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Supply chain and total quality management framework design for business performance-case study evidence

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Abstract

Purpose – The purpose of this paper is to identify the importance of integration of supply chain management practices with total quality management (TQM) practices to augment business performance. The objective of paper is to focus on the two important dimensions, namely, supply chain and TQM of an organization with special reference to the concepts: exploration and exploitation.

Design/methodology/approach – In total, 20 variables have been identified (independent variables) which impact business performance (dependent variable). Variables have been extracted into four categories with a combination of two orientations, i.e., exploitation and exploration, with respect to quality management and supply chain practices.

Findings – Configurationally four different combinations concerning supply chain and TQM were identified in which an enterprise can operate. This is supported with the four different case studies.

Practical implications – This study leads to some interesting practical implications for practicing managers as it offers a framework in which the supply chain and TQM practices can be implemented with respect to an organizational structure (mechanistic or organic structure), environmental conditions (uncertain environment and rapidly changing product life cycle) and identification of customer orientations (whether customer is price sensitive or customer makes buying decision on account of trust or relation to the product).

Originality/value – The concept of supply chain exploitation and supply chain exploration with different orientations of quality management is not studied comprehensively before. This paper provides a background for establishing a framework of strategies for supply chain and quality practices, with respect to the exploitation and exploration scenario.

Keywords Supply chain exploitation, Supply chain exploration

Paper type Research paper

1. Introduction

Organizations are made with a purpose to serve society, meet ever changing human needs and demands, lastly to generate profit. In Selldin and Olhager (2007) study, it is observed that 33 percent of firms choose physically efficient supply chain for functional products, and 10 percent firms choose market-responsive supply chains for functional products. Functional products are those, which are consumed in a wide range; do not change over time, have stable demand and long life cycle (i.e. toothpaste and soaps). In case of innovative products 16 percent firms choose physically efficient supply chains, whereas 9 percent firms choose market-responsive supply chains. Innovative products are those, which consumers buy for their special needs; these kinds of products have shorter life cycle and uncertain demand (i.e. android mobile phone, operating system, etc.). An efficient supply chain process is required for functional products, whereas responsive supply chain is very much necessary for innovative products (Fisher, 1997). This work relates products with the supply chain types. Supply chain can be optimized according to customer requirement or market demand

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with adoption of lean practices for products which are under stable environment; whereas responsive principle can be applied for products which are under uncertain demand/environment (Childerhouse and Towill, 2000). Supply chain planning can also be done by forecasting the product life cycle and different phases of product life cycle. The SCM strategies can also be made in accordance with product variety, demand variability, responsiveness of order cycle and annual demand (Childerhouse *et al.*, 2002). Another model developed by Payne and Peters (2004) advocate the design of supply chain which should base upon number of pallets in a consignment, order line value, order lines per year and number of customers per year. The mass production approach and order-based production have different supply chains to achieve better business results (Hameri and Lehtonen, 2001). The supply chain selection can also be done on the basis of whether the product is in hybrid category, standard category or innovative product category (Huang *et al.*, 2002).

In the twenty-first century with rapidly changing environment (uncertain environment and rapidly changing product life cycle) and increase or decrease in supply chain length, the role of supply chain and quality management practices led to the survival and performance of an enterprise. Today organizations are facing economic changes at global level, in which fast responses should be made in order to survive in competition and to respond to customer/market demand (Yan *et al.*, 2010). By adoption of flexibility to respond to market requirements, the role of supply chain is most important for providing products or services more effectively and flexibly. As competition is getting tougher day by day, the focus is shifting from single supply chain to an integration of supply chain and total quality management (TQM) practices. Integration is not only for internal practices, but also for moving from internal practices to integration and assurance of processes starting from suppliers to customers or vice versa (Foster and Ogden, 2008; Kaynak and Hartley, 2008; Robinson and Malhotra, 2005; Soltani *et al.*, 2011). In this respect there should be close co-operation and relation internally (among various functions of an organization) and externally (among partners, customers and suppliers). Long-term relationships are key features of supply chain management (SCM) (Williams *et al.*, 2006). The complete satisfaction of customers is possible by binding product quality, service and value in a bundle at every node of supply chain (i.e. at supplier level-at input level-at process level-at output level-at customer level) and quality management practices and should be exercised beyond the boundaries of concerned enterprises (Flynn and Flynn, 2005; Lee *et al.*, 2006; Williams *et al.*, 2006).

Quality management practices visibility for improvement is deeply associated with the performance of supply chain (Kuei *et al.*, 2008). The need of integration of SCM and TQM practices is supported by emphasis, such as, organizations having integrated supply chain and quality management practices are able to achieve competitive advantage over others, i.e., competitors. It is found that the organizations with sound total quality practices can achieve best supply chain performance (Flynn and Flynn, 2005).

There is positive correlation between quality management practices and performance measure (Kaynak and Hartley, 2008) and also concerning quality performance, process management, supplier quality management, management leadership, product service design, training, quality data and inventory management performance (Kaynak, 2003).

The complete satisfaction of customers can be achieved only when quality of products, processes and values are coupled with the quality management activities, and the nodes of supply chain and activities should be exercised beyond the internal boundaries of organizations. That is why TQM and SCM along with their integration made provision for improving the effectiveness and efficiency of an organization's operational functions. This covers all the departments, which in turn improve the business performance of an enterprise (Kannan and Tan, 2005). In most of the literature, either TQM or SCM has been studied in isolation. In few studies like Zhang *et al.* (2011), they have analyzed TQM with exploitation and exploration angle, but SCM has not been studied. Now we have made an attempt to combine TQM and SCM in synchronization to visualize the exploitation and exploration orientation. The present paper makes an attempt to identify the importance of integration of SCM practices with TQM practices to augment business performance.

2. Literature review

The quality management practices can be classified in two orientations (Zhang *et al.*, 2011) as quality exploitation and quality exploration, which can be used with respect to environment (internal and external to an enterprise) and structure of the organization (organic or mechanistic) as shown in Table I. One of the future research directions mentioned by the authors is its expansion to include the supply chain. The present paper makes an attempt to develop the domains with respect to total quality exploitation and exploration and supply chain exploitation and exploration and verification through case studies.

The two quality orientations, namely, quality exploration and quality exploitation have been discussed before. On similar lines and on the basis of existing literature, supply chain networks can be classified with respect to exploration and exploitation framework. The present paper makes an attempt to do this as shown in Table II for further synergy. This will help organizations to choose, which supply chain orientation and which TQM orientation should be applied with respect to the product class, customer demand orientation, etc.

