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Barriers to Total Quality Management for sustainability in Indian organizations

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Abstract

Purpose – The paper aims to identify key human and operational focused barriers to the implementation of Total Quality Management (TQM). It develops a comprehensive structural relationship between various barriers to successfully implement TQM for sustainability in Indian organizations.

Design/methodology/approach – With the help of expert opinions and extant literature review, we identified the case of TQM failure companies and barriers to implement TQM effectively. Interpretive Structural Modeling (ISM) and fuzzy MICMAC techniques are employed to develop a structural model and the identified barriers are categorized based on their dependence and driving power in the various categories.

Findings – From the intensive case analysis, we identify fourteen barriers that constrain the successful implementation of TQM. The findings also provide a hierarchy of barriers in which the absence of top management involvement and ineffective leadership are the human barriers having the highest dependence.

Research limitations/implications – The critical inputs show the implementation of TQM in the firms being more proactive and well prepared in the selected five companies. The study's emphasis on barriers will help organizations in implementing TQM for better sustainability in an organizational context.

Originality/value – In the successful implementation of TQM, barriers need to be identified because failure has often eliminated the organizations from the market. Thus, TQM is the source of strength to achieve higher productivity, profitability, and sustainable business performance. The barriers must be identified to improve organizational performance to contribute to sustainable development.

Keywords Total Quality Management (TQM), Human and operational barriers, Corporate social sustainability, ISM, Fuzzy MICMAC, Green management

Paper type Research paper

1. Introduction

There has been an increasing interest in the human dimension of Total Quality Management (TQM) programs (Patrick Neumann and Dul, 2010). Employees in companies are system

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operators and decision-making managers with their functioning roles strive to market products and services to improve the environmental performance (Hong *et al.*, 2012; Green *et al.*, 2019). According to Wild (1995) and Heizer and Render (2007), operation management practitioners recognize the importance of humans implicitly. Therefore, human dimensions are defined as "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system in order to optimize human well-being and overall system performance" (IEA-International Ergonomics Association Executive Council, 2000, p. 102). In addition, human dimensions significantly affect the acceptance of TQM (Fok *et al.*, 2000). For the successful implementation of any quality program, an organization needs both top management employees as well as the non-management workforce (Solomon, 1996; Lawler *et al.*, 1992; and Garson and Vasu, 1994). Apart from the role of human dimensions, the operational (functional) roles of the quality department are supported by the functions of core TQM program such as product design; supplier role in the TQM program, and planning; establishing a quality control system and supplier-rating scheme, and developing quality manuals and standards (Ho *et al.*, 1999; Wei *et al.*, 2017; Sweis *et al.*, 2019). Operational roles and operations will support TQM implementation. All employees in an organization and their operational roles have to contribute to the quality improvement process. Therefore, in order to have a successful TQM implementation, organizations need quality systems and a quality culture to enhance the quality improvement processes.

In the dynamic era of competition, companies play a major role in economic growth while the quality of products and services has become a primary consideration for customers that contribute to sustainable development (Moktadir *et al.*, 2018). Intensifying global competition has forced organizations to improve business environment including product quality and service criteria in order to draw attention to the customers and compete in the marketplace; the components of TQM support the sustainable business environment. To enter into a competitive environment, any business must invest substantial resources to implement TQM program and strategy (Demirbag *et al.*, 2006; Kumar and Sharma, 2017b) to improve its performance and achieve the path to excellence. The concept of TQM includes customer satisfaction (Muruganantham *et al.*, 2018) by providing superior performances, continuous improvement focused on increased productivity, better product quality, reliability at a lower cost, faster product delivery and optimal utilization of organizational resources. In addition, adoption of TQM principles leads to firms' continuous quality improvement in operational processes, develops an attitude towards quality culture, customer and employee satisfaction to achieve long term business sustainability while poor service quality decreases customer satisfaction and causes organizational failure (Lagrosen and Lagrosen, 2019). Zairi (2002), Rajesh (2018) and Rajesh (2019) defined the concept of sustainability as maintaining the competitiveness for an organization. Thus, the integration of TQM and sustainability meets the need for organizational development and vision to productivity and business performance (Bastas and Liyanage, 2019). By focusing on the "high yielding fruits" (quote, p. ??) and managing them, Elhuni and Ahmad (2014) argue that organizations can achieve more sustainable performance through key performance attributes.

All sectors of organizations are interested in knowing the various barriers that hinder the successful implementations of TQM. Companies need to make efforts to find out the barriers; to prevent them in performance improvement and sustain the business development process. However, companies are still unable to implement TQM successfully. Identifying barriers and preventing them must be the first priority in the direction of organizational efforts towards TQM success.

This research paper aims to address the following research questions –

(1) What are the barriers that constitute the implementation of TQM through failure companies?

(2) What is the interrelationship between the identified human and operational focused TQM barriers?

(3) How do the interrelated barriers affect sustainability in organizations?

This paper endeavors to address the above-stated research questions which help fulfill the following research objectives:

(1) To identify various human dimensions and operational focused barriers to implementation of TQM that promotes sustainability;

(2) To construct a contextual relationship between identified barriers and analyze their effects for sustainable business development;

(3) To draw significant implications from the research.

Thus, the aim of this research is to identify and analyze the different barriers (human and operational focused) that affect the implementation of TQM for sustainability in business. For the identification of barriers, several failure cases of different organizations along with literature were explored. Furthermore, a comprehensive structural relationship model of barriers has been developed using various Interpretive Structural Modelling (ISM) and fuzzy MICMAC (Matriced' Impacts Croise's Multiplication Appliquée a UN Classement) analysis (Gorane and Kant, 2013). The ISM–fuzzy MICMAC technique also helps to categorize the barriers based on their direct and indirect effects.

