology, analytical hierarchical process and fuzzy set theory to meet the objectives. For this purpose, as already stated authors have identified the options from the 'TQM-SCM' questionnaire and prepared position matrix by using weights of multiple regression and converting these weights into suitable fuzzy score. Further, generated weighted position matrix and on the basis of this further generated dominance matrix for ranking the various profiles through FST. Figure 3 describes the modelling technique employed. The first step of the qualitative modelling is the listing of options with the help of modified idea writing as a solution to TQM-SCM adoption on synergistic basis and adaptation for building performance enhancements capabilities.

Figure 3 Modelling technique employed in the current study (see online version for colours)



4.1 Options field methodology

The first step of the qualitative modelling is the listing of options with the help of modified idea writing as a solution to TQM-SCM adoption on synergistic basis and adaptation for building performance enhancements capabilities. As in this research, confirmatory approach is utilised in the design of TQM-SCM questionnaire. So, after listing all the options, these options are put directly under the clusters (predefined in the questionnaire).

The options concerning benefits through synergistic implementation are given below:

- achieving high returns on net assets and capital employed
- enhanced competitive image of the industry
- enhancements in production systems
- improvement in the market share
- up gradation in manufacturing quality
- improvement in quality of product and service at the part of suppliers
- decline in defects and rejections
- improvement in issues of customers related to warranty
- improvements in customer order compliance
- improvements in equipment availability
- improved man-power productivity
- better overall equipment effectiveness (OEE)
- decline in number of failures and unplanned downtime
- better control over production schedules
- reduction in product cost
- reduction in total cost of manufacturing
- reduction in cost associated with inventory
- reduction in operating cost and distribution cost
- improvements in ability to handle variation in demand
- improved ability to respond to and accommodate the periods of worst situations such as machine breakdown
- improved the quality of delivered products
- ensures delivery of goods on right time
- improved delivery reliability
- reduction in number of faultless delivery
- betterment in manufacturing lead time and supplier lead time
- improved customer order fill rate
- reduction in new product development time.

4.1.1 Formation of clusters

As TQM-SCM questionnaire has been designed using confirmatory approach, so clusters are predefined in this questionnaire. Then these options are directly put into clusters rather than forming categories and then clusters. The resulting clusters with sequenced options are given below

4.1.2 Strategic business performance

- achieving high returns on net assets and capital employed
- enhanced competitive image of the industry
- improvement in the market share
- enhancements in production systems
- reduction in product cost.

4.1.3 Quality

- up gradation in manufacturing quality
- improvement in quality of product and service at the part of suppliers
- decline in defects and rejections
- improvement in issues of customers related to warranty
- improvements in customer order compliance.

4.1.4 Production

- improvements in customer order compliance
- improvements in equipment availability
- improved man-power productivity
- better overall equipment effectiveness (OEE)
- decline in number of failures and unplanned downtime
- better control over production schedules.

4.1.5 Cost

- reduction in total cost of manufacturing.
- reduction in cost associated with inventory
- reduction in operating cost and Distribution cost.

4.1.6 Flexibility

- improvements in ability to handle variation in demand
- improved ability to respond to and accommodate the periods of worst situations such as machine breakdown
- better ability to deal with the periods of poor supplier performance
- improved ability to respond and manage the periods of poor delivery performance.

4.1.7 Delivery

- improved quality of delivered goods
- ensures timely delivery of goods
- improved Delivery reliability
- reduction in Number of faultless delivery.

4.1.8 Lead time

- betterment in manufacturing lead time and supplier lead time
- improved customer order fill rate
- reduction in new product development time.

4.2 Options profile methodology

Further OPM technique is applied as per the following steps:

1. Firstly, profiles of the design are selected.

2 Mapping of options from options fields with profiles.

Identified profiles for seeking performance improvement in context of Indian manufacturing organisations are as follows:

- Business performance related achievements (Y1)
- The quality related achievements (Y2)
- Production related achievements (Y3)
- Cost related achievements (Y4)
- Flexibility related achievements (Y5)
- Delivery related achievements (Y6)
- Lead time related achievements (Y7)

After the identification of various profiles, the next task is to do mapping of measures (from each input factor) with each profile using OPM as shown in Appendix 1.

4.3 AHP modelling

The next task is to identify various objectives of the design. Further, Table 2 represents eight objectives, which have been extracted through literature review (Kaur et al., 2019). Further, various objectives are compared with each other independently through AHP. Because, AHP is found on the priority among other MCDM methods that is usedfor solving different types of multi-criteria decision-making problems (Saaty, 1980) based on relative priorities assigned to each criteria (Handfield et al., 2002).

Table 2 Description of objectives

Objectives	*Abbreviation*
Top management support and leadership role	TMSLR
Workforce development issues	WDI
Total quality management issues	TQMI
Supply chain management issues	SCMI
Strategic supplier partnership issues	ISSP
Level of customer responsiveness Issues	LCR
Information technologies issues	ITI
Issues related to the transfusion of TQM and SCM	IRT

Source: Kaur et al. (2019)

Table 3 Pair-wise comparison scale

Intensity of importance	*Definition*
1	Equal importance both element
3	Weak importance of one element over another
5	Essential or strong importance of one element over another
7	Demonstrated importance of one element over another
9	The absolute importance of one element over another
2, 4, 6, 8	Intermediate values between two adjacent judgments

Source: Saaty (1980)

For the purpose of the paired comparison method of AHP, the experts from the company and Academic were asked to pair wise compare the eight objectives on a scale of 1–9 (Saaty, 1980) as represented in Table 3 and accordingly judgment matrices were created of size 8 x 8, where the total number of comparisons was 28. The pair-wise comparisons are performed to identify the dominancy of one element over another. A questionnaire employed for this purpose is shown in Figure 4. Table 4 depicts the pair-wise comparison matrix of various attributes involved in the current study.

Figure 4 Pairwise comparison of objectives (see online version for colours)

Table 4 Pair-wise comparison of various objectives

	TMSLR	*WDI*	*TQMI*	*SCMI*	*ISSP*	*LCR*	*ITI*	*IRT*
TMSLR	1	2	3	3	5	5	7	1
WDI	0.5	1	0.5	0.33	0.33	3	3	0.2
TQMI	0.33	2	1	1	3	2	3	0.33
SCMI	0.33	3	1	1	1	3	3	0.33
ISSP	0.2	3	0.33	1	1	3	3	0.2
LCR	0.2	0.33	0.5	0.33	0.33	1	0.33	0.2
ITI	0.14	0.33	0.33	0.33	0.33	3	1	0.2
IRT	1	5	3	3	5	5	5	1
Total	3.7	16.66	9.66	9.99	15.99	25	25.33	3.46

Further, Eigen vector of the comparison matrix after the attainment of pair wise comparison matrix is calculated. Then, the consistency index (CI) has been calculated, i.e., CI = (λmax – n)/ (n – 1). Finally, the CI value is divided by the corresponding RI value (see Table 5) to calculate the value of CR, which lies within the prescribed limit of 10% (see Table 6). The matrix representing the weight age of all the objectives is given in Table 7.

