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Interpretive structural modeling for integrating quality management in manufacturing and service counterparts

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Abstract

Purpose – The purpose of this paper is to identify and rank the contextual relationship among the quality management (QM) constructs for manufacturing and its related service organizations providing integrated value bundles, which has got limited research attention.

Design/methodology/approach – The QM constructs of manufacturing and services are selected by performing the citation analysis. Studies related to manufacturing and service are selected by reviewing their citations index in the three major research databases namely ProQuest, Scopus and Google Scholar. The subjective responses from both industry and academia are taken in order to gain better understanding of the contextual relationship among the QM constructs. Finally, an integrated model is proposed using Micmac analysis and Interpretive Structural Modeling (ISM).

Findings – The citation analysis lead to identification of 12 QM constructs: top management commitment, supplier relationship management, human resource management, strategic focus, customer focus, quality of information sharing, process management, servicescape, employee involvement, service quality, supply chain flexibility and customer satisfaction. The expert opinions of executives in the automotive industry and academia resulted in the development of contextual relationships among the identified QM constructs for the development of an ISM model, which is a major contribution of this study.

Originality/value – The unique focus of this study is on analyzing the contextual relationship among QM aspects in manufacturing and services as clubbed offering. The researchers in the existing literature have so far differentiated between manufacturing and services but this study integrates the QM constructs for manufacturing and its associated services through expert feedback and proposes an ISM model.

Keywords ISM, Quality management, Citation analysis, Supply chain performance, Automotive industry, Manufacturing and services

Paper type Research paper

1. Introduction

The modern day industry has evolved from the time of its relentless focus on manufacturing process alone to providing a manufacturing and associated service(s) of the highest degree as a bundled offering through its supply chain. Even the customers now a day demand integrated value bundles consisting of services and physical goods (Hamilton and Koukova, 2008) instead of buying standard physical goods alone (Becker *et al.*, 2010). As a result of this, it has become of paramount importance to view the manufacturing and service processes using an integrated approach. With an extended supply chain, it also becomes imperative for these organizations to ensure the superiority of the supply chain performance (SCP) levels. As more and more organizations are clubbing their offerings to provide an integrated value bundle that satisfies the needs of the customers, it has become a challenging task to distinguish services from

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products as illustrated by researchers in the past (Beaumont *et al.*, 1997; Fitzsimmions and Fitzsimmions, 2001; Brax, 2005; Cudney and Elrod, 2011).

Nowadays in an organization the manufacturing division produces the finished product, while its service counterpart provides the required resources for sales and after sales services. To assure their success, these types of organizations must try to view their extended supply chain containing both operational and service components from the lens of quality management (QM). For doing so, quality needs to be ensured for the whole clubbed offering (product and service) by combining it with the supply chain processes of the organization (both manufacturing and services). The researchers have articulated the fact that embedding quality practices in refining the firm's supply chain management (SCM) enables an organization to achieve superior SCP (Flynn *et al.*, 1995; Kuei and Madu, 2001; Flynn and Flynn, 2005; Kahnali and Taghavi, 2010; Kumar *et al.*, 2011). Thus, it becomes extremely important to identify the QM constructs for manufacturing and services offered together.

The process of identifying the primary constructs of QM with respect to SCP for a manufacturing organization is a very arduous task due to the complexity involved in the manufacturing system(s) (Beamon, 1999). It becomes even more complicated if we take into consideration the SCP of those manufacturing organizations that provide after sales service(s) as well. The review of literature suggests that limited studies have been undertaken that explicitly investigates the interaction among the QM constructs of manufacturing organizations providing after sales services for its finished products. Therefore, this study is an attempt to identify and rank the QM constructs that drive the SCP of a manufacturing organization providing associated services for its finished product. The Interpretive Structural Modeling (ISM) methodology is an approach by which the constructs are ranked and presented in a form of a model. Therefore, for this study ISM has been used to develop a structural model.

The reason for choosing automotive industry is twofold. First, various industry reports have suggested that the automotive industry has been focusing extensively on improving the quality issues in both manufacturing facilities as well as service networks (Becker and Nagporewalla, 2010; Gebauer *et al.*, 2010; Becker, 2015). In line with this, the current study aims to develops an ISM model for providing a clear directions to number of automotive organizations for improving the quality aspects with regards to manufacturing facilities and service networks taken together that can result in healthier financial bottom line for the firm. Second, it had also been reported that an emphasized focus on achieving a fine balance between product technology orientation and consumer centric service driven ideology is essential for attaining the sustainable advantageous competitive positioning (Becker, 2015). The proposed ISM model improves upon the quality aspects related to both manufacturing and its associated services, resulting in providing a platform for the management of the automotive organizations to improve their competitive positioning.

The presented study involves the review of relevant literature for investigating and selecting the QM constructs responsible for SCP of the organization, taking citation analysis into consideration. In the next section, the panel response of the experts from the automotive industry and the academia are analyzed for the formulation of the ISM model. This is followed by the MICMAC analysis and discussion on managerial implications. At last, the conclusion and future scope of the study are presented.

2. Literature review

The quality in the supply chain can be expressed as conformance to mutually agreed-upon requirements among the partner firms with the aim of improving the performance of transactions in the chain (Lai *et al.*, 2005). In fact, many studies on various industries like construction (Kanji and Wong, 1998; Wong and Fung, 1999; Benerji *et al.*, 2005), healthcare (Dean and Terziovski, 2001; Lagrosen and Lagrosen, 2007; Tutuncu and Kucukusta, 2008)

and wood (Espinoza *et al.*, 2010) have further reiterated the significance of embedding QM in refining the firm's SCM for achieving better SCP. The researchers have emphasized on comparing QM practices of manufacturing and service organizations for achieving enhanced SCP (Beaumont *et al.*, 1997; Woon, 2000; Sohal *et al.*, 2001; Prajogo, 2005; Sengupta *et al.*, 2006; Cudney and Elrod, 2011; Kumar *et al.*, 2011; Ooi, 2014), limiting the focus on the consideration of QM constructs for manufacturing organizations providing associated services. This subsequent review of literature focuses on identification of these QM constructs.

For manufacturing organizations, SCM is usually seen as a way to improve competitive performance by combining the internal functions of a company and linking them with external operations of suppliers, customers and other chain members (Tutuncu and Kucukusta, 2008). Considering this, a strategic focus is required to be developed so that competitive performance of the manufacturing organization can be improved (Gosain *et al.*, 2005; Sahay *et al.*, 2006; Melnyk *et al.*, 2009; Ou *et al.*, 2010). As a supply chain starts from suppliers providing high-quality raw material for manufacturing superior quality product and ends at the customer using that manufactured product (Romano, 2002; Lai *et al.*, 2005) thus, the commitment from top management is required toward developing strategies that must satisfy the ever demanding customer (Choi and Eboch, 1998; Forza and Flippini, 1998; Lau *et al.*, 2004). One of the strategic ways to ensure the management commitment is to focus on customer requirements in the organization's operational processes (Forza and Flippini, 1998; Nair, 2006). For doing so, commitment from the management is required for ensuring that the operational activities (internal and external) are optimized through sharing of desired quality information between the departments and supply chain partners (Samson and Terziovski, 1999; Wong, 2001; Prajogo and Sohal, 2003; Ou *et al.*, 2010). This will ensure in resolving the quality-related problems including design of processes, supplier selection and employee training (Flynn *et al.*, 1995; Ahire and Dreyfus, 2000; Tan, 2001).