The structure of the research paper is as follows. Section 2 contains a review of the literature while Section 3 explains the methodology of the research. Section 4 will discuss data analysis and present the results which will be followed by a discussion of the managerial implications in Section 5. Thereafter, a conclusion is provided.

2. Literature review

2.1 TQM implementation with a human and operational focus

The efforts of employees in the direction of quality improvement essentially help to meet customer expectations and contribute to continual improvement. Continuous improvement is a part of quality management, so based on this; employee effort has a significant role in TQM implementation. The coworker support plays a significant role in TQM and their performance (Joiner, 2007; Prakash *et al.*, 2017; and Khan and Naeem, 2018). A coworker is also considered as one of the human dimensions in TQM practices (Grover *et al.*, 2006). In the area of TQM practices, many authors have recommended human resource practices that develop the quality culture (Bou and Beltran, 2005). Moreover, Kufidu and Vouzas (1998) argue that keeping the issues of human resources on top management agenda strengthens the effectiveness of quality efforts. Thus, it is argued that from top to bottom level of employees or an entire workforce is responsible for the quality efforts.

There are also other researchers who focus on soft aspects of TQM program implementation. Lau and Idris (2001) found that trust, culture, employment continuity, teamwork, the role of top management and good leadership affect the quality of improvement programs. These dimensions help to implement TQM program successfully and they are considered as the soft critical success factors. Ho *et al.* (1999) found that there is a relationship between top management and core quality management adoption, training, employee relations and customer satisfaction. Further, Ho *et al.* (1999) considered employee relations and training as human aspects; and top management involvement in their study as operational roles for TQM implementation. Sharma's (1997) study found that most of the quality problems in an organization arise due to attitude, resilience, mindset and work culture of employees rather than knowledge and skills. Resistance to change is another inhibiting

factor for effective TQM implementation. Therefore, TQM recommends training in quality for all employees irrespective of the hierarchical levels, training the trainers, extensive job enrichment programs, appreciation of employees' work as the essential factors for successful TQM implementation. Additionally, Padhi and Palo (2005) have also very significant work on the effect of human dimensions on TQM implementation. Further, Padhi and Palo (2005) considered several human dimensions namely, quality awareness, vision, leadership, innovation and creativity, ethics, perception, communication, mental condition (stress and employees delight), rewards and recognition, maturity and breadth, attitude and morale, customer satisfaction sensitivity, quality task resources, teamwork, organization structure and process, total quality ecological sustainability, and commitment and involvement for successful TQM implementation.

Similarly, numerous researchers and scholars worked on the role of human dimensions for TQM and considered several human dimensions such as work culture, motivation, and role of top management, innovation, coordination and attitude to change (Grover *et al.*, 2006; Badiru, 1990; Taylor, 1997; Taveira *et al.*, 2003). According to Poonawalla (1999), the only route to achieve total quality in any organization is through the involvement of people.

2.2 Barriers to TQM and organizational sustainability

The previous section has reviewed various studies on TQM implementation. Mohammad (2006) and Muruganantham *et al.* (2018) argue on TQM practices that it is not easy to achieve its benefits. Glover (1993) suggested that companies without TQM implementation lose market share to companies focused on TQM execution. As a result, Kumar and Sharma (2015, 2017a, 2017b) identified various success factors for TQM implementation successfully in a developing country like India and the studies contain several success cases along with failure cases from the literature. Further, Patri and Suresh (2018) and Yadav *et al.* (2018) identified various factors for healthcare organizations and barriers in the implementation of lean and six sigma respectively. The successful implementation of the organizational factors determines the sustainability of TQM (Zairi, 2002; Lagrosen and Lagrosen, 2019). Based on the previous literature, Rajesh (2018, 2019) investigated the barriers that facilitate or restrain the success of TQM implementation. Exploring these factors helps to improve the TQM system and understand business sustainability (Rajesh, 2018, 2019). The companies that are selected for this study failed to implement TQM vigorously; although, Chiarini (2013) focused on the lack of power to make them flexible with organizational culture as identified by the major barriers to TQM adaptation and practices. It is observed that several studies have been done in the literature on TQM barriers; however, this study is focused on a unique way to consider the barriers from various failure cases, whereas most of the barriers are different from the past literature. The study, therefore, considered different TQM failure cases from various sources of literature to identify barriers responsible for the TQM performance. Curry and Kadasah (2002) perceived that TQM programs usually tend to fail without sustainability. Many studies find impediments to TQM success. Soltani *et al.* (2005) agreed with various causes of the TQM program failure in the organizations are not seriousness, stability and consistency on TQM practices. Thus, the integration of TQM and sustainable development added to the good quality, which contributes to the economy (Isaksson, 2006; Bastas and Liyanage, 2019). The identification of the barriers would help businesses to remove them and improve their organizational performance and to gain customer satisfaction. Many of the organizations benefit from the adoption of the TQM program successfully and sustain their business development while others fail due to non-compliance activities in their implementation procedures. The adoption of the TQM program with sustainability leads to productivity, performance improvement, the path to excellence and market share (Curry and Kadasah, 2002; Isaksson, 2006). This work has identified all the barriers which hinder the organization from reaping the benefits of TQM implementation and