In an uncertain environment of product or service life cycle under global pressure, only the quality of service or product cannot make significance to customer and market. But place and pace of deliverance play an important role for a business to perform (Chin *et al.*, 2004). For this reason the supplier should be capable of supplying the quantity as and when needed with a greater fluctuation in pace (Sharma, 2010, 2011, 2013). Two functions of business, i.e., TQM and supply chain practices play an important role in

	Total quality exploration management	Total quality exploitation management
Goal	To explore the unknown and meet the latent and emergent product needs of consumer	To exploit the current products/system to meet the needs of consumer
Environment	It is highly recommended in an uncertain, ever changing business environment	It is applicable in a stable product case, where environment is not uncertain
Organizational structure/ hierarchy	Applicable where there is less-formal system approach to management; or it works with organic type of structures	Where is a comprehensive hierarchy of management and the roles are defined; mechanically structured
Cost associated	Adoption of this type of quality management practices is a costly affair	Once an established system of quality is in place, then small change can occur in practice
Time frame	This set of quality practices changes rapidly, as customer demand changes	The main objective of quality management system does not change largely
Major role	Research and development plays a major role in quality exploration	The system reliability is essential in quality exploitation

Source: Zhang *et al.* (2011)

Table I. Total quality exploitation and exploration

Table II. Exploratory and exploitative supply chain

	Exploratory supply chain	Exploitative supply chain
Main focus	To respond to the rapidly changing customer needs for a product differentiation	To supply the product to maintain minimum cost for increased performance
Inventory	To maintain minimum stock so that unpredicted market demand can be met	To maintain inventory to the level, for maintaining lower carrying cost
Selection of suppliers	Suppliers who can meet demand on the basis of flexibility, speed and low cost	Suppliers who can provide quality products and are also cost effective
Manufacturing capability	Enterprise should have flexibility in respect of meeting unexpected demand	High utilization of all available resources to lower cost
Mode of movement	Selection of logistics partner who can quickly deliver goods and raw materials	Selection of logistics partner on the basis of low cost for goods and raw materials
Lead time	Lead time reduced, without taking care of the cost associated with processes	Reduction in lead time, but not at the expense of cost associated with products
Orientation of customer	Ready to pay higher price	Price sensitive customer

organizational competitiveness and survival (Sila *et al.*, 2006). TQM is an integrated approach to bring continuous improvement in products and services using proper tools, technology and training to meet customer's expectations on a continuous basis (Palo and Padhi, 2005), whereas SCM encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities as well as coordination and collaboration with channel partners (Gundlach *et al.*, 2006). This paper develops the conceptual framework (Figure 1) for TQM and SCM for customer satisfaction which leads to superior business performance of an enterprise. TQM focusses on the organization wide culture development which emphasizes aggressive involvement of employees in the manufacturing processes, whereas SCM emphasizes cost reduction, expedites the internal processes of movement of material toward finished goods and also expedites the processes externally from suppliers to distribution channels.

The organizations generally enhance performance by focussing on customer, process, innovation activities and environment in which an enterprise is operating (Mehra and Agrawal, 2003). This paper also includes customer satisfaction perspective of TQM which includes reduction of costs in supplier involvement, design of product and processes both internally and externally. There is a positive correlation of TQM programs on the performance of manufacturing industries (Terziovski and Samson, 1999) in Australia.

Cost effectiveness can be achieved in SCM through efficient supply chain (Kuei *et al.*, 2001; Chin *et al.*, 2004). Time and swiftness seek attention in SCM research with an aim of quick delivery and the lowest possible cost. Flexibility to respond to the needs of market/customer and speed to market is essentials of SCM (Samaranayake, 2005). Faster communication channel, flow of material from one process to another and information flow are pillars of SCM (Chase *et al.*, 2007; Lummus *et al.*, 2003). Other methods, tools and techniques are also applicable in SCM processes. This varies from scenario to scenario, like quick response and efficient customer response in an industry, vendor managed inventory in automobile industry (Vanichchinchai and Igel, 2009) and flexible response in electronics or technologically comprehensive industry or industry with uncertain environment.

Even with different primary goal of TQM and SCM, the ultimate goal of both is customer satisfaction. TQM which leads to customer satisfaction involves the focus on

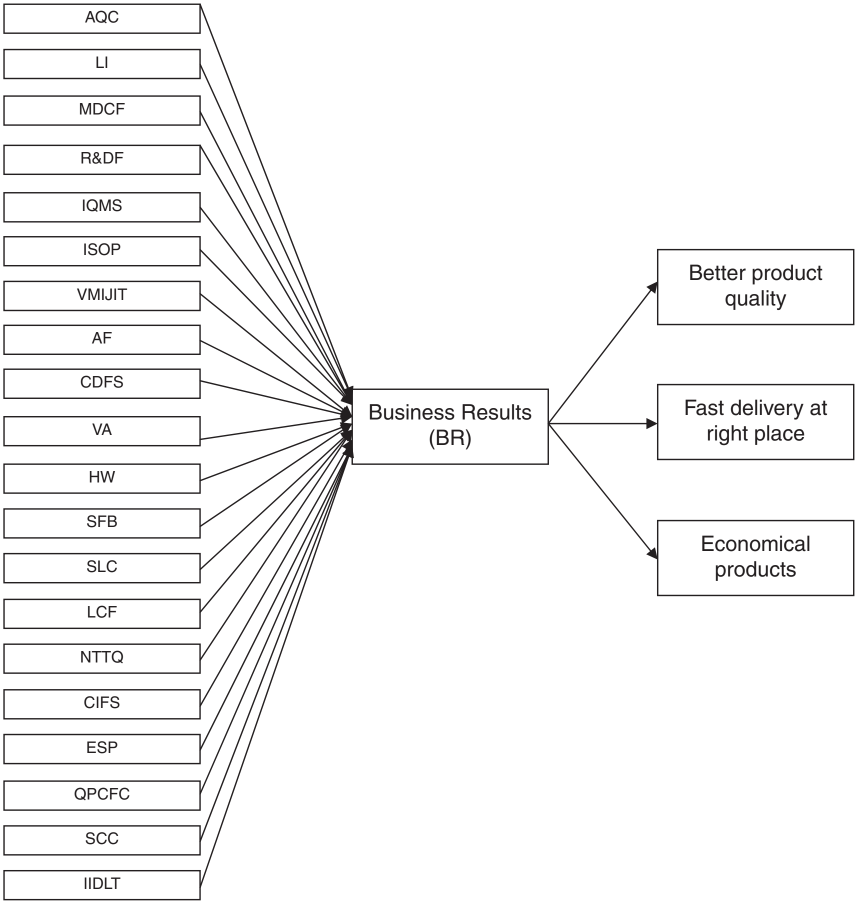
AQC
LI
MDCF
R&DF
IQMS
ISOP
VMIJIT
AF
CDFS
VA
HW
SFB
SLC
LCF
NTTQ
CIFS
ESP
QPCFC
SCC
IIDLT
Business Results (BR)
Better product quality
Fast delivery at right place
Economical products

Figure 1. Relationship of 20 factors to business deliverable (quality and supply chain)

issues such as customer-oriented practices, involvement of employees and process management by ensuring robust design; adoption of process control methods like statistical process control (SPC) and statistical quality control (SQC); development of kaizen activities; practicing quality assurance at large scale instead of quality control concept; employee satisfaction which is necessary before customer satisfaction to have an integrated approach. In case of supply chain, there are several practices exercised by an organization, can be ranked in order of importance as follows: internal operations→information sharing→IT (information technology)→training→strategic supplier partnership→customer relationship. The practices of SCM lead to performance in terms of improved lead time, market share and sales level of firm (Chong *et al.*, 2011). In a supply chain, supplier quality, supplier selection, supplier evaluation, distribution partners, logistics partners, wholesalers and dealers are important components of SCM process.