Another important aspect related to QM is the rapid changes in technology. Therefore, it has become very important for the organizations to update their employee's skill level (Das *et al.*, 2000; Kaynak, 2003; Talib *et al.*, 2011a, b). Organizations while concentrating on continuous training of their employees must try their level best to enhance manufacturing capability in order to cope up with any quality changes in manufacturing the desired product (Rungtusanatham *et al.*, 1998; Sun, 2000; Zakuan *et al.*, 2010). The continual training will not only boost the employee's moral but will also make them self-motivated toward achieving the goals and objectives of the whole organization (Samson and Terziovski, 1999; Foster and Ogden, 2008; Melnyk *et al.*, 2009).

In the supply chain, choosing an appropriate supplier based on cost and quality is of paramount importance (Mandal and Deshmukh, 1994; Romano, 2002; Lee *et al.*, 2003; Mandave and Khodke, 2010). Once the suppliers are selected, top management must further develop these suppliers so that they can maximize the flexibility of supply chain systems (Flynn and Flynn, 2005; Gosain *et al.*, 2005; Melnyk *et al.*, 2009). This will enable the manufacturing organizations to enhance their SCP, leading toward improvement in customer satisfaction (Samson and Terziovski, 1999; Lai, 2003; Foster and Ogden, 2008; Ou *et al.*, 2010).

The above discussion clearly emphasizes that the top management commitment, customer focus, quality of information sharing, supplier relationship management, human resource management, strategic focus, process management, employee involvement, supply chain flexibility and customer satisfaction are considered to be vital QM constructs for manufacturing organizations. The description and supporting references for these QM constructs are summarized in Table I.

Most of the supply chain concepts primarily focus on two types of flows in the supply chain system – "material" and "information" (Li *et al.*, 2005; Lo *et al.*, 2007; Wu *et al.*, 2011). Looking at the importance of the flow of information, the organization's top management

QM constructs	Construct description	Supporting references
Quality of information sharing (QIS)	The level of information sharing between and within the departments for resolving quality related problems including design of processes, supplier selection and employee training	Choi and Eboch (1998), Samson and Terziovski (1999), Sun (2000), Ho *et al.* (2001), Kaynak (2003), Lai (2003), Prajogo and Sohal (2003), Lau *et al.* (2004), Gosain *et al.* (2005), Li *et al.* (2005), Nair (2006), Melnyk *et al.* (2009), Ou *et al.* (2010), Zakuan *et al.* (2010), Datta and Christopher (2011), Talib *et al.* (2011a, b)
Supplier relationship management (SRM)	Supplier selection based on cost and quality; Supplier development; length of the relationship	Flynn *et al.* (1995), Forza and Flippini (1998), Samson and Terziovski (1999), Sun (2000), Ho *et al.* (2001), Tan (2001), Kaynak (2003), Lai (2003), Flynn and Flynn (2005), Lai *et al.* (2005), Nair (2006), Foster and Ogden (2008), Hsu *et al.* (2009), Zakuan *et al.* (2010), Datta and Christopher (2011), Talib *et al.* (2011a, b)
Customer focus (CF)	Products are manufactured according to the customer requirement	Flynn *et al.* (1994, 1995), Forza and Flippini (1998), Samson and Terziovski (1999), Das *et al.* (2000), Sun (2000), Lai (2003), Prajogo and Sohal (2003), Lau *et al.* (2004), Lai *et al.* (2005), Li *et al.* (2005), Nair (2006), Foster and Ogden (2008), Ou *et al.* (2010), Zakuan *et al.* (2010), Talib *et al.* (2011a, b)
Top management commitment (TMC)	Commitment to ensure right choice of supplier and supplier development; Commitment to ensure flow and transparency of information within and between the manufacturing supply chain partners	Flynn *et al.* (1994, 1995), Samson and Terziovski (1999), Sun (2000), Kaynak (2003), Lai (2003), Prajogo and Sohal (2003), Lau *et al.* (2004), Flynn and Flynn (2005), Gosain *et al.* (2005), Lai *et al.* (2005), Li *et al.* (2005), Nair (2006), Foster and Ogden (2008), Hsu *et al.* (2009), Melnyk *et al.* (2009), Ou *et al.* (2010), Zakuan *et al.* (2010), Datta and Christopher (2011), Talib *et al.* (2011a, b)
Strategic focus (SF)	The strategy that ensures achieving goals and objectives of the manufacturing firm	Flynn *et al.* (1994), Choi and Eboch (1998), Forza and Flippini (1998), Samson and Terziovski (1999), Sun (2000), Kaynak (2003), Lai (2003), Prajogo and Sohal (2003), Lau *et al.* (2004), Li *et al.* (2005), Foster and Ogden (2008), Melnyk *et al.* (2009), Zakuan *et al.* (2010), Talib *et al.* (2011a, b)
Supply chain flexibility (SCF)	Partnering flexibility and Service flexibility	Flynn and Flynn (2005), Gosain *et al.* (2005), Melnyk *et al.* (2009), Talib *et al.* (2011a, b)
Human resource management (HRM)	Managing employee's s manufacturing capability, selection of employees for performing a manufacturing task, maintaining employee's professional relationships and providing training to update the employees with respect to manufacturing processes	Flynn *et al.* (1994, 1995), Choi and Eboch (1998), Forza and Flippini (1998), Samson and Terziovski (1999), Sun (2000), Tan (2001), Kaynak (2003), Lai (2003), Prajogo and Sohal (2003), Lau *et al.* (2004), Nair (2006), Foster and Ogden (2008), Ou *et al.* (2010), Zakuan *et al.* (2010), Talib *et al.* (2011a, b)
Process management (PM)	Managing the supply chain processes with respect to design of the product, quality of the product and performance of the product	Choi and Eboch (1998), Forza and Flippini (1998), Samson and Terziovski (1999), Sun (2000), Tan (2001), Kaynak (2003), Lai (2003), Prajogo and Sohal (2003), Flynn and Flynn (2005), Gosain *et al.* (2005), Nair (2006), Hsu *et al.* (2009), Melnyk *et al.* (2009), Ou *et al.* (2010), Talib *et al.* (2011a, b)
Employee involvement (EI)	Employees are self-motivated for achieving the goals and objectives of the firm	Samson and Terziovski (1999), Das *et al.* (2000), Sun (2000), Ho *et al.* (2001), Kaynak (2003), Lai (2003), Foster and Ogden (2008), Melnyk *et al.* (2009), Talib *et al.* (2011a, b)
Customer satisfaction (CS)	Satisfaction with respect to finished product performance	Choi and Eboch (1998), Forza and Flippini (1998), Samson and Terziovski (1999), Das *et al.* (2000), Sun (2000), Lai (2003), Foster and Ogden (2008), Ou *et al.* (2010), Zakuan *et al.* (2010), Talib *et al.* (2011a, b)

Table I.
Description of manufacturing QM constructs and supporting references

must be committed to share quality information with their suppliers for delivery of quality goods and services (Gupta *et al.*, 2005). As the services are intangible in nature and customers can only experience and feel them after a service encounter (Sureshchandar *et al.*, 2001; Qin *et al.*, 2009), organizations must have a strategic focus toward designing their service encounter keeping in mind the customer's quality expectations (Brax, 2005; Seth *et al.*, 2005). For achieving excellence in customer satisfaction, the outlets of the service organizations must have an excellent servicescape for superior service encounter (Keillor *et al.*, 2004; Lagrosen and Lagrosen, 2007; Hume, 2008). This requires organizational strategic focus toward its design and development for delivering the quality service (Edvardsson, 1998; Keillor *et al.*, 2004).