Company	Barriers	Source
IBM	Over-abundance of training, Bureaucratic system (reward or punishment), Employees perception at IBM, only focus on innovation without consideration of optimizing the current process, Tried to TQM implement quickly, and volatile product market and shelf life	Ferris *et al.* (1998), Kenneth and Richard (1995), Qubein (2009), and Gauttam (2010)
Bridge stones/firestone	Lack of testing, lack of quality concern, mismatch of features between products, lack of top management involvement, lack of concern about assembled products, manufacturing defects, and supplier information	Greenwald (2001), Noggle and Palmer (2005), QMS (2011) and MCS (2015)
Pennsylvania department of transportation	Wrong leadership/ineffective leadership, massive organizational changes, badly managed by the top management, fewer team efforts/lack of teamwork, and training program implemented but not at the right time	Harris (1990), Poister and Harris (2000), Scheiner (1981), Stringham (2004)
US air force embraced "partial quality"	Lack of mission focus, mismanagement, little standardization, ineffective leadership, the success of operation desert storm, continuous improvement without resorting to activities and programs, and tried to implement programs quickly	Rinehart (2006)
Textile and apparel industrial organization in Pakistan	The mismatch between company strategy and TQM implementation, the absence of employee flexibility /employee's resistance to change, own TQM bureaucracies, the absence of planning, achieve too much in a short time, and the absence of feedback system	Hasan *et al.* (2013)

Table I.
Barriers to TQM implementation from failure companies

maintain the high-quality standard of product and service. Based on the description of the barriers from these five cases examined on their TQM implementation, these are summarized in Table I.

In addition, based on the previous literature, a total of 14 potential barriers (human and operational focused) to TQM for business sustainability are identified. The brief descriptions of all barriers are given in the following Table II.

2.3 Research gaps:

The research gaps identified are highlighted below:

(1) Most of the studies have highlighted TQM adoption success factors that assist organizations in its implementation, but removing identified barriers is also a big challenge in implementing a TQM program (Kelada, 1996). Thus, this work highlights the barriers from the various failure cases to implement TQM program successfully.

(2) The barriers of TQM have been linked to human dimensions (Lawler *et al.*, 1992; Solomon, 1996; Fok *et al.*, 2000; Garson and Vasu, 1994) and functionally (operationally) focused (Ho *et al.*, 1999). These two categories are critical drivers of any organizational performance and this research also focused on theoretical and practical application.

Barriers	Brief description	References
Lack of top management involvement (B1)	The role of top management imposed a TQM program that helps the organization to improve its economic-ecological-social performances, achieve its goals only by providing training and motivation to the employee. It emphasized that top management involvement as a success factor but lack of it is considered a barrier too. Lack of this barrier is always led to TQM efforts failure	Ellram (1991), Brown *et al.* (1994), Tsironis (2018), McAdam *et al.* (2019), Talapatra and Uddin (2019)
Ineffective leadership (B2)	Effective leadership is required to make the foundation of TQM. Top management provides the leadership for quality awakening in the organization. It fails to evolve effective plans and provide leadership in achieving sustainable development goals	Hasan *et al.* (2013), Kumar and Sharma (2017c, 2018), Talapatra and Uddin (2019)
Lack of teamwork (B3)	Teamwork is a critical factor in TQM. When the task is very complex then teamwork is very essential in the organization to create a clear path. Lack of teamwork fails to implement TQM to achieve sustainability in organizations	Colenso (2000), Castka *et al.* (2001), Khurshid *et al.* (2018), Saleh *et al.* (2018), McAdam *et al.* (2019), Cho and Linderman (2019), Talapatra and Uddin (2019)
Lack of proper training and education (B4)	A TQM program needs a well-trained and educated workforce to make the company's success. It has been also reported that proper training and poor education act as major barriers. Lack of proper training and education on quality creates the appropriate problem identification and its solution which leads to the TQM program failure. However, the proper training programs and well-educated taskforce need to effectively design in TQM implementation to achieve sustainability	Kumar and Sharma (2015), Baidoun *et al.* (2018), Cho and Linderman (2019), Talapatra and Uddin (2019)
Unawareness of measuring quality and customer satisfaction level (B5)	This barrier is a hindrance to the TQM to the sustainable development program. Lack of unaware of measuring quality increase the number of defects, product fail and customers are not satisfied so it is needed for the employee should be aware. A good leadership provides proper training and education program to their employees and motivates them also. It is needed customer satisfaction focus on the interaction between front-line employees and customer to be pleasant experiences, especially for the customers	Ugboro and Obeng (2000), Mohammad (2006), Saleh *et al.* (2018), McAdam *et al.* (2019), Talapatra and Uddin (2019), Dilawo and Salimi (2019)

Table II.
Brief description of all identified barriers

(*continued*)