Table 5 Random consistency index (RI)

n	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Table 6 Results of consistency test

λ (Max)	*CI*	*RI*	*CR*
8.544	0.077	1.41	0.055

Table 7 Weights of various objectives

Objectives	*TMSLR*	*WDI*	*TQMI*	*SCMI*	*ISSP*	*LCR*	*ITI*	*IRT*
Priority weights	0.2488	0.0741	0.1089	0.1056	0.0886	0.0347	0.0431	0.2620

4.4 Fuzzy set theory

The FST technique has been used to measure the contribution of each objective to different profiles and to rank these profiles. The ambiguous set is represented by a member function that can be defined as an actual number in the range 0 to 1. Therefore, the ambiguous set can be turned into a crisp set by maximising the functions of the members in the range 0 to 1 (Zadeh, 1965). In this paper, FST with AHP is used for the purpose of ranking profiles of option profiles in an integrated way. Furthermore, the ranking of profiles is achieved by the dominant matrix designed for the purpose. Moving forward, weights of multiple regressions are obtained, by utilising the data collected through TQM-SCM questionnaire; with the help of SPSS 25.0 as represented in Table 8 and further converting these values into fuzzy logic score between 0 and 1 as shown in Table 9. Further a position matrix that represents the contribution of each objective toward each profile (goal), as shown in Table 10 is obtained. Moreover, weighted position matrix is formulated with the help of position matrix, as shown in Table 11.

Table 8 Multiple regression weights

Profiles→ / *Objectives↓*	*Y1*	*Y2*	*Y3*	*Y4*	*Y5*	*Y6*	*Y7*
TMSLR	0.049	0.961	–0.025	0.233	0.022	0.269	0.335
WDI	–0.249	–0.171	–0.001	–0.192	0.028	–0.070	–0.256
TQMI	0.174	0.070	0.134	0.125	0.946	–0.065	0.205
SCMI	0.817	–0.015	0.030	0.601	0.048	1.000	0.701
ISSP	–0.205	0.042	0.007	–0.025	0.010	0.197	–0.167
LCR	–0.035	–0.112	0.006	–0.021	–0.074	–0.026	–0.101
ITI	0.098	0.010	0.075	0.014	–0.044	0.013	0.004
IRT	0.263	0.149	0.815	0.287	0.059	–0.258	0.188

Table 9 Conversion of multiple regression weights into fuzzy scores

Regression weights	*Fuzzy weights*
–0.3 to–0.1	0.12
–0.1 to 0.1	0.25
0.1 to 0.3	0.38
0.3 to 0.5	0.51
0.5 to 0.7	0.64
0.7to 0.9	0.77
0.9 to 1	0.9

Table 10 Position matrix

Profiles→ / *Objectives↓*	*Y1*	*Y2*	*Y3*	*Y4*	*Y5*	*Y6*	*Y7*	*WEIGHT*
TMSLR	0.250	0.900	0.250	0.380	0.250	0.380	0.510	0.2488
WDI	0.120	0.120	0.250	0.120	0.250	0.250	0.120	0.0741
TQMI	0.380	0.250	0.380	0.380	0.900	0.250	0.380	0.1089
SCMI	0.770	0.250	0.250	0.640	0.250	0.900	0.770	0.1056
ISSP	0.120	0.250	0.250	0.250	0.250	0.380	0.250	0.0886
LCR	0.250	0.120	0.250	0.250	0.250	0.250	0.250	0.0347
ITI	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.0431
IRT	0.380	0.380	0.770	0.380	0.250	0.120	0.380	0.2620

Table 11 Weight position matrix

Profiles→ / *Objectives↓*	*Y1*	*Y2*	*Y3*	*Y4*	*Y5*	*Y6*	*Y7*
TMSLR	0.062	0.224	0.062	0.095	0.062	0.095	0.127
WDI	0.009	0.009	0.019	0.009	0.019	0.019	0.009
TQMI	0.041	0.027	0.041	0.041	0.098	0.027	0.041
SCMI	0.081	0.026	0.026	0.068	0.026	0.095	0.081
ISSP	0.011	0.022	0.022	0.022	0.022	0.034	0.022
LCR	0.009	0.004	0.009	0.009	0.009	0.009	0.009
ITI	0.011	0.011	0.011	0.011	0.011	0.011	0.011
IRT	0.100	0.100	0.202	0.100	0.066	0.031	0.100

Moving forward, dominance matrix as shown in Table 12 has been prepared. In this matrix, the dominance of profile over the others has been computed.

Table 12 Dominance matrix

	Y 1	*Y 2*	*Y 3*	*Y 4*	*Y 5*	*Y6*	*Y7*	*ROW SUM*	*RANK*
Y1	0	2	3	2	3	4	2	16	1
Y2	6	0	4	3	3	4	3	23	3
Y3	5	4	0	2	7	6	6	30	5
Y4	6	5	6	0	5	6	2	30	5
Y5	5	5	1	3	0	6	6	26	4
Y6	4	4	2	2	2	0	3	17	2
Y7	6	5	2	6	2	5	0	26	4

Dominance matrix reveals that Y1- Business Performance related achievements secured first rank followed by Y6- Delivery related achievements,Y2- Quality related achievements,Y5-Flexibility related achievements, Y7-Lead time related achievements,Y3- Production related achievements andY4- Cost related achievements. Thus, it is clear that all measures represented in Appendix 1, contribute to these achievements as per their importance in the industry. All in all, all the measures should be considered for synergistic implementation of TQM-SCM. But because of practical constraints, focus is to see the order of acquisition of these measures in a phased manner.

5 Development of strategic framework for transfusion of TQM-SCM

Literature reveals that there should be a proper strategy and control to implement Total Quality Management along with Supply Chain Management in a supply chain. Otherwise the valuable effort will lead to unsatisfaction of the employee, which will results in to failure of successful implementation of purposed programme. Thus this research provides strategy to implement TQM-SCM in a phased manner. Further, as found from Appendix, all the measures should be considered for synergistic implementation of TQM-SCM. But acquisition of these measures should be in a phased manner in any manufacturing firms due to various constraints such as limited resource, cost and time constraints. Implementation of these measures in order to seek improvement in performance parameters is purposed into three phases. Where Phase I focuses on Preparedness for stepwise implementation of measures aimed at seeking enhancement in quality, delivery and finally the business performance and Phase II works on enhancing flexibility and lead time with improvement in related skills. Finally, Phase III focusing on initiatives of earlier phases to be stabilised and consolidating the gains of the earlier phases.

That's why; phase wise approach is adopted on the basis of a relationship between objectives and profiles (See apendix1).Where 11 measures are purposed for first phase (Transition phase), 12 for second phase (Stability phase) and 8 for third phase (Maturity Phase) as represented in Table 13.

The measures purposed for first phase are not costlier rather easy to implement and would have a positive and complimentary effect on not only organisation rather whole supply chain. Further, benefits of measures those belongs to phase I will motivate the management to put more efforts. to utilise further resources for implementation of the measures purposed to be considered in other phases, i.e., the second and third phase. Finally, the strategic framework is presented in Figure 5 representing the key inputs and output performance parameters of TQM-SCM implementation.