In services, the role of employees also becomes very critical as they are responsible for delivering the quality services to the customers (Hartline and Ferrell, 1996; Little and Dean, 2006). Therefore, it is required by the organizations to select employees based on their skill level to deliver requisite service (Hartline and Ferrell, 1996; Little and Dean, 2006). After the selection of employees based on their service capability, the organization must emphasize on continuous training of employees to enhance their service skills for the delivery of quality service (Farner *et al.*, 2001; Brown *et al.*, 2002).

Many researchers have suggested the direct impact of service quality on customer satisfaction (Cronin Jr. and Taylor, 1992; Hartline and Ferrell, 1996; Gustafsson *et al.*, 2003). This calls for the service organizations to necessarily have an emphasized focus toward improvement in the service quality (Brady *et al.*, 2002; Bourdeau *et al.*, 2007). The improvement in the service quality will dramatically increase the coordination between the supply chain partners and also results in achieving enhanced customer satisfaction, which can be noticed with the re-use intention of customers (Brady *et al.*, 2002; Keillor *et al.*, 2004; Gupta *et al.*, 2005; Hume, 2008).

Thus, from the service organizations' view, top management commitment, customer focus, quality of information sharing, supplier relationship management, human resource management, strategic focus, servicescape and service quality and customer satisfaction are recognized as important QM constructs. The description and supporting references for the QM constructs of service organization are presented in Table IV.

However, from the perspective of service-dominant logic (Vargo and Lusch, 2008), customers nowadays instead of buying stand-alone standard physical goods (Becker *et al.*, 2010) demand integrated value bundles consisting of physical goods and services (Hamilton and Koukova, 2008). It is a well-noticed fact that various researchers have focused on the issues of manufacturing and service organizations by comparing on their quality practices (Beaumont *et al.*, 1997; Prajogo, 2005; Kumar *et al.*, 2011; Sengupta *et al.*, 2006; Talib *et al.*, 2011a, b; Ooi, 2014), information technology practices (Sohal *et al.*, 2001), leadership practices (Woon, 2000; Vinkhuyzen and Karlsson-Vinkhuyzen, 2014), profit margins (Goddard and Wilson, 1996) and lean practices (Bowen and Youngdahl, 1998; Cudney and Elrod, 2011).

In the above discussed studies, none of the mentioned studies have concentrated on the relationships of vital QM constructs related to manufacturing and service taken together. Only a few exceptions are there wherein researchers have focused on elaborating how total quality management (TQM) practices help in attaining and maintaining quality in the Indian manufacturing and service sectors (Kumar *et al.*, 2011). Also, the extant literature does not analyze the contextual relationships among QM constructs for the organizations manufacturing the product as well as providing its associated services through its supply chain. This study aims to identify as well as rank the QM constructs of the manufacturing organizations providing associated services.

In the context of this research, the constructs derived from the literature are analyzed for their relevance and impact. In order to arrive at the constructs having a critical impact, citation analysis has been performed on the literature indexed in three major databases

namely – ProQuest, Scopus and Google Scholar. The research studies yielding higher citations in the manufacturing and service domain are being considered for the analysis. The criterion of minimal ten citations per database has been used for the selection of studies under the citation analysis (Tables II and V). This helps in ensuring that the research studies so selected are considered vital by the researchers and the number of important constructs extracted using this method are limited to build a significant interpretive model (Warfield, 1974; Thakkar *et al.*, 2005, 2008; Gupta *et al.*, 2013). The reason for not considering the other studies is either due to fewer citations than the selection criterion or due to the fact that they were not cited in one of the above mentioned databases chosen for analysis. After constructing a panel of such studies, a frequency analysis of constructs that are cited in these selected research studies was carried out in order to reflect their relative importance (Tables III and VI). A total of 12 QM constructs (top management commitment, strategic focus, customer focus, supplier relationship management, servicescape, quality of information sharing, process management, human resource management, employee involvement, service quality, supply chain flexibility and customer satisfaction) emphasized in these studies were identified and considered for further analysis (Tables III and VI). In the context of this research, the expert opinion also suggests that SCP must be considered along with QM constructs. The next section establishes the pair-wise relationship between these constructs by using the ISM approach based on the expert opinions of executives of the automotive industry and academia.

3. ISM methodology and development of a model

ISM is a widely used qualitative tool in supply chain and QM research works in various types of industry settings (Talib *et al.*, 2011a, b). For example, researchers have applied ISM in analyzing vender selection criterion (Mandal and Deshmukh, 1994), selection of third-party

Author (year)	Research citations ProQuest	Scopus	Google Scholar	Overall citations in the three databases (May 13, 2016)
Flynn *et al.* (1994)	349	901	1,818	3,068
Flynn *et al.* (1995)	229	453	1,137	1,819
Choi and Eboch (1998)	94	261	513	868
Forza and Flippini (1998)	63	173	357	593
Samson and Terziovski (1999)	248	623	1,314	2,185
Das *et al.* (2000)	60	146	291	497
Sun (2000)	13	42	71	126
Ho *et al.* (2001)	43	82	151	276
Tan (2001)	30	70	117	217
Kaynak (2003)	247	537	1,229	2,013
Lai (2003)	23	43	94	160
Prajogo and Sohal (2003)	70	168	361	599
Lau *et al.* (2004)	31	53	90	174
Flynn and Flynn (2005)	38	100	179	317
Gosain *et al.* (2005)	76	217	341	634
Lai *et al.* (2005)	47	58	105	210
Li *et al.* (2005)	133	270	616	1,019
Nair (2006)	95	191	356	642
Foster and Ogden (2008)	13	27	45	85
Hsu *et al.* (2009)	23	41	92	156
Melnyk *et al.* (2009)	18	37	95	150
Ou *et al.* (2010)	30	43	117	190
Zakuan *et al.* (2010)	20	38	75	133
Datta and Christopher (2011)	13	46	86	145
Talib *et al.* (2011a, b)	47	36	75	158

Table II. Research citations of manufacturing QM constructs as on May 13, 2016

(Study) (ProQuest) (Scopus) (Google Scholar)	QM constructs QIS	SRM	CF	TMC	SF	HRM	PM	EI	SCF	CS
Flynn *et al.* (1994) (349) (901) (1,818)			✓	✓	✓	✓				
Flynn *et al.* (1995) (229) (453) (1,137)		✓	✓	✓		✓				
Choi and Eboch (1998) (94) (261) (513)	✓				✓	✓	✓			✓
Forza and Flippini (1998) (63) (173) (357)		✓	✓		✓	✓	✓			✓
Samson and Terziovski (1999) (248) (623) (1,314)	✓	✓	✓	✓	✓	✓	✓	✓		✓
Das *et al.* (2000) (60) (146) (291)			✓					✓		✓
Sun (2000) (13) (42) (71)	✓	✓	✓	✓	✓	✓	✓	✓		✓
Ho *et al.* (2001) (43) (82) (151)	✓	✓						✓		
Tan (2001) (30) (70) (117)		✓				✓	✓			
Kaynak (2003) (247) (537) (1,229)	✓	✓		✓	✓	✓	✓	✓		
Lai (2003) (23) (43) (94)	✓	✓	✓	✓	✓	✓	✓	✓		✓
Prajogo and Sohal (2003) (70) (168) (361)	✓		✓	✓	✓	✓	✓			
Lau *et al.* (2004) (31) (53) (90)	✓		✓	✓	✓	✓				
Flynn and Flynn (2005) (38) (100) (179)		✓		✓			✓		✓	
Gosain *et al.* (2005) (76) (217) (341)	✓		✓	✓			✓		✓	
Lai *et al.* (2005) (47) (58) (105)		✓	✓	✓						
Li *et al.* (2005) (133) (270) (616)	✓		✓	✓	✓					
Nair (2006) (95) (191) (356)	✓	✓	✓	✓		✓	✓			
Foster and Ogden (2008) (13) (27) (45)		✓	✓	✓	✓	✓		✓		✓
Hsu *et al.* (2009) (23) (41) (92)		✓		✓			✓			
Melnyk *et al.* (2009) (18) (37) (95)	✓			✓	✓		✓	✓	✓	
Ou *et al.* (2010) (30) (43) (117)	✓		✓	✓		✓	✓			✓
Zakuan *et al.* (2010) (20) (38) (75)	✓	✓	✓	✓	✓	✓				✓
Datta and Christopher (2011) (13) (46) (86)	✓	✓		✓						
Talib *et al.* (2011a, b) (47) (36)(75)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Frequency of occurrence of QM constructs	16	16	16	20	14	16	15	9	4	9