Barriers	Brief description	References
TQM viewed as a quick fix with a focus on short-term goals (B6)	TQM program cannot be very quick fixes with focus on a short-term goal that will finish when a target has been met against many firms think the TQM program can be implemented shortly with a focus on short-term goals. After that such firms fail to implement it which is related to the various systematic approaches, people involvement and continuous improvement towards the result which can be measured quality and sustainability orientation. TQM is not short-term goals and it is a management process that recognizes that however much the firms may improve, their competitors will continue to improve and their customers will expect more from them	Mamman and Saffu (1998), Kanji (2012)
Lack of benchmarking standard (B7)	It is a practice that externally focused but lack of the benchmarking standard has been considered as a barrier that fails in helping organizations optimizes their capability in sustainable business development	Voss *et al.* (1994), Talib *et al.* (2011), Talapatra and Uddin (2019)
The mismatch between TQM strategy and business goals (B8)	Quality is made part of the business goals through integration in the strategic planning process lead to sustainable competitive advantage. TQM principles provide guidance in connecting daily activities and decisions with TQM's strategic objectives and business goals. TQM strategy and business goals lead to each other but the mismatches between both fail on quality pursue an operational strategy, profitability, growth and customer service	Porter (1980), Schonberger (1992), Alkhafaji (2003), Talapatra and Uddin (2019)
The absence of feedback system (B9)	The concept of the feedback system helps in order improving the quality of work, product and service so firms need not focus only on proper education and appropriate skill training, but also constant instructive and supportive feedback. The absence of feedback system firms faces difficulty to improve overall performance, product quality, etc.	ISO 8402 (1994), Padhi and Palo (2005), Teixeira *et al.* (2015), Aquilani *et al.* (2017)
Employee's resistance to change (B10)	TQM represents change on a large scale in the organization. It often encounters substantial resistance and dysfunctional behaviors so; the employee needs to change according to the various aspects of the process. Sometimes, employees with the old age suffered from illiteracy or language barrier are not interested to adopt new skills, knowledge, ideas and culture while many educated and specialized employees do not flexible with the quality of work and resist changing the process, then it becomes a barrier	Newall and Dale (1990), Pickard and Ermer (1994), Patyal and Koilakuntla (2018), McAdam *et al.* (2019), Talapatra and Uddin (2019)

(*continued*)

Table II.

Barriers	Brief description	References
Lack of program implementation at the right time (B11)	The TQM program aims to "*Do the right things, right the first time, every time*". Improving process efficiency, make decisions and strategy, check defects, proper training and education, good prior planning and working systematically all these observations and insights at right time brings about many benefits to the organizations in terms of costs, resource savings, higher ecological performance, and time. The TQM program fails to implement it at the right time to improve customer satisfaction include which reduction of waiting time; the product reaches the customer faster and better quality products	Kumar and Sharma (2015), Teixeira *et al.* (2015), Aquilani *et al.* (2017)
Lack of coordination between departments (B12)	It defines coordination as "*The pattern of decision making and communication among a set of actors who perform tasks to achieve goals*". Coordination between departments is considered to be employee relations who make strong communication within the departments and encourages mutual adjustment among employees. Poor coordination between departments is barriers that an organization inhibits and detrimental to the sustainable TQM implementation	Malone (1987), Grover *et al.* (2006), Gittell *et al.* (2008), Talib *et al.* (2011)
The absence of planning (B13)	A large number of organizations don't have a quality improvement plan to execute it effectively; because some of them are not able to execute it while others are not willing. They must have pre-planning before execute an ongoing process because the poor plans and strategies lead to a project that spends money and time on planning and creates more frustration, and organizations fail to improve the product and service performance. The role of top management is also responsible for poor strategic planning, which has often contributed to ineffective quality improvement and hence decreases in sustainable business gains	Talib *et al.* (2011), Patyal and Koilakuntla (2018), Cho and Linderman (2019), Talapatra and Uddin (2019)
TQM implementation without TQM culture (B14)	Quality culture in the organization creates an environment for quality continuous improvement program, organizations then move to a market focus from product focus. So, the customer and market focus, teamwork, employee participation, and process management help to develop quality culture from their institution's culture in TQM implementation. Organizations want to adopt TQM culture for sustainability but implementing TQM is not so easy and they always fail to execute it without TQM culture	Sirvanci (2004), Talapatra and Uddin (2019)

Table II.

(3) Many companies have already gone down on an expensive learning curve and the disappointment without TQM consideration (Curry and Kadasah, 2002). The lack of implementation of the TQM program successfully in developing countries is a big challenge of sustainability in industries. Bruun and Mefford (1996), Isaksson (2006), and Fernandes *et al.* (2017) state that TQM programs should be followed by flexible

culture and territorial proletariat attitude to improve the system and understanding of sustainability of businesses in a developing country like India.

(4) Reed *et al.* (2000) research focused on sustainability on TQM based advantage because of the operationalization problem. Further, Curry and Kadasah (2002) perceived that TQM programs usually tend to fail without sustainability. The integration of TQM and sustainable development add to the economic dimension such as the cost of poor quality as Isaksson (2006) and Bastas and Liyanage (2019) argue that good quality contributes to a good economy. Thus, it is important to know how long it sustains the competitive advantage of the customer's expectations.

(5) Literature also lacks in analyzing the relationships among barriers, classifying and identifying the dependent and independent effects of each barrier. The ISM and Fuzzy MICMAC analyses have been used for this purpose in this work.

3. Research methodology

In this study, ISM and fuzzy MICMAC techniques are considered for data analysis. The ISM is a systematic and comprehensive method used to recognize the relationship between specific barriers that define a problem (Sage, 1977; Warfield, 1974; Attri and Grover, 2018; Patri and Suresh, 2018). The ISM technique explains the group's decision on whether, and how, the barriers are associated in order to help the structure of the model at its hierarchical levels. Overall, the ISM method is a tool, interactive learning process, which deals with the complex situation and helps to analyze the relationships among the enablers/barriers of a system using graphical representation (Lee, 1988). The MICMAC technique has been considered to recognize the direct/indirect effects of one to another barrier (Mangla, 2014) and to analyze driving and dependent power among barriers. The methodology, relationship model and the respective results and findings are integrated with the ISM and fuzzy MICMAC (Gorane and Kant, 2013; Mandal and Deshmukh, 1994) analysis in the next sections. Here, we describe research methodology in three stages using flowchart and procedures as shown in Figure 1.