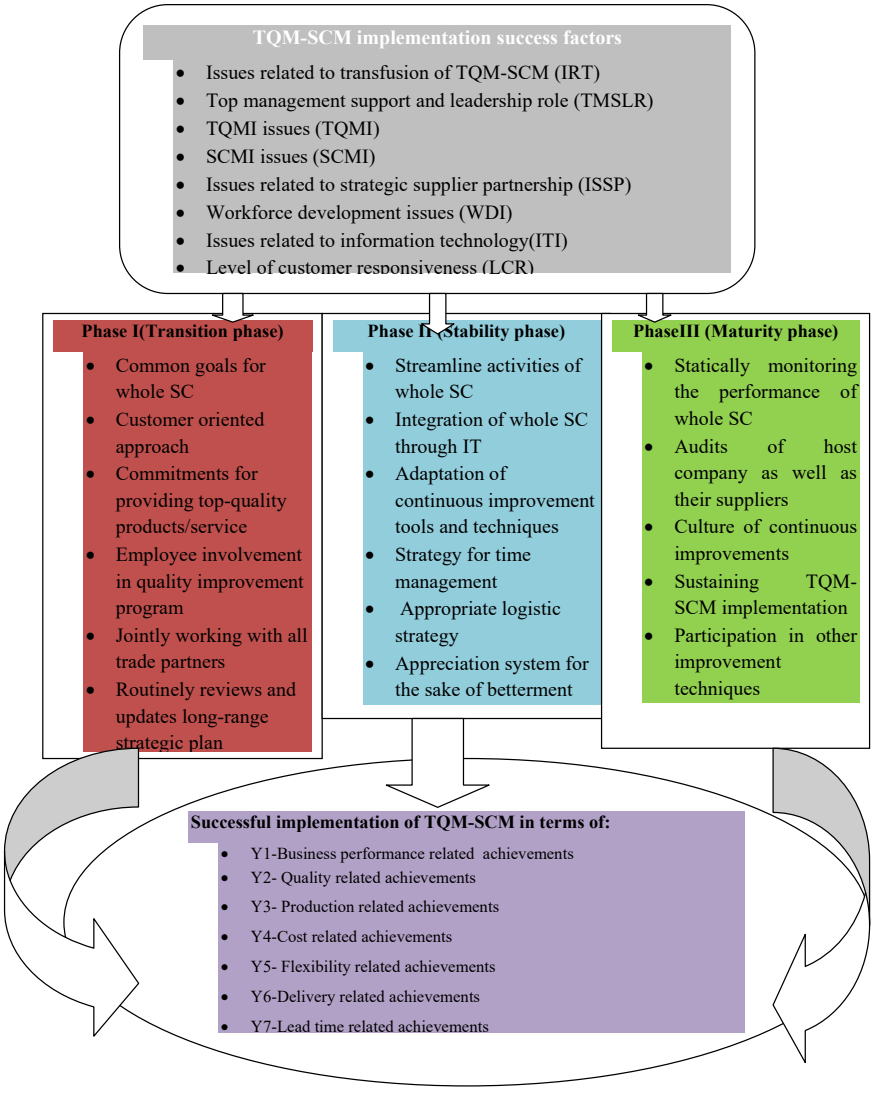
5.1 The introduction phase or transition phase

This focuses on the commonalities in the concept of both TQM and SCM; this is the first step to successfully implement TQM-SCM in a manufacturing organisation. In order to avail synergistic benefits for the betterment of supply chain performance, it is essential for organisations to address and implement issues related to quality and supply chain through the deployment of a common goal policy. Because having such a clear and common vision, a game plan and a clear picture of goals are contributing in a positive manner to the excellence of the supply chain (Sidhu et al., 2019).

Table 13 Phase wise description of measures

Transition phase	*Stability phase*	*Maturity phase*
• Set clear vision policy and common goals for obtaining business objectives for the whole supply chain. • Introduce and maintain the "customer focus" philosophy for the whole supply chain. • Ensure long term organizational alignment to suppliers/partners. • Joint customer-supplier quality goal setting. • Commitments for providing top-quality products/services. • Set quality standards taking the viewpoint of customers. • Communicates values, directions and ensuring effective top-down and bottom-up communication related to quality issues. • A complete check of quality being produced. • Employee (worker) involvement in quality improvement through the training program. • Conformance of products/services against established quality standards in the whole supply chain. • Routinely reviews and updates long-range strategic plan concerning quality improvements in whole supply chain.	• Streamline various activities (e.g., ordering, shipping, receiving, and other paperwork) of the whole supply chain. • Manufacturing of quality products using material management technique. • Adopt multi skilling approach for employees using quality circles, cross-functional teams, etc. • Adopt continuous improvement tools (brainstorming, check sheet, PDCA cycle, and other statistical process control) on a regular basis. • Strive to reduce response time across the supply chain. • Ensuring good logistic quality close to the customers in the whole supply chain. • Ensure IT enabled operations, logistics, and production using e-business systems MRP, ERP, CRM, SRM, etc.). • Maintain close communications within the supply chain regarding quality, delivery considerations, and design changes. • Frequent follow-up with customers for quality/service/delivery feedback. • Existence of vendor development department. • Appreciation system for internal employees as well as trade partners using supply chain performance criteria. • Existence of System for recognition of quality process to track rework, waste, rejects, and for continuous improvement.	• Statically monitoring the output performance and comparing the output results with the expected results. • Ensuring quality in supply chain performance measurement system. • .Endeavours for achieving consistent improvement in the quality through the utilization of customer feedback. • Culture of continuous improvement for ensuring quality, cost, and delivery. • Measurement and auditing within the organization and of its partners. • Conduct informal benchmarking and other forms of information acquisition and sharing within the whole supply chain. • Sustaining TQM-SCM implementation initiatives. • Lead and participate in other lean manufacturing practices.

Figure 5 Strategic TQM-SCM model for Indian manufacturing industry (see online version colours)



As Fawcett et al. (2008) point out that strategic supply chains may face performance hurdles to meet customer demand due to improper planning and poor collaborative vision. Further, it has been found that Indian organisations could not proceed in the same ways they use to, rather they should involve all supply chain members, i.e., suppliers and customers (Atul et al., 2010). So, this policy promotes jointly working with suppliers and customers. As it was found that the involvement of suppliers in quality improvement programs leads to an improved level of customer satisfaction and finally results in superior financial performance. Though literature supports that more joint efforts concerning problem solving and planning have a positive impact on organisational performance (Claro et al., 2003). Furthermore, it results in a reduction in enhanced

accuracy through the reduction of inventory level and cost (Luthra et al., 2010). As the involvement of suppliers in quality improvement processes and product design processes facilitates supplier's responsiveness to address quality-related issues on the priority (Kristal et al., 2010). Moreover, leading Indian manufacturers also have realised the benefits of involving suppliers in the decision-making process (Mohanty and Gahan, 2012).

Companies are always concerned to find the way to optimise their resources i.e human resources (Zaki et al., 2021). As the Employees play a significant role in the growth of any firm (Mehralian et al., 2012). So, this study also stresses on the training and empowerment of employees within the organisation. Because, employee involvement and training play a very important role in the success of any organisation (Altayeb and Alhasanat, 2014). Further, the role of employees in the integration of quality and supply chain management for the sake of betterment of supply chain performance cannot be overlooked. As Lack of effective skills or workforce development is considered a critical barrier to the effective management of quality (Miller, 2014; Mukhtar and Schiffauerova, 2016).