Notes: ()()() denotes "the study" and number of citations indexed in "Proquest," "Scopus" and "Google Scholar" respectively as on May 13, 2016. (✓) indicates the constructs considered in the respective study

Table III. Important QM constructs with respect to manufacturing

logistics (Thakkar *et al.*, 2005), supply chain risk mitigation (Faisal *et al.*, 2006), development of balanced scorecard (Thakkar, *et al.* 2007), implementation of TQM barriers (Talib *et al.*, 2011a, b), assessment of the lean performance of radial tyre manufacturing (Gupta *et al.*, 2013) and recently for critical success factors in online retail (Sahney, 2015).

The procedure of ISM is well documented and elaborated by various researchers (Warfield, 1974; Mandal and Deshmukh, 1994; Thakkar *et al.*, 2005, 2007, 2008; Talib *et al.*, 2011a, b; Gupta *et al.*, 2013; Sahney, 2015). The researchers have ensured the validity of contextual relationship through ISM model by seeking experts' opinion from across industrial sectors and academia with a different number of expert respondents in the group (Talib *et al.*, 2011a, b; Gupta *et al.*, 2013). Similarly, for the purpose of this study, we have formulated a panel comprising 20 industry experts and researchers with a comprehensive experience in the manufacturing industry and its related service domains (Table VII). The panel was chosen based on the snowball sampling technique that suggests choosing the future respondents based on the reference of current respondents. In this study, all the experts were invited on a common virtual platform to discuss and reach at a consensus on the contextual relationship among the QM constructs. Accordingly, their collective response was interpreted as a single response until all the members of the panel agree on the contextual relationships among selected vital QM constructs (Table IX) for the formulation of the ISM model. The various steps involved in the formulation of the ISM model for this study are as follows:

- Step 1: a total of 12 QM constructs were identified from the literature using a citation analysis (Tables I-VI).

QM constructs	Construct description	Supporting references
Quality of information sharing (QIS)	Level of information sharing between and within the departments for improving the quality related problems covering customer's service delivery processes and employee's training	Sureshchandar *et al.* (2001), Gupta *et al.* (2005), Little and Dean (2006)
Supplier relationship management (SRM)	Supplier selection based on service delivery; Supplier development with respect to improving services	Keillor *et al.* (2004), Brax (2005), Hume (2008)
Customer satisfaction (CS)	Behavioral and reuse intention of customers	Cronin Jr and Taylor (1992), Hartline and Ferrell (1996), Gummesson (1998), Edvardsson (1998), Brown *et al.* (2002), Brady *et al.* (2002), Keillor *et al.* (2004), Seth *et al.* (2005), Brax (2005), Gupta *et al.* (2005), Little and Dean (2006), Bourdeau *et al.* (2007), Hume (2008), Qin *et al.* (2009)
Top management commitment (TMC)	Commitment to ensure right choice of supplier and supplier development with respect to services; Commitment to ensure flow and transparency of service information between and within the supply chain partners	Gummesson (1998), Edvardsson (1998), Hartline and Ferrell (1996), Sureshchandar *et al.* (2001), Farner *et al.* (2001), Keillor *et al.* (2004), Gupta *et al.* (2005), Little and Dean (2006), Hume (2008), Qin *et al.* (2009)
Servicescape (SS)	The environment in which the services are being delivered	Gummesson (1998), Edvardsson (1998), Sureshchandar *et al.* (2001), Keillor *et al.* (2004), Seth *et al.* (2005), Gupta *et al.* (2005), Little and Dean (2006), Hume (2008), Qin *et al.* (2009)
Service quality (SQ)	Customers overall impression regarding organizations and its service	Cronin Jr and Taylor (1992), Hartline and Ferrell (1996), Gummesson (1998), Edvardsson (1998), Cronin Jr *et al.* (2000), Sureshchandar *et al.* (2001), Farner *et al.* (2001), Brady *et al.* (2002), Gustafsson *et al.* (2003), Keillor *et al.* (2004), Seth *et al.* (2005), Brax (2005), Gupta *et al.* (2005), Little and Dean (2006), Bourdeau *et al.* (2007), Hume (2008), Qin *et al.* (2009)
Customer focus (CF)	Orientation toward customer's service quality requirements	Hartline and Ferrell (1996), Gummesson (1998), Edvardsson (1998), Sureshchandar *et al.* (2001), Farner *et al.* (2001), Brown *et al.* (2002), Gustafsson *et al.* (2003), Keillor *et al.* (2004), Gupta *et al.* (2005), Bourdeau *et al.* (2007), Hume (2008), Qin *et al.* (2009)
Human resource management (HRM)	Managing employee's service capability, selection of employees for performing a service task and providing training toward service skills	Hartline and Ferrell (1996), Sureshchandar *et al.* (2001), Farner *et al.* (2001), Brown *et al.* (2002), Gustafsson *et al.* (2003), Little and Dean (2006)
Strategic focus (SF)	Focus toward improving services for achieving goals and objectives of the firm	Sureshchandar *et al.* (2001), Seth *et al.* (2005), Brax (2005), Little and Dean (2006)

Table IV.
Description of service QM constructs and supporting references

- Step 2: the constructs related to QM and SCP are arranged in rows and columns of the matrix. The matrix is developed by relating each of the constructs related to QM and SCP with each other, one by one and pairwise for establishing the contextual relationship in terms of *V*, *A*, *X*, *O*.