Nowadays, ISM methodology is being used by various key contributors including industries and academicians such as business analysts, management consultants, policy and risk analysts, and academic researchers. The relationships (direct and indirect) between the barriers tend to be more accurate than the individuals and it interprets the group members in the ISM outcomes. The utilization of the ISM method generally compels managers to reassure the perceived priorities and improve their understanding of relations between major concerns (Singh *et al.*, 2007). The identification of barriers establishes a contextual relationship. Then SSIM among barriers with relative pairs of barriers is examined; finally, a reachability matrix and digraph of ISM are drawn; these are basic steps of the ISM method which are given in the literature. The ISM model is reviewed and necessary modifications are made if there is any conceptual inconsistency.

For developing the contextual relationships among the TQM barriers, eight experts from industry and four academicians with a research interest in this area were consulted. From the sample respondents, there were 83 percent male and 17 percent female. From the respondent group, 16.67, 25, and 25 percent of respondents belong to 0–5 years, 6–10 years, and 11–15 years of work experience respectively while 33.33 percent of respondents belong to more than 15 years of work experience years' group. There were 25, 33.33, and 41.67 percent of respondents belonging to the education levels of graduate, postgraduate, and doctoral degree respectively.

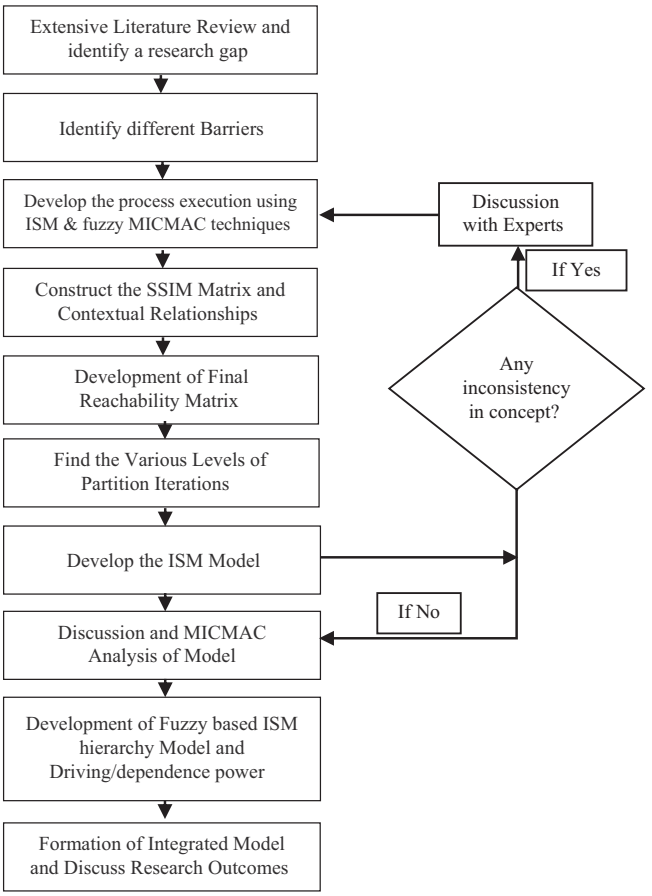


Figure 1.
Flowchart of the proposed research framework

4. Data analysis and results

In this study, first we identify the fourteen barriers from previous literature; next, the expert's opinion from manufacturing organizations and academia are used to validate and model the barriers. In this section, we describe data analysis and procedures as follows:

4.1 Structural self-interaction matrix (SSIM)

All have four to five years of experience in their field. Among the consensus techniques, brainstorming and literature review support are applied to establish the contextual relationship. In the construction of SSIM, four symbols *V*, *A*, *X*, and *O* are used to build the relationships among these barriers in respect of two barriers in row and column by *i* and *j* respectively. The symbol *V* means "the barrier *i* leads to Barrier *j*" while *A* is reverse of *V*. The symbol *X* means "*the barriers i* and *j* will lead to each other" while symbol *O* means "the barriers *i* and *j* are not related to each other". Table III represents the contextual relationships of SSIM.

4.2 Reachability matrix

After applying the ISM method rules, we represent the IRM (initial reachability matrix) for barriers using ISM to TQM implementation. First, create IRM in which SSIM is converted into

p_i Barriers	p_j Barriers B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14
B1		*X*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*
B2			*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*
B3				*A*	*V*	*V*	*V*	*V*	*O*	*V*	*V*	*A*	*O*	*V*
B4					*V*	*V*	*V*	*V*	*O*	*V*	*V*	*A*	*V*	*V*
B5						*A*	*A*	*A*	*A*	*O*	*A*	*A*	*A*	*O*
B6							*A*	*A*	*A*	*V*	*A*	*A*	*A*	*X*
B7								*V*	*A*	*O*	*X*	*A*	*A*	*V*
B8									*A*	*O*	*A*	*A*	*A*	*V*
B9										*O*	*V*	*O*	*V*	*V*
B10											*A*	*A*	*A*	*A*
B11												*A*	*A*	*V*
B12													*V*	*V*
B13														*V*
B14														