Even more, it is found that the desired performance as a result of TQM-SCM implementation could not be achieved unless there is strong dedication towards the vision, values, customer-oriented quality goals of the whole supply chain, and top management commitment towards enhancing coordination of whole supply chain. Customer satisfaction plays a significant role in the success of any organisation (Zakuan et al., 2010). As, the customer relationship management decrease lead time and stock-out ratio (Taheri-Moghadam et al., 2019). So efforts are required not only at the organisational level rather at the supply chain level (Chopra et al., 2006). Therefore, the whole supply chain partners must be customer-oriented and should be responsive to and accommodate the changing taste of customers, and measure customer satisfaction for further betterment. As Atul and Satish (2010) found that the majority of Indian organisations lack the alignment of supply chain strategy with customer-oriented, business strategy, and even more, organisations lack the supply chain mindset for trustworthy partnerships which in turn creates hurdles for the successful journey of any business. Thus, there is an urgent need to redesign supply chain strategies in the context of supply chain partners for the betterment of business performance.

5.2 Stability phase

Stability phase focuses primarily on enhancing flexibility and lead time in the whole supply chain through standardising and streamlining activities of whole SC by writing standard operating procedures, adopting IT, material management, and integrating whole SC through IT driven operations, logistics and production using various systems such as MRP, ERP, CRM, and SRM. The participative culture, learning orientation and cross-functional information sharing affect supply chain integration (Vankireddy and Baral, (2019).

This phase also contains actions aimed at continuous improvement in product and processes through multiple skills, existence of quality circles, giving opportunities to whole workforce to use these skills and accordingly appreciate the workforce. This will definitely result in reduction of response time across the whole SC, flexibility to accommodate changes.

The current business scenario demands information technology to transmit data between industry and customers in order to develop strong relationships (Smith et al., 2020). So, Supply chain managers should be aware that effective implementation of TQM-SCM practices is contingent on adequate information sharing with supply chain members. As, the seamless flow of products in the supply chain demands that all trade partners should integrate their production and logistics activities. Such type of integration can be facilitated only through information exchange through technology. Because Lack of IT leads to the lack of integration between the organisation and its suppliers hence it has been identified as another barrier to supplier quality management (Kumar et al., 2013) which creates hurdles for the smooth functioning of the whole supply chain (Mukhtar and Schiffauerova, 2016). Thus, to ensure the working of SC in an integrated way, information technology plays a very important role (Qrunfleh and Tarafdar, 2014; Zhou et al., 2014).

Another important factor that should be considered for the integration of supply chain is logistics strategy. As we know the supply chain is a dynamic process that involves the flow and exchange of goods across various nodes of a supply chain network (Jain et al., 2009; Kaur et al., 2019). To improve the timely delivery of goods at the lowest distribution cost, manufacturing organisations often demand that their trade partners should adopt the best logistic methods that are cheap and ensures safe and timely delivery of goods. So for successful distribution at the lowest cost, logistics plays an important role, as, Initiatives related to logistics issues are important for the smooth functioning of the supply chain (Kaur et al., 2019).

Continuous improvement tools and techniques contribute to the improved competitive image since these help organisations to be innovative and properly implement best ideas (Bon and Mustafa, 2013). So, continuous improvement is of major concern in terms of improving competitiveness and promoting a culture of further improvement to address all queries related to customers. That's why the positive effect of deployment of continuous improvement tools and techniques is observed in the supply chain performance (Terziovski and Hermel, 2011).

Another important factor for the smooth functioning of the whole SC is the existence of an appreciation system to motivate the employees and the suppliers. So the organisation should institutionalise efficient compensation, monetary rewards, and appraisal systems to ensure employee empowerment and a more trustworthy relationship with the suppliers just by adopting team incentives and motivation, individual incentive plans, gain sharing, profit sharing, certifying suppliers on the basis of quality, etc.

5.3 Standardisation or maturity phase

Finally the standardisation phase or maturity phase which requires initiatives of phase I and phase II to be stabilised and holistically pursued over a reasonable period of time to realise the true potential from synergy of both fields. This phase focuses on stability of organisations through continuous improvement in all the profiles involved in this research through monitoring of the output performance and comparing this performance with the expected one, ensuring quality in supply chain performance measurement system, culture of continuous improvement for ensuring quality, cost and delivery, measurement and auditing within organisation and of its partners, Conducing Informal benchmarking and adopting other means of information sharing within whole supply chain just to bridge the gap between expectations and actual results. Further, sustain

TQM-SCM implementation initiatives and also participate in other lean manufacturing practices.

This phase purposes that the manufacturing organisations should continue to work on the enhancement of the various TQM-SCM initiatives that are being pursued. Further, the organisation should adopt best methods for measuring performance parameters across all entities of whole SC. Quality management practices must be directly linked to the mission objectives of whole SC, concise and demonstrate the contributions to supply chain performance. As measurement of performance indicators are significant in terms of objectives, compare performance and define positive behaviours to realise top most manufacturing (Singh and Ahuja, 2015). For the measurement sake organisations should conduct audits of their suppliers on regular basis. Also, the benefits as a result of synergy of TQM-SCM programme should be shared with the whole SC partners to further motivation and ensure enhanced participation of all partners.

A predefined effort must be made to ensure sustained deployment of TQM-SCM initiatives in the manufacturing organisation. For further growth organisation must consistently move forward for sustaining the realised achievements through these improvement strategies and achieve improved levels of performance (Singh and Ahuja, 2015). This synergy of TQM-SCM has to be considered as a change process, rather than a project because the competencies that are gained by the organisation as a result of TQM-SCM initiatives might fade away after the project is completed. The audit process within organisations and of their trade partners and further gap analysis must be followed to track the evolution of the permanent changes that are taking place in the organisation as a result of the synergistic implementation of TQM-SCM.

Further, to address the challenges set by the era of globalisation, the manufacturing organisations must continuously work on other performance enhancement techniques in all aspects of their SC to further boost up their performance. As the implementation of a single improvement technique may not be sufficient to carry out innovations required for the survival of firms in this era (Singh et al., 2020). Therefore, this study purposes adaptation of other improvement techniques along with the TQM -SCM practices to improve further. Thus, benefits of measures those belongs to phase I will motivate the management to put more efforts to utilise further resources for implementation of the measures purposed to be considered in other phases, i.e., the second and third phase.

6 Conclusions

Nowadays Customers' major consideration is quality of products and services; they want timely delivery of good quality products with sufficient flexibility. Therefore, keeping in mind the customer satisfaction, organisations must be oriented on quality, flexibility and timely delivery for the sake of survival in this competitive era. All these requirements demands adaptation of quality principles along with supply chain management. However, it is very difficult to implement all measures of these strategies in a single stage because of so many constraints, i.e cost, resources and time. Thus, the aim of this paper is to purpose phase wise implementation of all necessary measures to achieve benefits as a result of synergy of quality management and supply chain management. So, after considering all aspects like costs associated with measures, results from these measures, time frame, effect on other areas of the whole SC, a phase-wise approach is purposed. Key findings of this research are listed below.