Author (year)	Research citations ProQuest	Scopus	Google Scholar	Overall citations in the three databases (May 13, 2016)
Cronin Jr. and Taylor (1992)	1,941	2,543	11,696	16,180
Hartline and Ferrell (1996)	580	708	1,896	3,184
Edvardsson (1998)	17	18	127	162
Gummesson (1998)	36	52	335	423
Cronin Jr. *et al.* (2000)	1,147	1,661	5,004	7,812
Farner *et al.* (2001)	13	13	62	88
Sureshchandar *et al.* (2001)	55	65	182	302
Brady *et al.* (2002)	196	313	889	1,398
Brown *et al.* (2002)	287	323	847	1,457
Gustafsson *et al.* (2003)	18	32	111	161
Keillor *et al.* (2004)	41	42	120	203
Brax (2005)	50	158	399	607
Gupta *et al.* (2005)	27	36	114	177
Seth *et al.* (2005)	114	195	708	1,017
Little and Dean (2006)	32	30	120	182
Bourdeau *et al.* (2007)	14	17	33	64
Hume (2008)	18	36	69	123
Qin *et al.* (2009)	17	13	24	54

Table V.
Research citations of service QM constructs as on May 13, 2016

(Study) (Proquest) (Scopus) (Google Scholar)	QM constructs QIS	SRM	CS	TMC	SS	SQ	CF	HRM	SF
Cronin Jr. and Taylor (1992) (1,941) (2,543) (11,696)			✓			✓			
Hartline and Ferrell (1996) (580) (708) (1,896)			✓	✓		✓	✓	✓	
Edvardsson (1998) (17) (18) (127)			✓	✓	✓	✓	✓		
Gummesson (1998) (36) (52) (335)			✓	✓	✓	✓	✓		
Cronin Jr. *et al.* (2000) (1,147) (1,661) (5,004)			✓			✓			
Farner *et al.* (2001) (13) (13) (62)				✓		✓	✓	✓	
Sureshchandar *et al.* (2001) (55) (65) (182)	✓			✓	✓	✓	✓	✓	✓
Brady *et al.* (2002) (196) (313) (889)			✓			✓			
Brown *et al.* (2002) (287) (323) (847)			✓				✓	✓	
Gustafsson *et al.* (2003) (18) (32) (111)						✓	✓	✓	
Keillor *et al.* (2004) (41) (42) (120)		✓	✓	✓	✓	✓	✓		
Brax (2005) (50) (158) (399)		✓	✓			✓	✓		✓
Gupta *et al.* (2005) (27) (36) (114)	✓		✓	✓	✓	✓	✓		
Seth *et al.* (2005) (114) (195) (708)					✓	✓			✓
Little and Dean (2006) (32) (30) (120)	✓		✓	✓	✓	✓		✓	✓
Bourdeau *et al.* (2007) (14) (17) (33)			✓			✓	✓		
Hume (2008) (18) (36) (69)		✓	✓	✓	✓	✓	✓		
Qin *et al.* (2009) (17) (13) (24)			✓	✓	✓	✓	✓		
Frequency of occurrence of QM constructs	3	3	14	10	9	17	13	6	4

Table VI.
Important QM constructs with respect to services

Notes: ()()() denotes "the study" and number of citations indexed in "Proquest," "Scopus" and "Google Scholar" respectively as on May 13, 2016. (✓) indicates the constructs considered in the respective study

- Step 3: the pair-wise relationships in step 2 leads to the development of a structural self-interaction matrix (SSIM) which is presented in Table VII.
- Step 4: SSIM guides development of reachability matrix by converting each cell obtained form step 3 into binary numbers "0" and "1" resulting into formulation of initial reachability matrix (Table X).

Work experience	No. of respondents (experience in the present organization)	No. of respondents (overall experience in automotive sector)
20 years and above	3	3
15-20 years	4	4
10-15 years	5	6
5-10 years	6	7
Under 5 years	2	0
Domain/Department	No. of respondents	
Automotive manufacturing experts		
VP operations	3	
Quality managers	6	
Supply Chain Managers	2	
Automotive service experts		
Director services	3	
Managerial director services	1	
Vehicle inspection in charge	2	
Academia	3	

Table VII.
Respondents demography

- Step 5: the initial reachability matrix is now checked for transitivity of the contextual relation. It assumes that if the QM construct *i* is related to *j* and *j* is related to *k*, then *i* is related to *k*. Thus, leading to a final reachability matrix (Table XI)
- Step 6: the final reachability matrix obtained is further partitioned into different levels on the basis of reachability and antecedents sets for each of the QM constructs and SCP through a series of iterations (Tables XII-XIX).
- Step 7: using level partitions (Step 6) and final reachability matrix (Step 5), a conical matrix is constructed. A directed graph or digraph is drawn and the transitive links are removed.
- Step 8: the conical matrix is converted into an ISM model (Figure 1).
- Step 9: finally, the ISM model (step 8) is reviewed to check for two conditions, one being conceptual inconsistency and second being incorporating necessary modifications through expert opinions.

3.1 SSIM

The literature review, citation analysis and experts opinion lead to the identification of constructs related to QM and SCP (Table VIII). A contextual relationship of "lead to" type, meaning one construct leads to another construct, is ascertained. The profile of the panel of experts for this study is presented in Table IX. As suggested in the ISM methodology (Warfield, 1974; Mandal and Deshmukh, 1994; Thakkar *et al.*, 2005, 2007, 2008; Talib *et al.*, 2011a, b; Gupta *et al.*, 2013; Sahney, 2015), the following four symbols have been used to denote the direction of the relationship between constructs (*i* and *j*):

(1) $V=$ is used for the relationship from construct *i* to construct *j* (i.e. construct *i* will help achieve construct *j*).

(2) $A=$ is used for the relationship from construct *j* to construct *i* (i.e. construct *j* will help achieve construct *i*).

(3) $X=$ is used for both direction relations (i.e. construct *i* and *j* help achieve each other).

(4) $O=$ is used for no relation between two constructs (i.e. construct *i* and *j* are not related).

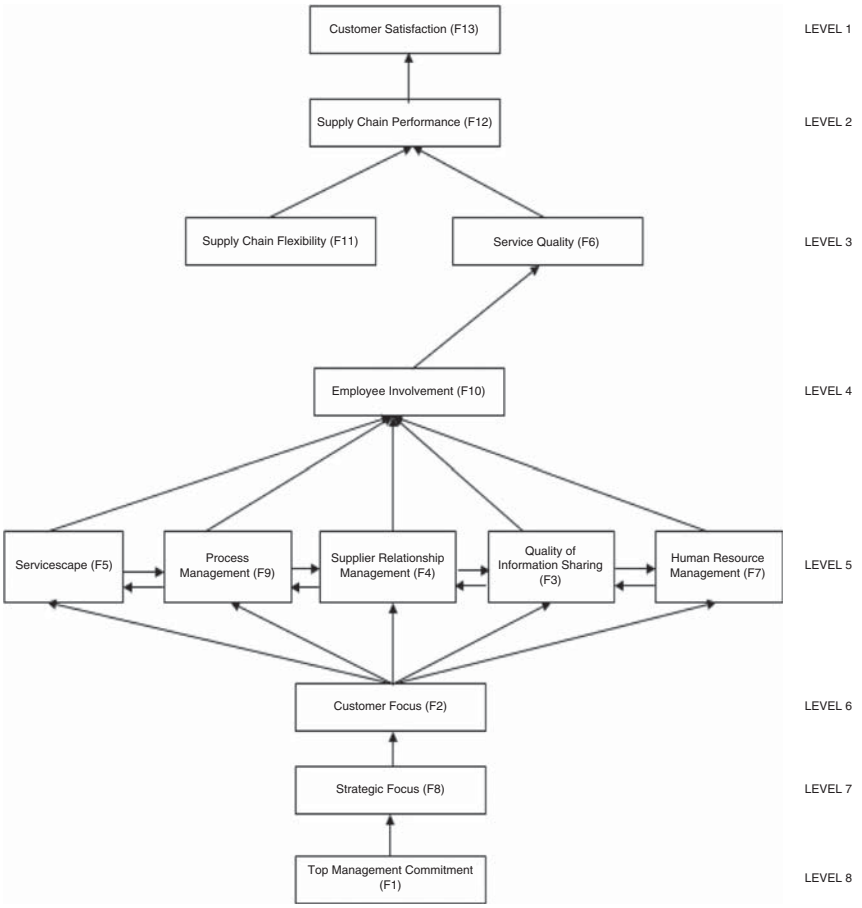

Figure 1.
ISM-based model for automotive organizations providing after sales services