3. Research methodology

In total, 20 factors have been identified related to business performance, namely, manufacturer adapt quickly to change (Aqc); low inventory (Li); modern distribution channel format (mdcf); manufacturer focus on research and development (Rdf); improved quality management system (Iqms); improved standard operating procedures (Isop), vendor managed and just in time inventory (VmiJit); accurate forecasting (Af); charging distributor for supply (Cdfs); variants and application (Va); health and wellness (Hw); support from other brands (Sfb); supply at low cost (Slc); low-cost freight (Lcf); use of new tools and techniques (Nttq); continuous improvement focus on supply (Cifs); economies of scale production (Esp); quality parameter change from customer to customer (Qpcfc); emphasis to supplier cost control (Scc); and improve interdepartmental lead time (Iidlt).

The above mentioned variables have been identified after careful review of literature (Table III) and further confirmed through expert opinion. Exploratory factor analysis (EFA) has been carried out to finalize the factors and regression analysis has been carried out to see the relationship between independent variables and business performance.

	Factor name	Literature support
1	Manufacturer adapt quickly to change (Aqc)	Matson and McFarlane (1999), Meehan and Dawson (2002), Holweg (2005), Storey *et al.* (2005), Reichhart and Holweg (2007), Chan and Chan (2010), Hsu and Li (2011)
2	Low inventory (Li)	Pan and Yang (2002), Jose *et al.* (2013), Naryana *et al.* (2013)
3	Modern distribution channel format (mdcf)	Sinha and Uniyal (2005), Minten and Reardon (2008), Swinnen and Vandeplas (2007), Prasad and Aryasri (2011)
4	Manufacturer focus on research and development (Rdf)	Zucker and Darby (1997), Gino and Pisano (2006), Tessarolo (2007), Haslam *et al.* (2011), Light and Lexchin (2012), Naryana *et al.* (2013)
5	Improved quality management system (Iqms)	Martínez-Lorente *et al.* (1998), Chini and Valdez (2003), Uyar (2009)
6	Improved standard operating procedures (Isop)	Silos (1999), Stup (2001), Heras *et al.* (2006), Casadesús and Karapetrovic (2005)
7	Vendor managed and just in time inventory (VmiJit)	Holweg *et al.* (2005), Kumar *et al.* (2009), Baird *et al.* (2011), Christopher (2011), Guimarães *et al.* (2013)
8	Accurate forecasting (Af)	Martin and Britain (1995), Czaplicka-Kolarz *et al.* (2009), Anderson *et al.* (2008), Lee *et al.* (2008), Lin *et al.* (2010)
9	Charging distributor for supply (Cdfs)	Gavirneni *et al.* (1999), Chen (2003), Fein (2007), Schwarz and Zhao (2011)
10	Variants and application (Va)	Schwarze (1994), Ulrich (1995), Ehrenberg and Uncles (2001)
11	Health and wellness (Hw)	French *et al.* (2001), Pingali (2006), Bushan (2011)
12	Support from other brands (Sfb)	Keller and Aaker (1992, 1998), Kirmani *et al.* (1999), Putsis and Bayus (2001), Akula (2008)
13	Supply at low cost (Slc)	Ross (1998), Lee and Wolfe (2003), Fan (2007), Naslund and Williamson (2010)
14	Low-cost freight (Lcf)	Mangan *et al.* (2008), Stahlbock and Vob (2008)
15	Use of new tools and techniques (nttq)	Mehra *et al.* (2011), Fotopoulos and Psomas (2010)
16	Continuous improvement focus on supply (Cifs)	Koh *et al.* (2007), Cook *et al.* (2011), Chi *et al.* (2009), Kim (2009)
17	Economies of scale production (Esp)	Krugman (1980), Basu and Fernald (1995), Pingali *et al.* (1997)
18	Quality definition change from customer to customer (Qpcfc)	Zeithaml (1988), Berry and Carbone (2007), Namkung and Jang (2008)
19	Emphasis to supplier cost control (Scc)	Monden and Hamada (1991), Lalonde and Pohlen (1996), Roberts and Mackay (1998), Frank (2002)
20	Improve interdepartmental lead time (Iidlt)	Moenaert *et al.* (1990), Gibson and Gibbs (2006), Tatikonda and Rosenthal (2000), Jansen *et al.* (2009), Tessarolo (2007), Troy *et al.* (2008)

Table III.
Factors and literature support

The expert opinion method has been adopted for arriving at factors impacting business performance. Ten experts were contacted for their opinions and responses. These experts were having minimum ten years of experience in the area of supply chain and plant-level operations. The designations of the respondents were deputy manager and above. For convenience, authors have selected the manufacturing organizations to understand the cases clearly. After arriving at the factors, the questionnaire was designed for collecting data and was further shown to the same experts for face validity. The items are designated under the above defined constructs. This study covered convenience sampling of 80 manufacturing plants in four domains (20 each) (electronics, cosmetics, noodle food and gum care). Primary data were collected through self-administered questionnaire on Likert's five-point scale (5 = strongly agree to 1 = strongly disagree). The questionnaire was distributed to middle-level managers who have been handling (or handled) the profile of quality and supply chain. In case a particular organization is not having middle-level manager with the experience of quality and supply chain, the general manager of the plant was considered. In total, 58 instruments were received, out of which four were rejected, because they were incomplete. The response rate for this survey was 72 percent (i.e. a sample size of 58 companies out of 80 companies). However, the data from only 54 companies were useful for the analysis. The Cronbach's α test has been performed to check the reliability. Cronbach's α must be above 0.70 (Nunnally and Bernstein, 1994) and 0.60 for exploratory research (Flynn *et al.*, 1990).

The mixed mode methodology has been used to analyze the data, as data were spread in 20 factors. To understand, which factors fall in exploration or exploitation with reference to TQM and SCM simultaneously, the mixed mode method is better approach.

Data have been analyzed in four stages using SPSS 20.0, supported with case studies finally. In first stage factor extraction has been done (Table IV). In second stage Cronbach's α has been checked for reliability of questionnaire, which measures the average correlation of items. Bi-variate correlation has been used in third stage to obtain the strength of relationship between independent and dependent variables. Finally multiple regression analysis has been carried out to check the individual contribution of constructs on business performance and R^2 (coefficient of determination) has been used to check the model adequacy. The results have been further supported with case studies in four categories (arrived in first stage). The research model used for this study is shown in Figure 1.

4. Analysis

The factors were extracted from expert opinion factors for constructs (Tables I and II). The scale was tested with Cronbach's α to check the internal consistency of variables. The Cronbach's α was 0.71, which means; data set has good internal consistency.

Bi-variate correlation was carried out with the help of SPSS on each item and the results are presented in Table VI. It is evident from the Table VI that modern distribution channel format (mdcf) is positively correlated with accurate forecasting (Af), research and development (Rdf) is positively correlated with adapt quickly to change (Aqc), improved quality management system (Iqms) is positively correlated with improved standard operating procedure (Isop), variants and applications has positive correlation with improved quality management system (Iqms), continuous improvement focus on supply (Cifs) is positively correlated with vendor managed and just in time inventory (VmiJit), continuous improvement focus on supply (Cifs) is positively correlated with accurate forecasting (Af), and so on.