- Based on the responses collected through the TQM-SCM questionnaire, the authors developed a standard model for ranking profiles (Y1-Y7) with the help of OFM-OPM, AHP and FST. The results of the AHP method show that the IRT parameter ranks first among all other factors, followed by the TMSLR, TQMI, SCMI, ISSP, WDI, ITI and LCR. This comparison of weight value shows that issues related to the transfusion of both TQM and SCM (IRT) have played a significant role in increasing the efficiency of the Indian manufacturing sector.
- Further, dominance matrix of FST represents the ranking of profiles (development Indicators). It is found that Y1- Business Performance related achievements secured first rank followed by Y6- Delivery related achievements,Y2- Quality related achievements, Y5-Flexibility related achievements, Y7-Lead time related achievements,Y3- Production related achievements andY4- Cost related achievements.
- Furthermore, all measures provided in Appendix play significant role in the implementation of synergistic approach but it is very difficult to implement these measures in a single stage due to various constraints. Therefore, implementation of these measures in order to seek improvement in performance parameters is purposed into three phases. Where Phase I focuses on Preparedness for stepwise implementation of measures aimed at seeking enhancement in quality, delivery and finally the business performance and Phase II works on enhancing flexibility and lead time with improvement in related skills. Finally, Phase III focusing on initiatives of earlier phases to be stabilised and consolidating the gains of the earlier phases.

6.1 Contributions and practical implications

This study is helping hand for both, experts from industry as well as from the academic. As this research provides the ranks of various profiles (performance parameters) utilising the interrelationship between TQM-SCM measures and profiles and based on this, finally purposes the phase wise implementation methodology. Thus the results of the study may be utilised by supply chain managers in order to take decision concerning implementation priorities of TQM-SCM measures.

6.2 Limitations and scope for future research

Although this study has been quite useful in purposing phase wise implementation methodology for synergistic approach but still possesses some limitations like scope of this study that is limited to only manufacturing firms of India. Therefore, the results obtained from this research must be verified before applying to other type of industries other than India.

In spite of such limitations, still there is scope of future research. For example, techniques other than OFM, OPM, AHP, and FST can be utilised to report new findings. All in all, this study acts as a foundation for a further and future study on this synergistic approach.

References

Ahmed, A. and Ferdousi, F. (2020) 'TQM components as a source of competitive advantage in a beverage organization: a resource based view', *International Journal of Business Strategy and Automation*, Vol.1, No.2, pp.25–36.

Altayeb, M.M. and Alhasanat, M.B. (2014) 'Implementing total quality management (TQM) in the Palestinian construction industry', *International Journal of Quality and Reliability Management*, Vol. 31, No. 8, pp.878–887.

Apornak, A. and Hezaveh, M.A. (2019) 'Extension of the model of manufacturing supply chain quality management: an empirical study', *International journal of Productivity and Quality Management*, Vol. 28, No. 4, pp.417–437.

Atul, B., Borade, S. and Bansod, V. (2010) 'Study of vendor-managed inventory practices in Indian industries', *Journal of Manufacturing Technology Management*, Vol. 21, No. 8, pp.1013–1038.

Bastas, A. And Liyanage, K. (2018) 'Sustainable supply chain quality management: a systematic review', *Journal of Cleaner Production*, Vol. 181, pp.726–744.

Bon, A. and Mustafa, E. (2013) 'Impact of total quality management on innovation in service organizations: literature review and new conceptual framework', *Procedia Engineering*, Vol. 53, No. 2, pp.516–529.

Cai, S., Jun, M. and Yang, Z. (2010), 'Implementing supply chain information integration in China: the role of institutional forces and trust', *Journal of Operations Management*, Vol. 28, No. 3, pp.257–268.

Carvalho, F., Santos, G. and Gonçalves, J. (2018) 'The disclosure of information on sustainable development on the corporate website of the certified Portuguese organizations', *International Journal for Quality Research*, Vol. 12, No. 1, pp.253–276.

Chopra, S., Meindl, P. and Kalra, D.V. (2006), *Supply Chain in Management Strategy, Planning, and Operation*, 3rd ed., Pearson Education, Saddle River, NJ.

Claro, D.P., Hagelaar, G. and Omta, O. (2003) 'The determinants of relational governance and performance: how to manage business relationships?', *Industrial Marketing Management*, Vol. 32, No. 8, pp.703–716.

Cogollo-Florez, J.M. and Correa-Espinal, A.A. (2019) 'Analytical modeling of supply chain quality management coordination and integration: a literature review', *Quality Management Journal*, Vol. 26, No. 2, pp.72–83.

Dellana, S. and Kros, J. (2014) 'An exploration of quality management practices, perceptions and program maturity in the supply chain', *International Journal of Operations and Production Management*, Vol. 34, No. 6, pp.786–806.

Doshi, J.A. (2019) 'The significance of supplier performance management in quality improvement– a case of construction equipment manufacturing', *International Journal of Quality and Innovation*, Vol. 4, Nos. 1–2, pp.88–98.

Fawcett, S.E., Gregory, M.M and Matthew, W.M. (2008) 'Benefits, barriers, and bridges to effective supply chain management', *Supply Chain Management: An International Journal*, Vol. 13, No. 1, pp.35–48.

Fawcett, S.E., Jones, S.L. and Fawcett, A.M. (2012) 'Supply chain trust: the catalyst for collaborative innovation', *Business Horizons*, Vol. 55, No. 2, pp.163–178.

Fernandes, A.C., Sampaio, P., Sameiro, M. and Truong, H.Q. (2017) 'Supply chain management and quality management integration', *International Journal of Quality and Reliability Management*, Vol. 34, No. 1, pp.53–67.

Flynn, B.B. and Flynn, E.J. (2005) 'Synergies between supply chain management and quality management: emerging implications', *International Journal of Production Research*, Vol. 43, No. 16, pp.3421–36.

Flynn, B.B., Schroeder, R.G. and Sakakibara, S. (1995) 'The impact of quality management practices on performance and competitive advantage', *Decision Sciences*, Vol. 26, No. 5, pp.659–691.

Foster, S.T. and Ogden, J. (2008) 'On differences in how operations and supply chain managers approach quality management', *International Journal of Production Research*, Vol. 46, No. 24, pp.6945–61.

Handfield, R., Walton, S.V., Sroufe, R. and Melnyk, S.A. (2002) 'Applying environmental criteria to supplier assessment: a study in the application of the analytical process hierarchy', *European Journal of Operational Research*, Vol. 141, No. 1, pp.70–87.

Hu, H. and Zhao, X. (2018) 'Building supply chain quality management theory from case study in China', *International Journal of Services Technology and Management*, Vol. 24, Nos. 1–3, pp.4–29.

Jain, V., Wadhwa, S. and Deshmukh, S.G. (2009) 'Revisiting information systems to support a dynamic supply chain: issues and perspectives', *Production Planning and Control*, Vol. 20, No. 1, pp.17–29.

Kaur, M., Singh, K. and Singh, D. (2019) 'Synergetic success factors of total quality management (TQM) and supply chain management (SCM): a literature review', *International Journal of Quality and Reliability Management*, Vol. 36, No. 6, pp.842–863.

Kaur, M., Singh, K. and Singh, D. (2020) 'Justification of synergistic implementation of TQM-SCM using fuzzy-based simulation model', *World Journal of Science, Technology and Sustainable Development*, Vol. 17, No. 1, pp.71–89.

Kaynak, H. and Hartley, J.L. (2008) 'A replication n and extension of quality management into the supply chain', *Journal of Operations Management*, Vol. 26, No. 4, pp.469–489.