Construct number	Construct description	Construct notation
1	Top management commitment (TMC)	F1
2	Customer focus (CF)	F2
3	Quality of information sharing (QIS)	F3
4	Supplier relationship management (SRM)	F4
5	Servicescape (SS)	F5
6	Service quality (SQ)	F6
7	Human resource management (HRM)	F7
8	Strategic focus (SF)	F8
9	Process management (PM)	F9
10	Employee involvement (EI)	F10
11	Supply chain flexibility (SCF)	F11
12	Supply chain performance (SCP)	F12
13	Customer satisfaction (CF)	F13

Table VIII.
Construct abbreviation

Construct	CS (F13)	SCP (F12)	SCF (F11)	EI (F10)	PM (F9)	SF (F8)	HRM (F7)	SQ (F6)	SS (F5)	SRM (F4)	QIS (F3)	CF (F2)
TMC (F1)	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*
CF (F2)	*V*	*V*	*V*	*V*	*V*	*A*	*V*	*V*	*V*	*V*	*V*	
QIS (F3)	*V*	*V*	*O*	*O*	*A*	*A*	*V*	*V*	*V*	*V*		
SRM (F4)	*V*	*V*	*V*	*O*	*V*	*A*	*O*	*O*	*O*			
SS (F5)	*V*	*V*	*O*	*O*	*V*	*A*	*O*	*V*				
SQ (F6)	*V*	*V*	*O*	*A*	*A*	*A*	*A*					
HRM (F7)	*V*	*V*	*O*	*V*	*V*	*A*						
SF (F8)	*V*	*V*	*V*	*O*	*V*							
PM (F9)	*V*	*V*	*V*	*V*								
EI (F10)	*V*	*V*	*O*									
SCF (F11)	*V*	*V*										
SCP (F12)	*V*											

Table IX.
Structural self-interaction matrix (SSIM)

Based on the above relationships, the SSIM has been developed in discussion with the experts (Table IX). The following statements will illustrate the use of the symbols in Table IX:

(1) Symbol *V* is assigned to cell (1, 1) as construct F1, that is, top management commitment leads to construct F13 that is customer satisfaction.

(2) Symbol *A* is assigned to cell (4, 6) since construct F8 that is strategic focus would help in achieving construct F4 that is supplier relationship management.

(3) Symbol *X* is not assigned to any of the cells, this is due to the fact that the experts think that no construct help achieve each other.

(4) Symbol *O* is assigned to cell (5, 7) because construct F5 that is servicescape and F7 that is human resource management are not related.

3.2 Reachability matrix (initial and final)

For the development of the reachability matrix, two sub-steps are followed.

Step a: the SSIM table is converted into the initial reachability matrix by transforming information into binary digits "0" and "1" as represented in Table X using the following rules:

- The cell (i, j) assigned with symbol *V* will lead to entry "1" in cell (i, j) and entry "0" in cell (j, i).
- The cell (i, j) assigned with symbol *A* will lead to entry "0" in cell (i, j) and entry "1" in cell (j, i).

Construct	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13
F1	1	1	1	1	1	1	1	1	1	1	1	1	1
F2	0	1	1	1	1	1	1	0	1	1	1	1	1
F3	0	0	1	1	1	1	1	0	0	0	0	1	1
F4	0	0	0	1	0	0	0	0	1	0	1	1	1
F5	0	0	0	0	1	1	0	0	1	0	0	1	1
F6	0	0	0	0	0	1	0	0	0	0	0	1	1
F7	0	0	0	0	0	1	1	0	1	1	0	1	1
F8	0	1	1	1	1	1	1	1	1	0	1	1	1
F9	0	0	1	0	0	1	0	0	1	1	1	1	1
F10	0	0	0	0	0	1	0	0	0	1	0	1	1
F11	0	0	0	0	0	0	0	0	0	0	1	1	1
F12	0	0	0	0	0	0	0	0	0	0	0	1	1
F13	0	0	0	0	0	0	0	0	0	0	0	0	1

Table X.
Initial reachability matrix

- The cell (i, j) assigned with symbol X will lead to entry "1" in cell (i, j) and entry "1" in cell (j, i).
- The cell (i, j) assigned with symbol O will lead to entry "0" in cell (i, j) and entry "0" in cell (j, i).

Step b: in the second sub-step, the final reachability matrix is obtained by incorporating the transitivity concept as per the explanation provided in step 5 of the ISM methodology. The initial reachability matrix is than converted into final reachability matrix and the transitivity is marked as 1* (Table XI).

3.3 Level partitions

The reachability matrix helps in finding out the reachability and antecedent set for each construct (Warfield, 1974). The reachability set for a given QM construct consists of the construct itself and the constructs which it may help to achieve. It could be noticed that construct F3, when read row wise (Table XI), achieves F3, F4, F5, F6, F7, F9, F10, F11, F12 and F13, as represented under reachability set for F3 in Table XII. Whereas, the antecedent set includes the QM construct consists itself and the constructs which may help achieving it. For example, construct F3, when read column wise (Table XI), includes F1, F2, F3, F4, F5, F7, F8 and F9, as represented in the antecedent set for F3 in Table XII. The intersection set consists of common constructs in the reachability and antecedent set. The construct for which the reachability and intersection set are same is assigned at the top level in the ISM hierarchy and would not help in achieving other constructs. It can be noticed from Table XII that customer satisfaction is considered as the top level QM construct and will be positioned at the top of the ISM model and will be removed for further iterations. In the ISM modeling for this study, seven iterations were performed to determine the various partition levels (Tables XII-XIX).

3.4 Conical matrix

All the constructs of QM and SCP are rearranged as per their level partitions and are represented in the conical matrix in Table XX. The constructs relationships are taken from the conical matrix and are graphically presented in the developed ISM Model.

Construct	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	Driving power	Rank
F1	1	1	1	1	1	1	1	1	1	1	1	1	1	13	I
F2	0	1	1	1	1	1	1	0	1	1	1	1	1	11	III
F3	0	0	1	1	1	1	1	0	1*	1*	1*	1	1	10	IV
F4	0	0	1*	1	0	1*	0	0	1	1*	1	1	1	8	V
F5	0	0	1*	0	1	1	0	0	1	1*	1*	1	1	8	V
F6	0	0	0	0	0	1	0	0	0	0	0	1	1	3	VII
F7	0	0	1*	0	0	1	1	0	1	1	1*	1	1	8	V
F8	0	1	1	1	1	1	1	1	1	1*	1	1	1	12	II
F9	0	0	1	1*	1*	1	1*	0	1	1	1	1	1	10	IV
F10	0	0	0	0	0	1	0	0	0	1	0	1	1	4	VI
F11	0	0	0	0	0	0	0	0	0	0	1	1	1	3	VII
F12	0	0	0	0	0	0	0	0	0	0	0	1	1	2	VIII
F13	0	0	0	0	0	0	0	0	0	0	0	0	1	1	IX
Dependence	1	3	8	6	6	10	6	2	8	9	9	12	13		
Rank	IX	VII	V	VI	VI	III	VI	VIII	V	IV	IV	II	I		