Table III.
Contextual relationships of SSIM

a binary matrix by substituting with symbols *V*, *A*, *X*, and *O* using 1 and 0 as per the VAXO rule. The substitution of 1s and 0s are as per the following rules: (a) 1 if the (*i*, *j*) entry in the SSIM is *V*, the (*i*, *j*) entry in the reachability matrix becomes 1 and the (*j*, *i*) entry becomes 0; (b) if the (*i*, *j*) entry in the SSIM is *A*, the (*i*, *j*) entry in the reachability matrix becomes 0 and the (*j*, *i*) entry becomes 1; (c) 3 if the (*i*, *j*) entry in the SSIM is *X*, the (*i*, *j*) entry in the reachability matrix becomes 1 and the (*j*, *i*) entry also becomes 1; and (d) if the (*i*, *j*) entry in the SSIM is *O*, the (*i*, *j*) entry in the reachability matrix becomes 0 and the (*j*, *i*) entry also becomes 0. The initial reachability matrix for barriers is shown in Table IV. A final reachability matrix (FRM) then it has been obtained after integrating the transitivity phase of the ISM method, depicted in Table V. This FRM helps to evaluate the "driving power" and "dependence power" of all barriers in TQM implementation, which are used to measure the influence referred and a measure of being influenced respectively (Dubey and Singh, 2015). The driving and dependence power for each variable is the total number of barriers (including itself) in the fuzzy MICMAC (shown in Table V) and further, these barriers have been classified into the four categories of autonomous, linkage, dependent and drivers.

p_i Barriers	p_j Barriers B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14
B1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
B3	0	0	1	0	1	1	1	1	0	1	1	0	0	1
B4	0	0	1	1	1	1	1	1	0	1	1	0	1	1
B5	0	0	0	0	1	0	0	0	0	0	0	0	0	0
B6	0	0	0	0	1	1	0	0	0	1	0	0	0	1
B7	0	0	0	0	1	1	1	1	0	0	1	0	0	1
B8	0	0	0	0	1	1	0	1	0	0	0	0	0	1
B9	0	0	0	0	1	1	1	1	1	0	1	0	1	1
B10	0	0	0	0	0	0	0	0	0	1	0	0	0	0
B11	0	0	0	0	1	1	1	1	0	1	1	0	0	1
B12	0	0	1	1	1	1	1	1	0	1	1	1	1	1
B13	0	0	0	0	1	1	1	1	0	1	1	0	1	1
B14	0	0	0	0	0	1	0	0	0	1	0	0	0	1

Table IV.
Initial reachability matrix for barriers

p_i Barriers	p_j Barriers B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	DrP
B1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*14*
B2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	*14*
B3	0	0	1	0	1	1	1	1	0	1	1	0	1*	1	*9*
B4	0	0	1	1	1	1	1	1	0	1	1	0	1	1	*10*
B5	0	0	0	0	1	0	0	0	0	1*	0	0	0	0	*2*
B6	0	0	0	0	1	1	0	1*	0	1	0	0	0	1	*5*
B7	0	0	0	0	1	1	1	1	0	1*	1	0	0	1	*7*
B8	0	0	0	0	1	1	0	1	0	1*	0	0	0	1	*5*
B9	0	0	1*	1*	1	1	1	1	1	1*	1	1*	1	1	*12*
B10	0	0	0	0	1*	0	0	0	0	1	0	0	0	0	*2*
B11	0	0	0	0	1	1	1	1	0	1	1	0	0	1	*7*
B12	0	0	1	1	1	1	1	1	1*	1	1	1	1	1	*12*
B13	0	0	1*	0	1	1	1	1	0	1	1	0	1	1	*9*
B14	0	0	0	0	1*	1	0	1*	0	1	0	0	0	1	*5*
DeP	*2*	*2*	*7*	*5*	*14*	*12*	*9*	*12*	*4*	*14*	*9*	*4*	*7*	*12*	*113*

Note(s): 1* transitivity relationship; DrP: driving power; DeP: dependence power

Table V.
Final reachability matrix for barriers

4.3 Level partitions

From the FRM, level partitioning is performed and the reachability and antecedent sets for each barrier (Warfield, 1974; Farris and Sage, 1975) are determined. The reachability set $R(p_i)$ for every component p_i, consists of barriers itself and other barriers to influence. Similarly, an antecedent set $A(p_j)$ is defined for every component p_j. The intersection sets have been derived from all other barriers after deriving these two sets. The barriers having the same "reachability and intersection set" of p_i are referred to as top-level barriers and set in the first iteration.

The significance of top-level barriers does not influence any other barriers in their own level of the hierarchy. After finding the top level, it is then removed for searching for further levels. This iterative process continues until finding the level of each barrier. The seven iterations have been found from the level partition iterations and conclude to top and bottom levels of barriers. The unawareness of measuring quality and customer satisfaction level (B2) and employee's resistance to change (B10) are set up at level one in a digraph.

4.4 Building the ISM-based model

The dependence and driving power diagram is shown by ISM techniques which have shown the relationships (direct and indirect) among barriers and overall structure in Figure 2. From FRM, the structural ISM model is developed through the vertices and edges (Jharkharia and Shankar, 2005). After accounting for the transition phase, the digraph is then converted into the ISM model. The Fuzzy-based ISM hierarchy model the barriers are shown in Figure 2.

4.5 Fuzzy MIC-MAC analysis

Fuzzy MIC-MAC analysis was first proposed by Duperrin and Godet (1973). MIC-MAC analysis means across-impact matrix multiplication and is applied to classify the barriers while dependence and driving power of the variables are analyzed using fuzzy MICMAC (Gorane and Kant, 2013; Mandal and Deshmukh, 1994). In this section, these barriers are categorized into four clusters such as "autonomous," "driver," "linkage," and "dependent" barriers.