Rotation converged in eight iterations, 1-SERTER (supply chain and total quality exploration); 2-SETTER (supply chain exploitation and total quality exploration);

Table IV.
Factor loading of items

	Rotated component matrix[a] Component 1	2	3	4
Aqc			0.512	
Li	−0.709			
Mdcf	−0.553			
Rdf				0.732
Iqms			0.516	
Isop				0.558
VmiJit			0.816	
Af		0.502		
Cdfs			0.624	
Va		0.496		
Hw			0.593	
Sfb	0.543			
Slc	0.673			
Lcf		0.795		
Nttq	0.594			
Cifs				0.671
Esp		0.696		
Qpcfc	0.576			
Scc				0.532
Iidlt	0.508			

Notes: [a]Rotation converged in 5 iterations. Extraction method: principal component analysis; rotation method: Varimax with Kaiser normalization

3-SERTET (supply chain exploration and total quality exploitation); 4-SETTET (supply chain and total quality exploitation).

The factors are extracted from 20 items, which resulted into four categories namely, SERTER, SETTER, SERTET and SETTET by consulting experts. These four categories (Table V) were found in real world in the form of different organizations during case study analysis (Table VI).

Business performance is negatively correlated with manufacturer adapt quickly to change (Aqc), low inventory (Li) and modern distribution channel format (mdcf).

To study the causality between independent and dependent variables, multiple regression method was carried out with the help of SPSS. The results are shown in Table VII.

The R^2 value (0.714) shows that 71.4 percent variance in business performance is explained by the 20-independent variables. Table VIII gives the results of regression analysis. From Table VIII it is evident that data set is free from multi-co linearity as variance inflation factor (VIF) is below 5.

Table V.
Categorization of variables

SERTER		SETER		SERTET		SETTET	
Li	−0.709	Af	0.502	Aqc	0.512	Rdf	0.732
Mdcf	−0.553	Va	0.496	Iqms	0.516	Cifs	0.671
Sfb	0.543	Lcf	0.795	VmiJit	0.816	Scc	0.532
Slc	0.673	Esp	0.696	Cdfs	0.624	Isop	0.558
Nttq	0.594			Hw	0.593		
Qpcfc	0.576						
Iidlt	0.508						

	Aqc	Li	Mdcf	Rdf	Iqms	Isop	VmiJit	Af	Cdfs	Va	Hw	Sfb	Slc	Lcf	Nttq	Cifs	Esp	Qpcfc	Scc	Iidlt	Bp
Aqc	1.000																				
Li	0.325*	1.000																			
Mdcf	0.200	0.412**	1.000																		
Rdf	0.099	0.084	−0.054	1.000																	
Iqms	−0.110	−0.351**	−0.322*	−0.316*	1.000																
Isop	−0.327*	−0.137	−0.225	0.142	0.249	1.000															
VmiJit	−0.137	−0.157	−0.005	−0.115	0.327*	0.226	1.000														
Af	−0.288*	0.054	−0.840	0.006	0.326*	0.237	0.332*	1.000													
Cdfs	−0.247	−0.221	−0.176	−0.027	0.313*	0.161	0.410**	0.403**	1.000												
Va	−0.480**	−0.285*	−0.335*	−0.228	0.263	0.142	0.141	0.356**	0.424**	1.000											
Hw	−0.335*	−0.312*	−0.298*	0.042	0.393**	0.401**	0.419**	0.215	0.462**	0.346*	1.000										
Sfb	−0.371**	−0.449**	−0.432**	−0.043	0.136	0.295*	−0.036	0.047	0.231	0.350**	0.240	1.000									
Slc	−0.226	−0.419**	−0.318*	−0.105	0.129	0.192	0.185	0.116	0.158	0.397**	0.304*	0.291*	1.000								
Lcf	−0.306*	−0.200	−0.209	−0.272*	0.283*	0.291*	0.169	0.336*	0.194	0.293*	0.043	0.310*	0.143	1.000							
Nttq	−0.163	−0.318*	−0.329*	−0.056	0.152	0.273*	0.113	0.014	0.195	0.363**	0.292*	0.302*	0.385**	0.185	1.000						
Cifs	−0.027	−0.246	−0.407**	0.242	0.445**	0.307*	0.246	0.266	0.423**	0.186	0.380**	0.152	0.119	0.156	0.324*	1.000					
Esp	−0.159	−0.274*	−0.210	−0.268*	0.357**	0.220	0.100	0.206	0.257	0.350**	0.109	0.381**	0.325*	0.459**	0.006	0.147	1.000				
Qpcfc	−0.296*	−0.439**	−0.299*	−0.165	0.294*	0.321*	0.255	0.123	0.274*	0.351**	0.362**	0.206	0.273*	0.172	0.250	0.221	0.193	1.000			
Iidlt	−0.306*	−0.341*	−0.420**	−0.212	0.297*	0.393**	0.381**	0.249	0.287*	0.376**	0.305*	0.334*	0.390**	0.353**	0.210	0.179	0.243	0.502**	1.000		
Bp	−0.237	−0.221	−0.361**	0.010	0.405**	0.491**	0.460**	0.295*	0.347*	0.360**	0.313*	0.179	0.178	0.549**	0.278*	0.426**	0.432**	0.429**	0.445**	1.000	

Notes: *,**Correlation is significant at the 0.05, 0.01 level, respectively (two-tailed)

Table VI.
Bi-variate correlation matrix

It is clear from the values of standardized coefficients (Table VIII) and their corresponding values that only VmiJit, Lcf and Esp are supported and regression equation can be written as:

$$\text{BP (Business Performance)} = -0.168 + 0.270 \times \text{VmiJit} + 0.267 \times \text{Lcf} + 0.204 \times \text{Esp} \quad (1)$$

The independent variables, namely, Aqc, Li, mdcf, Rdf, Iqms, Isop, Af, Cdfs, Va, Hw, Sfb, Slc, Nttq, Cifs, Qpcfc, Scc, Iidlt are not included in regression model as they do not have significant effect on business performance.

ANOVA (Table IX) is produced, which indicates the significance of overall predicted regression model. Since *p*-value in Table IX is less than 0.01, which means at 99 percent confidence level the regression model is valid and adequate for current data set.