Note: 1*entries are included to incorporate transitivity

Table XI.
Final reachability matrix

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13	F1	F1	
F2	F2, F3, F4, F5, F6, F7, F9, F10, F11, F12, F13	F1, F2, F8	F2	
F3	F3, F4, F5, F6, F7, F9, F10, F11, F12, F13	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5, F7, F9	
F4	F3, F4, F6, F9, F10, F11, F12, F13	F1, F2, F3, F4, F8, F9	F3, F4, F9	
F5	F3, F5, F6, F9, F10, F11, F12, F13	F1, F2, F3, F5, F8, F9	F3, F5, F9	
F6	F6, F12, F13	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10,	F6	
F7	F3, F6, F7, F9, F10, F11, F12, F13	F1, F2, F3, F7, F8, F9	F3, F7, F9	
F8	F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13	F1, F8	F8	
F9	F3, F4, F5, F6, F7, F9, F10, F11, F12, F13	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5,F7, F9	
F10	F6, F10, F12, F13	F1, F2, F3, F4, F5, F7, F8, F9, F10,	F10	
F11	F11, F12, F13	F1, F2, F3, F4, F5, F7, F8, F9, F11	F11	
F12	F12, F13	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12	F12	
F13	F13	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12, F13	F13	I

Table XII. Construct level interaction I

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12	F1	F1	
F2	F2, F3, F4, F5, F6, F7, F9, F10, F11, F12	F1, F2, F8	F2	
F3	F3, F4, F5, F6, F7, F9, F10, F11, F12	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5, F7, F9	
F4	F3, F4, F6, F9, F10, F11, F12	F1, F2, F3, F4, F8, F9	F3, F4, F9	
F5	F3, F5, F6, F9, F10, F11, F12	F1, F2, F3, F5, F8, F9	F3, F5, F9	
F6	F6, F12	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10,	F6	
F7	F3, F6, F7, F9, F10, F11, F12	F1, F2, F3, F7, F8, F9	F3, F7, F9	
F8	F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12	F1, F8	F8	
F9	F3, F4, F5, F6, F7, F9, F10, F11, F12	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5,F7, F9	
F10	F6, F10, F12	F1, F2, F3, F4, F5, F7, F8, F9, F10,	F10	
F11	F11, F12	F1, F2, F3, F4, F5, F7, F8, F9, F11	F11	
F12	F12	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11, F12	F12	II

Table XIII. Construct level interaction II

3.5 Development and significance of ISM model for QM and SCP

In the development of the ISM model, the highest level QM constructs are positioned at the top followed by the second level and so on until the lowest level QM constructs are placed at the bottom level (Figure 1). The ISM model based on this study emphasizes that the customer satisfaction is the top level QM construct in automotive SCP (positioned at the top

Table XIV.
Construct level interaction III

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11	F1	F1	
F2	F2, F3, F4, F5, F6, F7, F9, F10, F11	F1, F2, F8	F2	
F3	F3, F4, F5, F6, F7, F9, F10, F11	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5, F7, F9	
F4	F3, F4, F6, F9, F10, F11	F1, F2, F3, F4, F8, F9	F3, F4, F9	
F5	F3, F5, F6, F9, F10, F11	F1, F2, F3, F5, F8, F9	F3, F5, F9	
F6	F6	F1, F2, F3, F4, F5, F6, F7, F8, F9, F10,	F6	III
F7	F3, F6, F7, F9, F10, F11	F1, F2, F3, F7, F8, F9	F3, F7, F9	
F8	F2, F3, F4, F5, F6, F7, F8, F9, F10, F11	F1, F8	F8	
F9	F3, F4, F5, F6, F7, F9, F10, F11	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5,F7, F9	
F10	F6, F10	F1, F2, F3, F4, F5, F7, F8, F9, F10,	F10	
F11	F11	F1, F2, F3, F4, F5, F7, F8, F9, F11	F11	III

Table XV.
Construct level interaction IV

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F3, F4, F5, F7, F8, F9, F10	F1	F1	
F2	F2, F3, F4, F5, F7, F9, F10	F1, F2, F8	F2	
F3	F3, F4, F5, F7, F9, F10	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5, F7, F9	
F4	F3, F4, F9, F10	F1, F2, F3, F4, F8, F9	F3, F4, F9	
F5	F3, F5, F9, F10	F1, F2, F3, F5, F8, F9	F3, F5, F9	
F7	F3, F7, F9, F10	F1, F2, F3, F7, F8, F9	F3, F7, F9	
F8	F2, F3, F4, F5, F7, F8, F9, F10	F1, F8	F8	
F9	F3, F4, F5, F7, F9, F10	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5,F7, F9	
F10	F10	F1, F2, F3, F4, F5, F7, F8, F9, F10,	F10	IV

Table XVI.
Construct level interaction V

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F3, F4, F5, F7, F8, F9	F1	F1	
F2	F2, F3, F4, F5, F7, F9	F1, F2, F8	F2	
F3	F3, F4, F5, F7, F9	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5, F7, F9	V
F4	F3, F4, F9	F1, F2, F3, F4, F8, F9	F3, F4, F9	V
F5	F3, F5, F9	F1, F2, F3, F5, F8, F9	F3, F5, F9	V
F7	F3, F7, F9	F1, F2, F3, F7, F8, F9	F3, F7, F9	V
F8	F2, F3, F4, F5, F7, F8, F9	F1, F8	F8	
F9	F3, F4, F5, F7, F9	F1, F2, F3, F4, F5, F7, F8, F9	F3, F4, F5,F7, F9	V

Table XVII.
Construct level interaction VI

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1, F2, F8	F1	F1	
F2	F2	F1, F2, F8	F2	VI
F8	F2, F8	F1, F8	F8	

of the ISM hierarchy). This provides a clear insight that automotive organizations which are essentially making a clubbed offering need to integrate QM and SCP for enhanced customer satisfaction. The model also highlights how these organizations should approach the development of an effective integration.

As per the ISM model, the top management commitment leads to the strategic focus with respect to the manufacturing of an automobile as well as associated services. The strategic focus of the automotive organizations leads to customer focus, which is the basis of product development and promotion in this highly competitive industry. The strategic focus must be built keeping customer expectations in mind with regard to both manufacturing as well as service (Ooi, 2014). Further, the customer focus leads to supplier relationship management, process management, quality of information sharing, human resource management and servicescape which are at the same level. These constructs together highlight the importance of their closer interaction for developing the product bundle (physical product and associated services) of the highest order. The clarity about manufacturing and service excellence to be achieved enhances the employee involvement (level 4) through self-motivation. At level 3, the supply chain flexibility also emerges as an independent factor leading to SCP, while service quality at the same level is directly influenced by employee involvement. This is due to the fact that supply chain flexibility is a source of competitiveness in automotive organizations referring to close coordination among partners providing resources and services. The constructs of

Table XVIII. Construct level interaction VII

Construct (Ci)	Reachability Set R (Ci)	Antecedent Set A (Ci)	Intersection Set R (Ci) ∩ A(Ci)	Level
F1	F1, F8	F1	F1	
F8	F8	F1, F8	F8	VII

Table XIX. Construct level interaction VIII

Construct (Ci)	Reachability set R (Ci)	Antecedent set A (Ci)	Intersection set R (Ci) ∩ A(Ci)	Level
F1	F1	F1	F1	VIII

Table XX. Conical matrix

Construct number	Construct description	F13	F12	F6	F11	F10	F3	F4	F5	F7	F9	F2	F8	F1
F13	Customer satisfaction (CS)	1	0	0	0	0	0	0	0	0	0	0	0	0
F12	Supply chain performance (SCP)	1	1	0	0	0	0	0	0	0	0	0	0	0
F6	Service quality (SQ)	1	1	1	0	0	0	0	0	0	0	0	0	0
F11	Supply chain flexibility (SCF)	1	1	0	1	0	0	0	0	0	0	0	0	0
F10	Employee involvement (EI)	1	1	1	0	1	0	0	0	0	0	0	0	0
F3	Quality of information sharing (QIS)	1	1	1	1	1	1	1	1	1	1	0	0	0
F4	Supplier relationship management (SRM)	1	1	1	1	1	1	1	0	0	1	0	0	0
F5	Servicescape (SS)	1	1	1	1	1	1	0	1	0	1	0	0	0
F7	Human resource management (HRM)	1	1	1	1	1	1	0	0	1	1	0	0	0
F9	Process management (PM)	1	1	1	1	1	1	1	1	1	1	0	0	0
F2	Customer focus (CF)	1	1	1	1	1	1	1	1	1	1	1	0	0
F8	Strategic focus (SF)	1	1	1	1	1	1	1	1	1	1	1	1	0
F1	Top management commitment (TMC)	1	1	1	1	1	1	1	1	1	1	1	1	1

SCP and service quality (built upon employee involvement) together help in achieving superior SCP (level 2). The enhanced SCP of the automotive organizations will result in customer satisfaction.