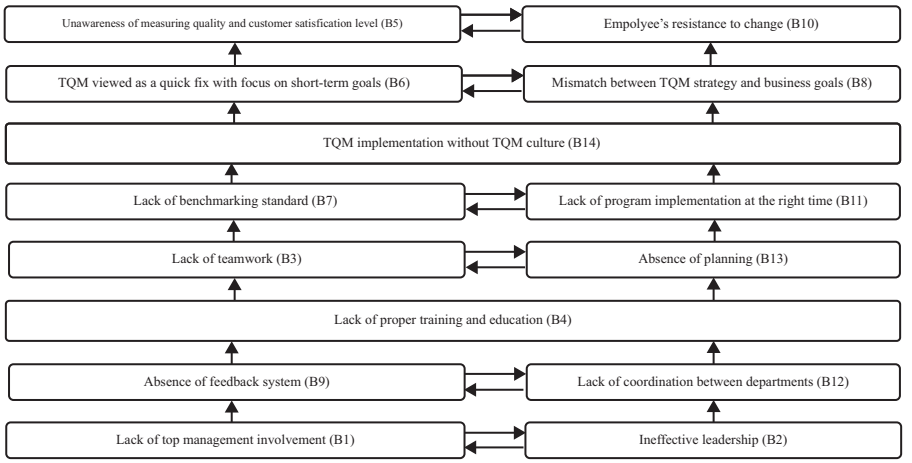


Figure 2. Fuzzy-based ISM hierarchy model

Based on these fourteen main barriers, the analysis drives the arrangement in different classifications and checks the relationships among barriers; sometimes, the relationship between barriers is the same while strong and better in some other cases. The fuzzy ISM helps to categorize the barriers based on their ability and influence on others (Gorane and Kant, 2013). The following steps need to be performed in ISM Fuzzy MICMAC analysis.

4.6 Binary direct relationship matrix (BDRM) and fuzzy direct relationship matrix (FDRM)

The BDRM relationship is prepared by the diagonal entries that converted into 0 (Gorane and Kant, 2013), depicted in Table V. In the fuzzy MICMAC analysis ISM model, binary digits (0 or 1) have been considered for the foundation of dependence and driving power analysis. The FDRM has been then developed to increase the MICMAC analysis sensitivity considering the fuzzy set theory (FST) (Sindhu *et al.*, 2016). In this method, no relationship and perfect relationship are denoted by 0 and 1 respectively. From the FRM values depicted in Table VI, FDRM to obtain a stabilized matrix of barriers of TQM is obtained as depicted in Table VII.

4.7 Fuzzy MICMAC stabilized the matrix

After the FDRM formation, FDRM and FRM are used to start the process then create the stabilized matrix using fuzzy MICMAC where it follows the fuzzy matrix multiplication principle. The product matrix is similar to the fuzzy matrix while two fuzzy matrices are considered together multiplied. The fuzzy matrix rules are given in the following formula:

$$P = Q,\ R = \max\ k[(\min\ (\text{aik},\ \text{bkj}))],\ \text{where}\ Q = [\text{aik}]\ ,\ \ \text{and}\ R = [\text{bkj}]$$

Table VII represents the summary of the final stabilized matrix using fuzzy MICMAC.

In the table, the values of barriers in the row and column section indicate the dependence and driving power. The barriers with their weak and strong dependence and driving power have been identified as the "key barriers" and fall into the four categories of barriers

Table VI. Possibility of numerical values of the reachability

Possibility of reachability	No	Very low	Low	Medium	High	Very high	Complete
Value	0	0.1	0.3	0.5	0.7	0.9	1

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	
B1	0	0.9	0.9	0.9	0.7	0.5	0.5	0.7	0.5	0.7	0.9	0.9	0.9	0.7	*9.7*
B2	0.9	0	0.9	0.9	0.7	0.5	0.5	0.7	0.5	0.7	0.9	0.9	0.9	0.7	*9.7*
B3	0	0	0	0	0.5	0.7	0.5	0.9	0	0.7	0.7	0	0	0.7	*4.7*
B4	0	0	0.3	0	0.7	0.7	0.5	0.5	0	0.9	0.5	0	0.5	0.7	*5.3*
B5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*
B6	0	0	0	0	0.5	0	0	0	0	0.5	0	0	0	0.7	*1.7*
B7	0	0	0	0	0.7	0.7	0	0.9	0	0	0.5	0	0	0.7	*3.5*
B8	0	0	0	0	0.5	0.7	0	0	0	0	0	0	0	0.5	*1.7*
B9	0	0	0	0	0.7	0.7	0.9	0.9	0	0	0.9	0	0.9	0.5	*5.5*
B10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*0*
B11	0	0	0	0	0.9	0.5	0.5	0.7	0	0.9	0	0	0	0.5	*4*
B12	0	0	0.9	0.5	0.5	0.7	0.5	0.7	0	0.9	0.5	0	0.7	0.7	*6.6*
B13	0	0	0	0	0.7	0.5	0.7	0.9	0	0.9	0.9	0	0	0.5	*5.1*
B14	0	0	0	0	0	0.7	0	0	0	0.9	0	0	0	0	*1.6*
	0.9	*0.9*	*3*	*2.3*	*7.1*	*6.9*	*4.6*	*6.9*	*1*	*7.1*	*5.8*	*1.8*	*3.9*	*6.9*	