Table VII.
Model summary

Model	*R*	R^2	Adjusted R^2	SE of the estimate
1	0.845[a]	0.714	0.540	0.71717

Notes: [a]Predictors: (constant), Iidlt, Cifs, Esp, Aqc, Nttq, VmiJit, Rdf, Af, Qpcfc, Slc, Isop, Sfb, Lcf, Cdfs, Mdcf, Scc, Li, Hw, Va, Iqms

Table VIII.
Regression analysis

Coefficients[a]

Model		Unstandardized coefficients *B*	SE	Standardized coefficients *β*	*t*	Sig.	Collinearity statistics Tolerance	VIF
1	(Constant)	−0.168	1.109		−0.152	0.880		
	Aqc	−0.001	0.106	−0.001	−0.010	0.992	0.539	1.855
	Li	0.093	0.099	0.129	0.936	0.356	0.458	2.185
	Mdcf	−0.131	0.102	−0.164	−1.279	0.210	0.528	1.894
	Rdf	0.215	0.110	0.258	1.955	0.059	0.500	1.999
	Iqms	0.071	0.107	0.096	0.670	0.507	0.421	2.374
	Isop	0.123	0.096	0.169	1.291	0.206	0.508	1.970
	VmiJit	0.270	0.097	0.346	2.780	0.009	0.561	1.783
	Af	−0.116	0.097	−0.152	−1.198	0.239	0.537	1.863
	Cdfs	−0.003	0.104	−0.004	−0.029	0.977	0.524	1.908
	Va	0.125	0.102	0.169	1.222	0.230	0.452	2.214
	Hw	−0.066	0.109	−0.083	−0.604	0.550	0.464	2.157
	Sfb	−0.154	0.119	−0.169	−01.288	0.207	0.501	1.995
	Slc	−0.097	0.104	−0.120	−0.934	0.357	0.522	1.917
	Lcf	0.267	0.092	0.364	2.911	0.006	0.556	1.798
	Nttq	0.078	0.093	0.104	0.832	0.411	0.559	1.790
	Cifs	0.045	0.108	0.059	0.413	0.682	0.433	2.309
	Esp	0.204	0.101	0.267	2.028	0.049	0.499	2.005
	Qpcfc	0.157	0.096	0.206	1.638	0.111	0.548	1.825
	Scc	−0.023	0.104	−0.030	−0.227	0.822	0.492	2.031
	Iidlt	0.028	0.104	0.037	0.266	0.792	0.454	2.202

Note: [a]Dependent variable: Bp, business performance

5. Case study evidence for configurations

Rigorous statistical analysis has been done in Section 4 for categorization of industry on the basis of different combination of exploration and exploitation concerning TQM and SCM practices (Table V). However to find these practically and also to validate, the case study approach is useful for practitioners. Accordingly in this section the four categories (Table V) have also been linked to the four practical cases. The cases are as follows:

1. supply chain exploitation and total quality exploitation (SETTET);
2. supply chain exploitation and total quality exploration (SETTER);
3. supply chain exploration and total quality exploitation (SERTET); and
4. supply chain exploration and total quality exploration (SERTER).

Manager's decisions directly influence the profit margin, revenues and cost components associated with different activities of a firm. The practicing managers can be the best sample for supply chain and TQM approach for better business results. This is the reason to select case study approach. Many researchers used this method for many years in various disciplines. In particular, social science researchers used this qualitative research method in real life situation, by which application of ideas and extension of methods is possible (Yin, 1984). The selection of manufacturing sites is considered from fast moving consumer goods (FMCG) sector mainly. The authors have selected one of the products which are in frequent use. The authors have selected only that firm which was having at least four or greater than four manufacturing facilities. After arriving at the categorization of variables in four groups, the interview method has been adopted to verify through case study. In case study, authors have selected the four industries (fairness cream, toothpaste, noodle food and electronics), which were the best suitable for the present categorization.

The interview method was adopted to verify the information and on the basis of information collected, we have classified these organizations into four configurations corresponding to Table IV. The interview was conducted telephonically and some personal visits have been done where authors were facing difficulty in collecting information on telephone. The interview was a mixture of descriptive and relational questions. In total, 20 organizations are chosen from each configuration. The companies have been named as A (toothpaste industry), B (fairness cream industry), C (noodle-food industry) and D (electronics industry). For each organization at least four manufacturing plants or site mangers are interviewed. From each plant or site two respondents were undertaken who were managers of the site. In total, 80 plant managers were interviewed from the four manufacturing domains to verify the categorization of variables (Table IV).

This paper will now explain the cases which comprise four configurations applicable for products from different industries.

Model		Sum of squares	df	Mean square	*F*	Sig.
1	Regression	42.286	20	2.114	4.11	0.000[b]
	Residual	16.973	33	0.514		
	Total	59.259	53			

Notes: [a]Dependent variable: Bp, business performance; [b]predictors: (constant), Iidlt, Cifs, Esp, Aqc, Nttq, VmiJit, Rdf, Af, Qpcfc, Slc, Isop, Sfb, Lcf, Cdfs, Mdcf, Scc, Li, Hw, Va, Iqms

Table IX.
ANOVA[a]

5.1 Case-1 – SETTET

In this category the organizations focus on improving the structure of quality systems, distribution channel and select low-cost supplier to compete over their rivals. This combination of orientation can be practiced for a particular product of enterprise. These orientations are most suitable when product is stable in the market. Stability can be in terms of low-cost product, which leads to an enhanced business performance on the basis of economies of scale. The distribution channel for product remains similar since its inception except some minor changes.

Industry A which is in toothpaste manufacturing and selling business, can fit at best in this configuration. Industry A is operating on economies of scale with refinement in quality every time. Here organization aims to select the new supplier companies and women-owned business suppliers. This kind of suppliers provides expected quality with low-cost structure among other aspects. Here the organization focusses on reducing the cost for: renting a warehouse; selection of vendor for mass production; bulk purchasing negotiation; contract manufacturing (due to high requirement of product in market, enterprise manufactures toothpaste with the help of other local vendors). In this configuration parent organization and supplier develop the mutual benefit relationship. Industry which falls under category A emphasizes continuous improvement in existing quality management system and at the same time not ignoring cost viewpoint.

This combination is applicable in upstream value chain as well as downstream value chain. Downstream supply chain starts from finished goods to low-cost rented warehouse. It continues from warehouse to distributors and distributors to retailers via dealers with low margins. This distribution channel is one of the oldest. With significant improvements over time it is still practiced and proved efficient in FMCG industry. In this type of high demand and stable product environment, enterprise grows and generates the profit by reaching to masses. Figure 2 summarizes this case.

5.2 Case-2 – SETTER

In this orientation an enterprise aims to develop the suppliers for cutting the cost on various operations of supplying components and raw material. On the other hand distribution channel partners need not change much and low-cost freight carrier are preferred for delivery. The center of focus lies in enhancing quality, consistency and features of the product. The quality perspective is not limited to only this organization, but transfers to the supplier's side also. The joint practices of quality standards can be

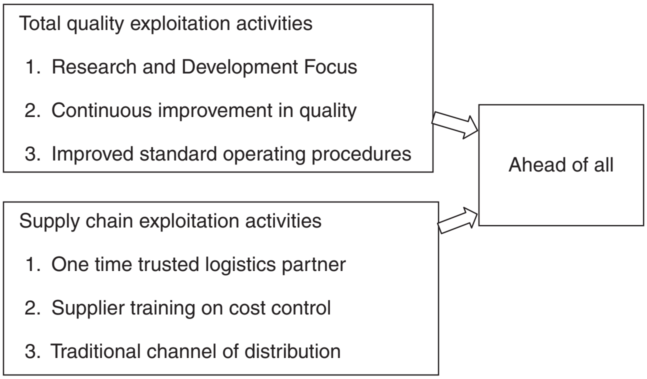
Total quality exploitation activities
1. Research and Development Focus
2. Continuous improvement in quality
3. Improved standard operating procedures
Ahead of all
Supply chain exploitation activities
1. One time trusted logistics partner
2. Supplier training on cost control
3. Traditional channel of distribution

Figure 2.
Total quality exploitation and supply chain exploitation practices for toothpaste Industry A

practiced with suppliers to improve the overall quality of product. Supply chain context is exploited rather than exploration in this configuration.