Kristal, M.M., Huang, X. and Schroeder, R.G. (2010)'The effect of quality management on mass customization capability', *International Journal of Operations and Production Management*, Vol. 30, No. 9, pp.900–922.

Kuei, C. and Madu, C.N. (2001) 'Identifying critical success factors for supply chain quality management', *Asia Pacific Management Review*, Vol. 6, No. 4, pp.409–423.

Kuei, C.H., Madu, C.N. and Lin, C. (2008) 'Implementing supply chain quality management', *Total Quality Management and Business Excellence*, Vol. 19, No. 11, pp.1127–1141.

Kuei, C.H., Madu, C.N. and Lin, C. (2010) 'Developing global supply chain quality management systems', *International Journal of Production Research*, Vol. 49, No. 15, pp.4457–4481.

Kumar, A., Singh, R.K. and Modgil, S. (2020) 'Influence of data-driven supply chain quality management on organizational performance: evidences from retail industry', *The TQM Journal*, Working Paper, http.//www.doi.org/10.1108/TQM-06-2020-0146.

Kumar, N., Kumar, S., Haleem, A and Gahlot, P. (2013) 'Implementing lean manufacturing system: ISM approach', *Journal of Industrial Engineering and Management*, Vol. 6, No. 4, pp.996–1012.

Lin, C., Chow, W.S., Madu, C.N., Kuei, C. and Yu, P.P. (2005) 'A structural equation model of supply chain quality management and organizational performance', *International Journal of Production Economics*, Vol. 96, No. 3, pp.355–365.

Lin, Chinho., Kuei, C.H. and Chai, K.W. (2013)'Identifying critical enablers and pathways to high performance supply chain quality management', *International Journal of Operations and Production Management*, Vol. 33, No. 3, pp.347–370.

Lin, L. and Gibson, P. (2011) 'Implementing supply chain quality management in subcontracting system for construction', *Quality Journal of System and Management Sciences*, Vol. 1, No. 1, pp.46–58.

Luthra, S., Kumar, V., Kumar, S. and Haleem, A. (2010) 'Green supply chain management issues: aliterature review approach', *Journal of Information Knowledge and Research in Mechanical Engineering*, Vol. 1, No. 1, pp.12–20.

Malhotra, A., Gosain, S. and Elsawy, O.A. (2005) 'Absorptive capacity configurations in supplychains: gearing for partner-enabled market knowledge creation', *MIS Quarterly*, Vol. 29, No. 1, pp.145–187.

Marino, G., Zotteri, G. and Montagna, F. (2018) 'Consumer sensitivity to delivery lead time: a furniture retail case', *International Journal of Physical Distribution and Logistics Management*, Vol. 48, No.6, pp.610–629.

Mehralian, G., Rajabzadeh, A., Sadeh, M.R. and Rasekh, H.R. (2012) 'Intellectual capital and corporate performance in Iranian pharmaceutical industry', *Journal of Intellectual Capital*, Vol. 13, No. 1, pp.138–158.

Miller, M.J. (2014) 'Theorizing, testing, and concluding for mediation in SCM research: what to do, what not to do', *Journal of Operations Management*, Vol. 32, No. 3, pp.99–133.

Mohanty, M.K. and Gahan, P. (2012) 'Buyer supplier relationship in manufacturing industry–findings from Indian manufacturing sector', *Business Intelligence Journal*, Vol. 5, No. 2, pp.319–333.

Mukhtar, H. and Schiffauerova, A. (2016) 'Analysing barriers to supplier quality management via interpretive structural modeling: the case of Saudi industry', *International Journal of Logistics Systems and Management*, Vol. 24, No. 4, pp.452–465.

Ni, J.Z., Li, Y. and Flynn, B.B. (2015) *Importance of Product Recalls in Global Supply Chain Quality Management: Product Recalls and Their Impact*, pp.15–30, CRC Press and Taylor and Francis Group, Boca Raton, FL.

Nosratpour, M., Nazeri, A. and Soofifard, R. (2018) 'Study on the relationship between supply chain quality management practices and performance in the Iranian automotive industry', *International journal of Productivity and Quality Management*, Vol. 23, No. 4, pp.492–523.

Paras, M.M. (2013) 'Supply chain quality management', *International Journal of Quality and Reliability Management*, Vol. 30, No. 5, pp.511–552.

Qrunfleh, S. and Tarafdar, M. (2014) 'Supply chain information systems strategy: impacts on supply chain performance and firm performance', *International Journal of Production Economics*, Vol. 147, Part B, pp.340–350.

Quang, T.H., Sampaio, P., Sameiro, C., Fernandes, A.C. and Vihenac, E. (2016) 'An extensive structural model of supply chain quality management and firm performance', *International Journal of Quality and Reliability Management*, Vol. 33, No. 4, pp.444–464.

Rashid and Aslam (2012) 'Business excellence through total supply chain quality management', *Asian Journal on Quality*, Vol. 13, No. 3, pp.309–324.

Rebelo, M.F., Silva, R., Santos, G. and Mendes, P. (2016) 'Model based integration of management systems (MSs)–Case Study', *TQM Journal*, Vol. 28, No. 6, pp.907–932.

Robinson, C.J. and Malhotra, M.K. (2005) 'Defining the concept of supply chain quality management and its relevance to academic and industrial practice', *International Journal of Production Economics*, Vol. 96, No. 3, pp.315–337.

Saaty, T.L. (1980) *The Analytic Hierarchy Process*, McGraw, Hill, New York.

Sahoo, S. (2020) 'Exploring the effectiveness of maintenance and quality management strategies in Indian manufacturing enterprises', *International Journal of Benchmarking*, Vol. 27, No. 4, pp.1399–1431.

Sharma, S. and Modgil, S. (2015) 'Supply chain and total quality management framework design for business performance-case study evidence', *Journal of Enterprise Information Management*, Vol. 28, No. 6, pp.905–930.

Sidhu, M., Singh, K. and Singh, D. (2019) 'Strategic impact of SCM and SCQM practices on competitive dimensions of Indian manufacturing industries', *The TQM Journal*, Vol. 31, No. 5, pp.696–721.

Singh, K. and Ahuja, I.P.S. (2015) 'Synergising the effects of transfusion of TQM and TPM for Indian manufacturing industries: a tactical TQM-TPM model', *International Journal of Process Management and Benchmarking*, Vol. 5, No. 4, pp.456–482.

Singh, R.K., Modgil, S. and Acharya, P. (2020) 'Identification and causal assessment of supply chain flexibility', *International Journal of Benchmarking*, Vol. 27, No. 2, pp.517–549.

Sivakumar, K., Jeyapaul, R. and Vimal, K.E.K. (2020) 'Analysing organisational competitiveness through sustainable manufacturing using a hierarchical approach', *International journal of Process Management and Benchmarking*, Vol. 10, No. 4, pp.550–577.

Smith, A.D., Smith-Ditizio, A.A. and Kendall, W.R. (2020) 'Fantasy sports' outcomes as controversial issues from a gender perspective', *International journal of Process Management and Benchmarking*, Vol. 10, No. 3, pp.321–349.

Soares, A., Soltani, E. and Liao, Y.Y. (2017) 'The influence of supply chain quality management practices on quality performance: an empirical investigation', *International Journal of Supply Chain Management*, Vol. 22, No. 2, pp.1–64.