3.6 MICMAC analysis

The purpose of the MICMAC analysis is to analyze the driving power and dependence of the variables by categorizing them into four clusters: autonomous, dependent, linkage and independent (Mandal and Deshmukh, 1994). The driving power and dependence of the QM constructs and SCP are presented in Table XI. The driving power and dependence matrix for this study is presented in Figure 2. The next section, that is discussion and managerial implication, discusses the results of the MICMAC analysis.

3.7 Discussion and managerial implications

The results of the ISM Model and MICMAC analysis with respect to managerial implications are discussed as below:

(1) The autonomous cluster has weak driver power and weak dependence, therefore highlighting the fact that the constructs are disconnected from the system. In the presented study, none of the QM constructs lie in this cluster. Therefore, the management of the automotive organizations must have an emphasized focus on all the QM constructs for improving the quality issues related to both manufacturing facilities and service networks taken together.

(2) The dependence cluster has strong dependence and weak driving power. In the ISM model, customer satisfaction (F13), SCP (F12), supply chain flexibility (F11), service quality (F6) and employee involvement (F10) possess strong dependence on other QM constructs (Figure 2). These QM constructs can be monitored by resolving the quality issues covering defect rate (related to manufacturing) and service delivery complaints (with respect to services). With continual improvement in quality, the employees' involvement will improve which may further result in the overall improvement in supply chain flexibility as well as service quality. These results boosts the SCP of the automotive organizations by continuously achieving the customer satisfaction and thereby further improving the competitive positioning of the firm.

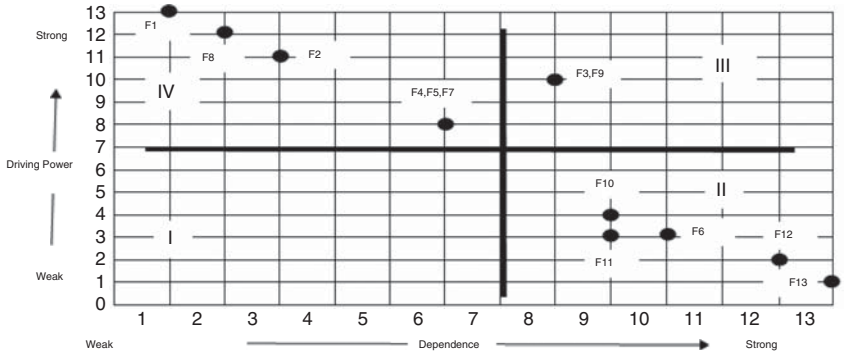

Figure 2.
Driving power and dependence diagram

Notes: I – Autonomous QM constructs; II – Dependent QM constructs; III – Linkage QM constructs; IV – Independent (driver) QM constructs

(3) The linkage cluster has strong dependence and strong driving power. Therefore, the QM constructs mapped in this cluster are quite unstable in a way that they have a very strong impact on the other QM constructs and also a strong dependence as well. The quality of information sharing (F3) and process management (F9) are two QM constructs included in this cluster and are considered to be the backbone of any business. The management of the automotive organizations must ensure that the changes in customer requirements are captured frequently as well as accurately and might try to incorporate them into their manufacturing processes and service networks as much as they can for achieving greater customer satisfaction. Moreover, the management of the automotive organization should strive to attain a balance in their production and sales by having quality of information sharing thus, resulting in short-circuiting of the bullwhip effect. This will enable the automotive organizations to concentrate on management of their manufacturing and service processes at the same time, thus providing them with an opportunity to strike a fine balance between manufacturing technology improvement and consumer centric service improvement.

(4) In the fourth quadrant, the independent cluster shows the constructs with strong driving power and weak dependence. The top management commitment (F1), strategic focus (F8), customer focus (F2), servicescape (F5), supplier relationship management (F4) and human resource management (F7) are the constructs with strong driving impact on other QM constructs in this ISM model. They must be treated as key QM constructs for effective integration of QM in both manufacturing and its service counterparts. The management must set organizational goals and objectives to fulfill the customer's manufacturing and service requirements. With respect to the set goals and objective, the management must ensure that the employees possess skills for manufacturing the product as well as delivering its related services. If the management identifies any deficiency in the same, they must arrange appropriate training for their employees. The management is also required to ensure that the environment in which the manufacturing and services are performed ought to result in improving of the employee's individual performance as well. By doing so, the organization will be able to enhance both its overall SCP and customer satisfaction at the same time. Moreover, the management must have a set policy and procedure for selecting and maintaining the relationship with their supplier(s) with respect to the manufacturing of an automobile component(s) and its related services. This will help in facilitating production and delivery of associated services, resulting in capitalization of the market share and further improving the organizational competitive positioning.

The literature also highlights that there are very few studies that have concentrated on developing a model covering quality improvements in terms of both manufacturing and its related services. The research of Brax (2005) highlights on the challenges faced by the manufacturer by steadily adding services offering to its overall offering but lacks in terms of considering manufacturing and service as clubbed bundle offering. The study of Talib *et al.* (2011a, b) concentrated on TQM barriers in the service sector, limiting their research with respect to the manufacturing aspect. Recently, Sahney (2015) focused on the critical success factors in online retail limiting its focus toward services. This presented study may help in improving the profit margins of the manufacturing organizations that also provides after sales service for its product. The current study proposes an interpretive model based on the contextual relationships among the QM constructs that will help the management in making an appropriate strategy to fulfill the customers manufacturing and its related service requirements, thereby overcoming the various limitations of the above discussed models.

4. Conclusion and future scope

Based on a scientific approach, this study identifies 12 important QM constructs and establishes a hierarchical relationship among them for developing an integrated model for a clubbed offering (manufacturing and services) in the context of the automotive industry. Using the citation analysis and ISM, the identified QM constructs – top management commitment, strategic focus, customer focus, servicescape, process management, supplier relationship management, quality of information sharing, human resource management, employee involvement, service quality, supply chain flexibility and customer satisfaction – are ranked and partitioned into different levels highlighting their contextual relationships. This leads to relationships analyzed using the MICMAC analysis, highlighting on the dependence and driving power among these constructs, which can be helpful to the managers and professional in the automotive industry for developing and implementing a strategic plan to ensure customer satisfaction. Thus, this integrated model set the directions for business managers in planning the operational strategies for addressing QM and supply chain issues in manufacturing and its associated services. The proposed ISM model offers a promising conceptual model but needs to be further empirically validated paving the way for the future direction of research that may further enhance the proposed model and its managerial applications. Another future direction could be testing this model in other industries that integrate QM in manufacturing and service counterparts such as electronics and electrical goods.

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