Fairness cream Industry B falls under this configuration of supply chain exploitation and total quality exploration. Cosmetics industry improved a lot since last few years in terms of quality (features, design of product and associated benefits). Due to awareness of customer about features and uniqueness of the product the role of quality becomes crucial. Fairness cream industry is more focussed on how to produce products with different variants and designs. By producing different variants organization can address more number of customer segments.

The user friendliness of a product and its environmental impact on society become important parameters. The organization has changed their processes to produce an improved product which is more sterile and have no side effects. The industry has changed their procedure/methods of testing and it came up with new quality control and quality assurance practices. As a part of quality assurance, the organization B has changed their sampling design, sampling frequency and is practicing SPC and SQC for monitoring of processes and products by attribute and variable control charts through MINITAB software. The use of lean tools is made (like Pareto chart, poka yoke for fool proofing, and cause and effect diagrams) to take decisions. These decisions help to solve complex problems by identifying the potential reasons. From supply chain perspective Industry B may use existing suppliers to develop other associated products. Other products falling under fairness cream product length like ointment come under the same product category.

The distribution of products (like ointment and fairness cream) may adopt same distribution channel (from warehouse to distributor and distributor to retailers via wholesaler). In this distribution channel the supply chain performance depends upon trust between channel members. The trust and commitment between channel members result in improved supply chain performance of the Industry B. To reach masses, it uses low-cost logistics partner for the products under umbrella of that brand. Manufacturer (fairness cream industry B) is dominant in the upstream supply chain as well as downstream supply chain. Downstream members and upstream members generally follow the rules and regulations designed by the manufacturer. These types of products which are frequently used have low margin due to a long supply chain. Retailer requires these products due to high demand in market. Strong presence and brand image of the product since many years, direct distributors to push the product to market. Figure 3 shows this orientation strategy of fairness cream adopted by them to be a market leader.

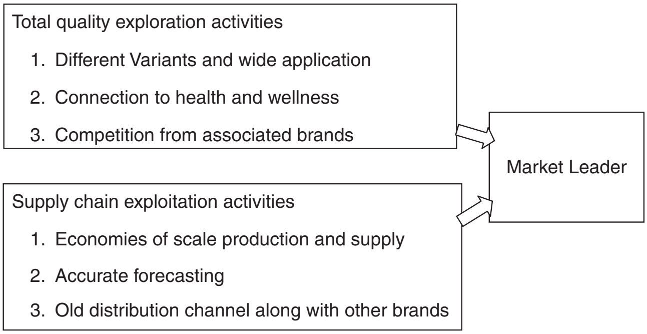
Total quality exploration activities
1. Different Variants and wide application
2. Connection to health and wellness
3. Competition from associated brands
Market Leader
Supply chain exploitation activities
1. Economies of scale production and supply
2. Accurate forecasting
3. Old distribution channel along with other brands

Figure 3.
Total quality exploration and supply chain exploitation practices for fairness cream Industry B

5.3 Case 3 – SERTET

Today organizations are intriguing supply chain practices as cost saving measure with the arrangement of every element optimally at every node of the supply chain. Suppliers and distribution channel selection are critical for organizational performance. The location of wholesalers and retailers, and logistic partner selection play an important role in the performance of organization. The organization can be a leader due to channel efficiency. Channel efficiency depends upon channel performance. Upstream and downstream supply chain will be one of the competencies of organization rather than design and quality parameters. Quality is assumed as an improved version of previous one, because of stability of the product.

Industry C is in the business of instant food sector. The industry has taken significant emergence in previous years and falls under the configuration of supply chain exploration and total quality exploitation. Since its brand inception it continuously penetrates into the market with improved variants of product. Industry C is focussing on a change in design considering the mothers and children. They later changed their target by projecting themselves as health and wellness industry. It is in the state of an established market up to a considerable level. Now the need is to exercise the supply chain in more innovative way to reduce the logistics cost and other hidden costs in the movement of product in a channel. Industry C is now focussing on the generation of profits from supply chain. They are charging distributors for transportation and logistics activities. Per unit charge may be minimum (say 0.5 percent of price). Due to mass requirement by distributors the amount charged by this industry will contribute a lot in the business performance. To make supply chain more responsive, it has started message system using mobile phone. The salesman's mobile is directly linked to the system of industry, by which order of a distributor or wholesaler can be delivered within next 12-14 hours. This configuration of quality and supply chain aspects is shown in Figure 4. The forecasting is almost 60-70 percent accurate.

5.4 Case 4 – SERTER

Ever changing products or service expectations support this combination of supply chain exploration and total quality exploration. In this scenario parent organization does not select suppliers on the basis of cost efficiency. The basis of selection may be capability and how quickly vendor can supply the components or raw material due to unpredicted demand. Quality excellence is also important criteria in this configuration.

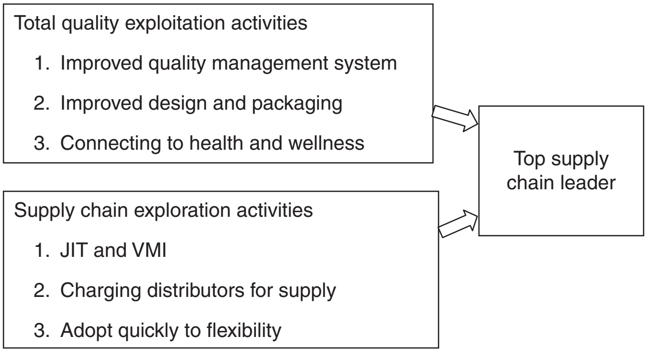
Total quality exploitation activities
1. Improved quality management system
2. Improved design and packaging
3. Connecting to health and wellness
Supply chain exploration activities
1. JIT and VMI
2. Charging distributors for supply
3. Adopt quickly to flexibility
Top supply chain leader

Figure 4.
Total quality exploitation and supply chain exploration practices for noodle-food Industry C

How much cost incurred to produce product might not matter much. Careful selection of distribution channel is also a distinct characteristic of this configuration.

Electronics industry fits best in this configuration, more appropriately television and cell phone segment. After Asian crises (1997) when electronics and technology changed its phase, the situation forced the electronics industry to go global. It faced the difficulty to serve the global consumers due to high-end technological demand. The industry was perceived as an original equipment manufacturer in developed states. To change this perception, it focusses on product design and also initiated to launch the innovative products that attract consumers. Today design of a mobile phone is such that it is more like a friend than a device. Product should be able to create an emotional journey with consumer by virtue of which it seems as fresh brand. Industry D has transformed itself into a steady source of cutting-edge technology.

From quality exploration perspective Industry D meets the changing needs of customer. The television sector journey started from black and white television to LED 3D television (light emitting diode three dimensional televisions). Another example is the ordinary mobile phone to smart phone journey with the phases of mobile with camera. The product ranges from mobile with facility of radio to mobile with extra memory and graphics to touch screen mobile are available. Now mobile phone is appearing with additional applications like 3G/4G supported, pdf and word files supporter. Mobile phones also appear with extensive use of internet like social media web sites, pre-loaded applications such as face book, LinkedIn and also e-mail facility. This all happen due to a rapid change in technology and customer requirements. In this manner the design, configuration and distribution formats are changed with the passage of time.