Sroufe, R. and Curkovic, S. (2008) 'An examination of ISO 9000:2000 and supply chain quality assurance', *Journal of Operations Management*, Vol. 26, No. 4, pp.503–520.

Taheri-Moghadam, A., Razmi, J. and Baki, M.F. (2019) 'Designing and planning a sustainable supply chain network considering economic aspects, environmental impact, fixed job opportunities and customer service level', *International journal of Process Management and Benchmarking*, Vol. 9, No. 1, pp.73–100.

Talib, F., Rahman, Z., Qureshi, M.N. (2011)'A study of total quality management and supply chain management practices', *International Journal of Productivity and Performance Management*, Vol. 60, No. 3, pp.268–288.

Terziovski, M. and Hermel, P. (2011) 'The role of quality management practice in the performance of integrated supply chains: a multiple cross-case analysis', *Quality Management Journal*, Vol. 18, No. 2, pp.10–25.

Vanichchinchai, A. and Igel, B. (2009) 'Total quality management and supply chain management: similarities and differences', *The TQM Journal*, Vol. 21, No. 3, pp.249–260.

Vankireddy, K. and Baral, R. (2019) 'Organisational and inter-organisational competencies for supply chain integration', *International journal of Process Management and Benchmarking*, Vol. 9, No. 1, pp.101–123.

Yeung, A.C.L. (2008) 'Strategic supply management, quality initiatives, and organizational performance', *Journal of Operations Management*, Vol. 26, No. 4, pp.490–502.

Zadeh, L.A. (1965) 'Fuzzy sets', *Information and Control*, Vol. 6, No. 3, pp.338–353.

Zaki, A., Benbrahim, M. and Ayad, G. (2021) 'Using AHP and TOPSIS techniques for assessment of multi-skilled workforce in manufacturing industry', *International Journal of Process Management and Benchmarking*, Vol. 11, No.1, pp.1–27.

Zakuan, N., Yusof, S.M., Saman, M.Z.M. and Saharoun, A.M. (2010) 'Confirmatory factor analysis of TQM practices in Malaysia and Thailand automotive industries', *International Journal of Business and Management*, Vol. 5, No. 1, pp.160–175.

Zhou, H., Shou, Y., Zhai, X., Li, L., Wood, C. and Wu, X. (2014) 'Supply chain practice and information quality: A supply chain strategy study', *International Journal of Production Economics*, Vol. 147, Part C, pp.624–633.

Appendix

Table A1 OPM

Legends	*Top management support and leadership role (TMSLR)*
□ ◊	Is actively involved in creating and communicating the company's vision for quality performance to all the employees?
□ ◊	Is committed to providing top-quality products/services?
□ ◊	Defines quality, taking the view-point of customers?
◊	Frequently enquire from customers about the quality of work they are receiving?
□∇⊗	Provides necessary resources to carry out a market survey to determine customer's needs and to fulfil them?
◊	Has a complete check of quality being produced?
□◊∇⊗	Endeavors for achieving consistent improvement in quality?
□◊	Regularly reviews and updates along-range strategic plan for better quality.
◊	All major department heads within the plant accept their responsibility for quality?
□	Set and deploy organizational values?
◊,∇	Lead and participate in lean manufacturing practices like TQM, TPM, etc.?
⊕∅	Communicate values, directions, expectations, and ensures effective top-down and bottom-up communication?
□	Create an environment for employee learning?
◊∇	Strongly encourage employee (worker) involvement in quality improvement and management?
□◊∅	Ensure organizational alignment to suppliers/partners' quality requirements?
□◊	Extend the company's quality leadership to the external community?
	Level of workforce development issues (WDI)
□◊∇	Is there a well-administered training and testing program in effect in your organization?
□◊∇⊗	What percentage of employees are involved in education and training programs?
□	What type of training programs are organized for workers/operators in your organization?
□ ⊕	Does your organization provide training for employees to improve multi-skilling (such as communication skills, effective meeting skills, and empowerment and leadership skills)?
◊⊕	Do your supervisors frequently hold group meetings for quality-related discussion amongst employees?
□ ◊⊕	Whether your organization adopts a team approach (such as quality circles, cross-functional teams) for problem-solving and continuous improvement?
□ ∇	Whether your employees feel supported, valued, and appreciated?
□ ∇	Whether working environment provided to employees is safe and comfortable (free from physical and mental harassment)?

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.

Table A1 OPM (continued)

Legends	*Level of workforce development issues (WDI)*
□	Does your organization value the contribution of employees to its well-being?
□ ⊕	Are the employees satisfied with various welfare facilities like subsidized food, housing, medical aids, additional family support, education to children, etc.?
□	Does your organization recognize the career growth needs of its employees?
□ ◊⊕	Does your organization have a mechanism for recognition and appreciation of the quality efforts and success of individuals and teams?
□	In what ways the organization appraises its employees?
□ ⊕	Whether the rewards and incentives fairly distributed and strictly linked to employees' performance
	TQM issues (TQMI)
□ ◊	Whether your organization has long-term goals concerning quality improvements?
□	Whether the culture of your organization supports continuous improvement?
□ ∇	Does your organization conduct Informal benchmarking and other forms of information acquisition and sharing with an organization in different sectors and industries to identify best practices for improvements and opportunities?
□ ◊∇⊗	Whether Supervisors, unit heads, and divisional managers assume active roles as facilities of continuous improvement, coaches of new methods, mentors, and leaders of empowered employees?
□ ◊∇∅	Is there an existence of a system for recognition of quality processes to track rework, waste, rejects, and continuous improvement?
∇⊗⊕	Whether continuous improvement tools (brainstorming, check sheet, and other statistical process control) are applied on a regular basis?
□∇⊗∅	Do you practice various continuous improvement approaches (Deming approach, kaizen approach, Shingo approach, and Golddraft's approach) in your organization?
□	Does your organization use self-assessment tools and other mechanisms to track and improve performance gaps in the implementation and effectiveness of system, processes, and practices?
□	Whether the outcomes of the self-assessment are linked to the business planning processes?
□ ◊∇⊗	Whether the key processes in your organization are regularly measured and audited?
◊	Do your organization document and implement all quality initiatives?
◊∇	Whether your organization conducts effective incoming, in-process, and final inspection and use the information to seek quality improvements?
◊	Does your organization implement and modify all quality system documents through quality audits and management reviews?
∇⊗⊕∩∅	Whether the job being produced is acceptable (quality-wise) and usually finished without delay without wastage of material?
∇⊗	Whether your organization conducts breakdown and preventive equipment maintenance on the shop floor?

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.

Table A1 OPM (continued)

Legends	*TQM issues (TQMI)*
∇	Does your organization emphasize putting all tools and fixtures in their place?
□ ◊∇⊗	Does your organization use the PDCA cycle, seven QC tools, and statistical process control extensively for different activities?
□	Whether your organization collects information about customer's needs and expectations through the market investigation?
□	Whether your organization takes feedback from customers and follows up on the suggestions?
□	Does your organization contact the end-users of your products to get feedback on product performance and service?
□∩	Whether your organization uses data on customer expectations when designing new processes?
◊∩	Does your organization have customer satisfaction levels on the quality of products/services and use them for quality improvements?
□ ◊	Does your organization provide a quality warranty on products sold to customers?
□ ◊	Does your organization consider customer complaints to identify patterns and prevent the same problem from recurring?
□ ∩	Whether your organization has service standards and implements the standards strictly?
	SCMI issues (SCMI)
⊕∅	Does your organization strive to reduce time wastage in operations?
⊕∅	Does your organization work on reducing response time across the supply chain?
□ ⊕	Whether your organization streamlines your business processes (e.g., ordering, shipping, receiving, and other paperwork) with your trade partners?
□ ∅	Whether your organization ensures Completion of the daily schedule as planned?
⊕∅	Is there an existence of a contingency management system for unexpected events in your organization (e.g., order change or cancellation, computer network down)?
∇⊗	Does your organization work on reducing inventory levels?
∇⊗	Does your organization work on Kanban pull system?
∩∅	Do your organization's goods are stored at appropriate distribution points close to customers in the supply chain?
∩	How do you rate the delivery activity throughout your supply chain?
∅	How important is logistics quality for your organization?
∅	Should logistics be part of the organization's strategy?
□ ∅	Is your organization taking steps to improve the logistics?
□ ∅	Which factor has more influence on Logistics
□ ∅	What should be focused more on to improve your organization's transportation?
□ ∅	Which are the major transportation issues in your organization?

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.

Table A1 OPM (continued)

Legends	*SCMI issues (SCMI)*
∅	Has your organization implemented 3PL (Third-party logistics) for solving your logistics service?
∅	What effects can 3PL have on your organization's logistics plan?
□ ∩	Do your organization's supply chain members have common, agreed goals for the supply chain?
□ ∩	Whether your organization seeks new ways to integrate activities of the entire supply chain?
□ ∅	Whether the entire interfaces of your supply chain work well together?
□ ∅	Whether your supply chain members clearly define the roles and responsibilities of each other corporately?
□	Do you Involve all members of the supply chain in your product/service/marketing plans?
□	Whether your organization and its trading partners keep each other informed about events or changes that may affect the other partners of your supply chain?
□	The functions in your organization cooperate to solve conflicts between them when they arise?
∇	Whether your organization frequently interacts with customers to set its reliability, responsiveness, and other standards?
∇	Whether your organization frequently holds group meetings for discussion among members of the supply chain?
□	During problem-solving sessions, your organization makes an effort to get all team members' opinions and ideas before making a decision.
	Strategic supplier partnership issues (ISSP)
∩∅	Whether your organization strives to establish long-term relationships with its suppliers?
□ ∅	Whether the selection of suppliers is based on geographical location?
⊗	Does your organization select suppliers based on cost?
□ ◊	Does your organization prefer Quality as the number one criterion in selecting suppliers?
□	Does your organization apply environmental criteria when making purchasing decisions, i.e., supplier selection?
◊	Does Your organization certify its suppliers for quality?
□ ◊∩	Does your organization mostly use suppliers that are certified by your organization?
□ ◊	Does your organization Frequently interact with its suppliers?
□ ◊∩	Whether your organization ensures the development and maintenance of a trustworthy/positive relationship with its suppliers?
□	Does your organization involve its key suppliers in its planning and goal-setting activities?
□	Do your organization's key suppliers Actively participate in your new product development?

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.

Table A1 OPM (continued)

Legends	*Strategic supplier partnership issues (ISSP)*
□	Does your organization conduct regular meetings and interactions with the related departments of its supplier?
□◊⊗⊕∩∅	Does your organization have a separate vendor development department?
□ ◊∇⊗	Whether your organization has continuous improvement programs that include its key suppliers?
□ ◊∇∩	Whether your organization shares improvement benefits as well as other risks and rewards with its suppliers?
	Level of customer responsiveness (LCR)
□	Have your organization introduced and maintained the "customer focus "philosophy for a long time?
□	Does every employee of your organization care about your customers?
◊∩	Does your organization have a frequent follow-up with its customers for quality/service /delivery feedback?
□	Whether your organization collects customer's complaints extensively and treats them with top priorities?
□	Is your organization committed to improving the management of everything that your customers suggest?
□	Whether your organization promotes customer involvement from the early stage of development until the commercialization stage?
□	Does your organization jointly work with its customers to overcome difficulties?
□	Does your organization participate in the marketing efforts of its customers?
	Information technologies issues (ITI)
⊕∅	Does your organization exchange information with its supply chain partners regularly?
⊕∅	Does your organization inform its trading partners in advance of changing needs?
□	Whether your organization and its trading partners exchange information that helps in the establishment of business planning?
□	Does your organization share its business units' proprietary Information with its trading partners?
□	Do trading partners of your organization share their proprietary information with your organization?
□ ⊕∅	Do your trading partners keep your organization fully informed about issues that affect its business?
∇⊕∩∅	Information exchange between your organization and its trading partners is timely.
∇⊕∩∅	Information exchange between your organization and its trading partners is accurate and complete
□∇⊕∩∅	The use of Information Technology (IT) is considered an important tool in achieving a strategic objective.

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.

Table A1 OPM (continued)

Legends	*Information technologies issues (ITI)*
□∇⊕∅	The ability of your organization's IT system is to enhance collaboration and Convey trust between the supply chain interfaces
□∇⊗⊕∩∅	Do you currently use e-business systems (MRP, ERP, CRM, SRM, etc.) in your organization to ensure the smooth functioning of the entire Supply Chain?
∇⊕∅	Whether your organization ensures IT-enabled operations, logistics, and production?
□ ⊕∅	Whether Your organization's ordering system from major customers is IT enabled and Automated.
□	Whether your organization uses advanced information systems to track and/or expedite shipments?
□∇⊕∅	Does your organization have Direct computer-to-computer links with your key suppliers?
□ ∇⊕∅	Whether your organization uses IT-based automated ordering to send the purchase order to major suppliers?
	Transfusion of TQM and SCM (IRT)
□ ◊	Is quality taken into consideration in your organization's supply chain?
□ ◊∇⊕	Does your supply chain's entire workforce understands and is committed to the vision, values, and quality goals of your organization?
□ ◊∅	Does your organization ensure the conformance of products/services against established quality standards in the supply chain?
□◊∇⊕∩∅	Does your organization ensure Joint customer-supplier quality goal setting?
□ ◊	Is quality taken into consideration while purchasing?
□ ◊	Whether the emphasis is given on quality instead of the price while selecting the supplier?
□ ◊∇	Whether your organization has methods to audit selected supplier's quality of products?
□◊∩	Whether your organization maintains close communications with its suppliers about quality, delivery considerations, and design changes?
□ ◊⊗∩	Does your organization certify its suppliers using supply chain performance criteria (e.g., quality, cost, delivery)?
□ ◊	Does your organization help its suppliers to improve their quality?
□ ◊⊗	Whether your organization provides training to its suppliers on quality aspects?
□ ◊⊗	Does your organization actively engage its key suppliers in strategic quality improvement of products?
□ ◊∇∩	Whether your organization has established a mechanism to get feedback on your quality and delivery performance from the customers?
□ ◊∇	Whether your organization uses customer feedback for effective continuous quality improvements in the supply chain?
□	Does your organization reset your standards with the rapidly changing needs and expectations of customers?

Notes: □ – Business performance related achievements, ◊ – quality related achievements, ∇ – production related achievements, ⊗ – cost related achievements, ⊕ – flexibility related achievements, ∩ – delivery related achievements and ∅ – lead time related achievements.