Industry D has been leading innovator in design and technology across categories of products and processes of operations. It has aligned with continually improving quality by design and innovation with business performance.

Industry D designed a program for effective supply chain communication between first tier suppliers and second tier suppliers. This reflects electronics industry features and various other transaction facilities with unique properties of SCM. In 2010 the basic version of program was tested and the industry is planning to expand its services with all the suppliers at first and second tier. This is an ERP system, through which supplier companies will be updated toward supply information and transactions. In this way of integration of supplier level, Industry D has come forward to solve the issues related to supplier's chain for smoother functioning and also for an enhancement of business performance.

It has found new ways to integrate more closely with the entire supply nodes. This industry will focus on recognizing the changing voice of customer till the delivery of the products by use of innovative channel partners in an effective manner.

On distribution part, Industry D does not ask retailer/distributors to pay in advance for products. This ensures that dealers will push brand in the market to generate the cash, which was not the case with other sector players. This action creates the trust between dealers and the industry. The stocks grow at faster rate in retail and trading business of electronics sector, especially where demand is unpredicted due to uncertainty.

Industry D philosophy is to keep minimum inventory as possible. It has joined hands with large retail channels such as Best Buy (BBY), Reliance digital, e-zone and Circuit Buy (CC) for distribution. This new strategy of Industry D will compensate the gap between old and new prices for their inventory in stores. It is prioritizing the inventory optimization and minimal possible inventory level. In this way the industry is practicing supply chain exploration and quality exploration. Figure 5 explains the strategic mix of electronics Industry D, with respect to such orientations.

These four configurations are applicable in different scenario, different industry profiles and domain in which they are operating in. To enhance business performance in competitive business environment different companies approach the problem differently. Organizations measure their performance considering either "year by year" or "quarter by quarter" through the customer satisfaction. Customer satisfaction also varies from segment to segment, product to product and service to service, as discussed above. Sometimes customer seeks product availability nearer. The nearness may be one of quality product criteria for that customer. Other segment may be high-technology oriented that they can wait for a product or can go to a selected dealer. Another case may be the customer segment which wants quality product and also availability of the product as early as possible after launch of product in the market.

6. Results and discussion

This paper explains the combination of TQM and SCM with the two orientations as shown in Figure 6, which will help to view the concept more clearly.

Here Q1, Q2, Q3 and Q4 are the four quadrants in which the exploitation and exploration point of reference is considered with the quality and supply chain aspect. In quadrant 1 where exploration from quality perspective (design, variant, economic price) and exploitation from supply chain perspective are addressed in the fairness cream Industry B. Supply chain exploitation improves channel performance, downstream and upward supply by using existing resources. Main focus is on low-cost perspective and

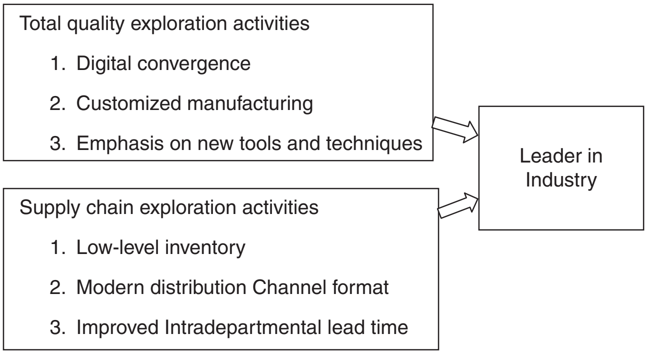
Total quality exploration activities
1. Digital convergence
2. Customized manufacturing
3. Emphasis on new tools and techniques
Supply chain exploration activities
1. Low-level inventory
2. Modern distribution Channel format
3. Improved Intradepartmental lead time
Leader in Industry

Figure 5. Total quality exploration and supply chain exploration practices for Industry D (television and cell phone)

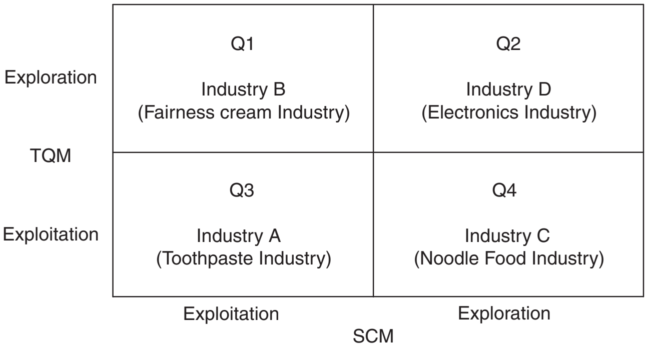
Q1
Industry B
(Fairness cream Industry)
Q2
Industry D
(Electronics Industry)
Q3
Industry A
(Toothpaste Industry)
Q4
Industry C
(Noodle Food Industry)
Exploration
TQM
Exploitation
Exploitation
Exploration
SCM

Figure 6. Combination of two orientations with TQM and SCM

quality practices are exercised with improvement in quality system and the industry fall in quadrant 3 such as toothpaste industry A. Noodle-food industry C (quadrant 4) is in the practice of TQM exploitation and exploration from supply chain perspective. The industry focusses on distribution channel where customer is concerned more about the availability of noodle food. Availability is important because it is preferred by children and food makers like working mothers. In quadrant 2, electronics industry falls which operates with environmental uncertainty. Their operations are more engineered by continuously changing technology in which customer seeks innovative product and new design as aspects of high quality. Industry also focusses on the most innovative channel for the availability of products. They use modern trade and large retail formats to serve the purpose which emerged in recent years.

The present paper has addressed both aspects, i.e., quantitative and qualitative. In quantitative aspects, the 20 variables have been extracted from literature and converged in four categories (Table V) through EFA. Bi-variate correlation matrix has been devised to understand the inter-correlation between 20-independent variables and correlation between dependent (business performance) and independent variables (Table VI). From Table VI, it is evident that the correlation between Bp (business performance) and VmiJit (vendor managed and just in time inventory) is 0.460, between Bp and Lcf (low-cost logistics/freight) is 0.549, and between Bp and Esp (economies of scale production) is 0.432 at 0.01 level, however other factors also have significant correlation at 0.01 and 0.05 level with business performance, but were eliminated in regression analysis as p-value is less than 0.05 (Table VIII). From Table VIII, it is evident that for VmiJit, Lcf and Esp are significantly correlated with business performance ($p < 0.05$) with intercept equivalent to −0.168. It is very important to check the multi-collinearity in the regression analysis to avoid any bias in results. VIF and tolerance are both widely used measures to check the multi-collinearity. With reference to collinearity statistics from Table VIII, the tolerance value should be more than 0.20 and VIF should be less than 5 (Menard, 1995). Table VIII finds these values within limits. Moreover R^2 represents the percentage of response variable variation that is explained by a linear model. R^2 value varies between 0 and 100 percent. From Table VII, the R^2 value is 71.4 percent, which means 71.4 percent variance in business performance is explained by the 20-independent variables mentioned in Table III.

From Equation (1) it is evident that, in any industry just in time and vendor managed inventory (VmiJit), economies of scale production (Esp) and low-cost distribution/freight (Lcf) are directly affecting business performance (Kaynak and Hartley, 2008).

The qualitative aspects include the case study approach concerning the categories of organizations, identified in Section 4. The organizations which fall in the category of practice of supply chain and total quality exploration (SERTER), do have support from other brands, supply at low cost, use of new tools and techniques, provision of the customized quality products, limited supply sources and improvement in interdepartmental lead time. The organizations with practice of SETTER (supply chain exploitation and total quality exploration), achieve more accurate forecasting, products with variety, low-cost logistics and economies of scale production. Supply chain exploration and total quality exploitation (SERTET)oriented organizations, are more focussed toward an improved quality management systems, just in time and vendor managed inventories, and products are having value proposition in terms of health and wellness view, and the manufacturer is able to adapt quickly to the changing demands. The last type of organizations falls under supply chain and total quality exploitation category (SETTET), which are more focussed on research and development in terms of new initiatives (Zhang *et al.*, 2011), continuous improvement of standard operating procedures, and total focus on supplier cost control.

7. Managerial implications

A business manager is usually concerned with the following questions:

1. How quality orientations and supply chain orientations can be aligned with business performance?
2. How to sense upcoming changes and act accordingly?
3. How to take considerable actions in response to dynamic market without affecting business performance?
4. When to release products on credit basis and when to give on debit basis?
5. What manager should have to do in response to their rivals?

This paper attempts to answer these questions with the help of case study evidence after appropriate categorization.

The potential benefits of integration of TQM and SCM for operational performance cannot be ignored. This potential will be realized only if practicing managers are able to have an optimized combination of TQM as well as SCM. The appropriate alignment between TQM and SCM is crucial for the success of an organization, whether it is in manufacturing industry or service. For practicing managers it is essential to know how the both orientations of TQM and SCM should be combined and up to what extent these should be mixed. This depends upon the type of supply chain partners, type of products, orientation of customers, geographic location, type of industry environment and other associated operational processes. Sometimes market may not have stable demand and at this time it is necessary to know how well these aspects of TQM and SCM should be carried on. The optimized forecasting with a combination of exploration and exploitation by keeping in view of customer demand might help in changing environment and it can be practiced by the concerned managers. The practitioners, who are associated with taking the decisions pertaining to SCM and TQM perspective, will have to take measures for firm performance without affecting business processes. They can take decisions on the basis of TQM and SCM orientations such as when to release the products on credit basis and when to float on debit basis. Further this is also helpful in choosing the channel that will be preferable for delivery to customer, depending on the nature of product. The managers should also monitor the rivals, which are operating in similar industry and can affect their business on different competitive and strategic parameters.

Today competition is not much between organizations, but between their supply chains (Li *et al.*, 2006). Logistics is one of the major activities in supply chains; therefore logistics partner selection is also one of the crucial decisions taken by managers. This will ensure the timely delivery of goods from factory to warehouse, and warehouse to market. The mode of transportation depends on the organizational structure. When it comes to purchasing, managers will play a crucial role in deciding about material requirements and how it should come from other companies and also negotiating on cost parameters. In an organization, whose supply chain is under exploratory orientation like an electronics industry, the goods may move from factory to consumer directly. To move goods these companies go for larger retail formats like Croma, Wall Mart, Big Bazaar, Reliance digital, NEXT and E-Zone . If organization is exploitative in nature then the goods may move from factory to warehouse, then warehouse to wholesaler, wholesaler to dealer, dealer to retailer and finally retailer to customer. In exploitative kind of organization the role of supplier can be only to produce the required components for enterprise. Managers should have to think about whether supplier should be involved in early stage of development or after a considerable development of a product.

8. Conclusion

The present paper concerns with the four different combinations related to supply chain and TQM. It addressed both quantitative and qualitative aspects. Rigorous statistical analysis has been performed after extracting 20 variables from the literature, converging to four categories through EFA. An effort is made to understand the inter-correlation between 20-independent variables and correlation between dependent (business performance) and independent variables. Additionally, we conclude the paper by discussing practical findings, limitations and scope for future work.

8.1 Findings

To maintain pace with growing competition and changing demands, different strategies can be adopted that differ from industry to industry, and product to product. In industry like electronics in which technology is changing at a faster rate, it is necessary to produce innovative products. Due to the changing preferences from time to time on features and applications of the electronic products, the industry needs to be responsive for their survival. In electronics industry one has to be continuously concerned about design, application and ease of use. One has to explore on quality and supply chain aspect as well in case of such industry. Innovation should be created within prescribed time to meet the ever changing needs of consumers.

In industries like toothpaste, the company tends to exploit on quality front and supply chain as well. This is due to the stability of the product and stable environment of the industry. For toothpaste industry there may not be significant difference between urban and rural population in terms of supply channel. The food industry is more prominent in urban areas. This is the reason they have to optimize their supply chains irrespective of improvement in products. Food industry is more conscious about the supply chain innovation, which will help to generate more revenue. As the product will be available in large volumes, it will generate more sales. For this reason food industry needs to be more supply chain oriented to generate more profit in the chain. The FMCG industry, where tastes and preferences are changing from time to time, the mix of orientations can be applied. Regardless of taste and preferences the ultimate aim of TQM and SCM is to achieve customer satisfaction in terms of product availability, delivery, innovation and quality dimensions.

The suggested configurations are also applicable in the case where market conditions differ from urban to rural market. Suppose in the rural market consumer is not much design oriented, such customer generally decides to purchase on the basis of price. In contrast urban market or urban customer might be more concerned about product features and an additional application/usage of product or service. So according to segment or scenario, configurations mix can be practiced/applied. With strategic practice of appropriate configuration, a hub enterprise in the chain can compete with its rivals. This paper explains the combination of four configurations based on the two orientations, i.e., exploration and exploitation. This paper explains the configuration on supply chain level rather than enterprise level individually.

8.2 Limitations

The study is not without limitations. This study has covered one respondent per plant in quantitative analysis. The single source of interview may have responded according to their inclination, perception/awareness and thought about TQM/SCM. This study was conducted in cross-sectional manner. The type of organizational structure, supply chain structure and organizational size were not considered in the present work particularly regarding their changes with respect to long time span. The culture, management values and an associated philosophy are not considered along with the combination of exploitation and exploration approach.

8.3 Scope for future research

For future research, one can include other dimensions of TQM and SCM like procurement/purchasing, outsourcing of activities, contract manufacturing and six sigma. The TQM can be further divided into two parts; hard TQM and soft TQM. Hard TQM includes product quality, technology management, research and development, quality data and reporting, and total productive maintenance. Soft TQM can include top management support, customer focus, workforce management, rewards and recognition and training and development. Also supply chain effort can be divided into two parts such as upstream supply chain practices and downstream supply chain practices for further analysis. The upstream and downstream supply chains can include warehousing, inventory control and supply chain push/pull. The mentioned aspects can be carried out through longitudinal study also.

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