Table VII.
Fuzzy MICMAC stabilized the matrix

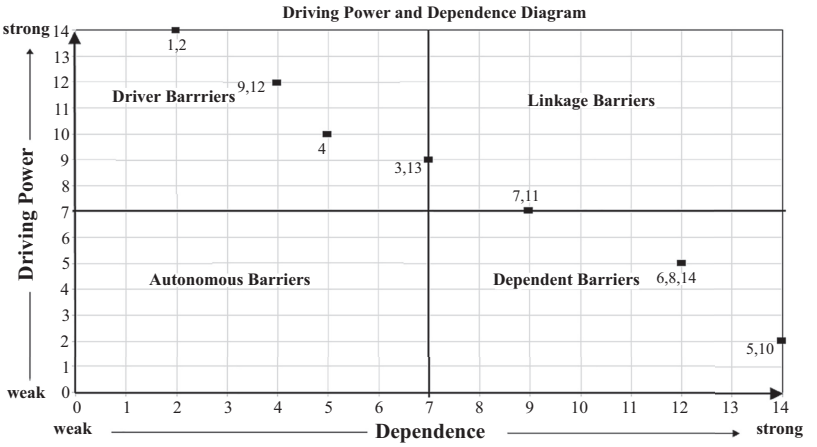


Figure 3.
Driving power and dependence power diagram

(Jharkharia and Shankar, 2005). Figure 3 represents the graph between dependence and driving power to TQM implementation is given below.

5. Discussions and findings

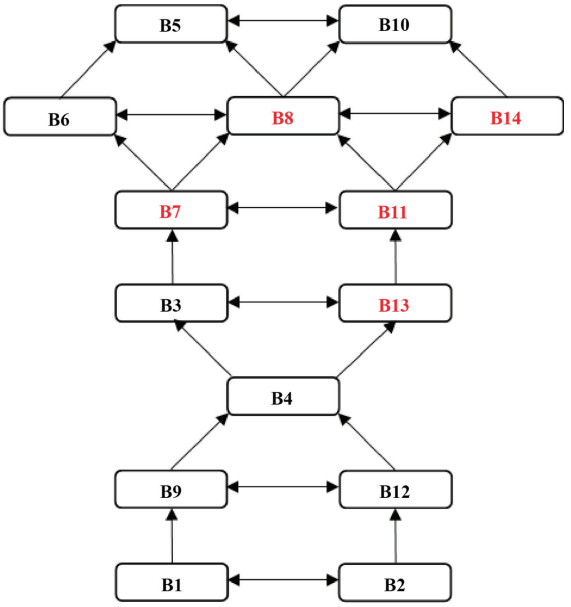
In this study, the organizations are looking for TQM implementation from the identified major barriers while most of them face many challenges to implement it in this current business environment. However, it is observed that the organizations' effort towards TQM program can help to sustain the business. From all the identified barriers, the two barriers "lack of top management involvement" and "ineffective leadership" are the most influential barriers and they have been put at the first level, while "unawareness of measuring quality and customer satisfaction level" and "employee's resistance to change" are the least influential (Figure 3). "Lack of top management involvement" (Talib *et al.*, 2011; Tsironis, 2018; McAdam *et al.*, 2019; and Talapatra and Uddin, 2019) and "ineffective leadership" (Talib *et al.*, 2011; Hasan *et al.*, 2013; Kumar and Sharma, 2017c, 2018; and Talapatra and Uddin, 2019) are most significant barriers therefore, organizations should focus on setting up good leadership and top management involvement to TQM sustainability. On the other hand,

Saleh *et al.* (2018), McAdam *et al.* (2019), Talapatra and Uddin (2019), Dilawo and Salimi (2019) found "unawareness of measuring quality and customer satisfaction level" and Patyal and Koilakuntla (2018), McAdam *et al.* (2019), Talapatra and Uddin (2019) found "employee's resistance to change" is the top of hierarchy level of ISM model that should be also avoided for minimizing the barriers in TQM implementation. The same level barriers mutually support each other and lead to the next level barriers. Based on the ISM model, we established seven levels of hierarchy. The matrix of dependence power and driver power depicted in Figure 3, provides valuable insights into the interdependencies and relative importance among the barriers. For the successful implementation of the TQM program, organizations need to identify the barriers that are incorporated at their strategic level of the organizations. The current research emphasizes that TQM practitioners and decision-makers need to keep in mind these barriers while they plan TQM program execution to enhance organizational performance and sustainable development. Based on the effectiveness of human and functional (operational) barriers, Figure 4 presents the integrated ISM model.

The major findings are highlighted given below:

Autonomous barriers: From the fuzzy MICMAC results and analysis, no barrier is identified in this category to the process of TQM implementation, depicted in Figure 3. In this category, the absence of barriers holds all the barriers as significant; thus, all fourteen barriers have an important influence and role in the successful TQM program implementation. These barriers have both weak dependence and driving power as they slow down the entire system, so barriers falling into this cluster are not very efficient and effective in leading towards TQM implementation. In this cluster, the barriers are comparatively disconnected and do not have much influence on the other barriers.

Dependent barriers: In this category, there is a weak drive but strong dependence power among barriers' relationship. It includes five barriers which have been identified as



Note(s): B7, B8, B11, B13, and B14 are operational focused barriers and rest is human dimension barriers

Figure 4.
Integrated ISM-based model of the barriers

"Unawareness of measuring quality and customer satisfaction level" (B5), "TQM viewed as a quick fix with focus on short-term goals" (B6), "Mismatch between TQM strategy and business goals" (B8), "Employee's resistance to change" (B10), and "TQM implementation without TQM culture" (B14) from the fuzzy MICMAC results. These barriers are seen in the top five of the ISM hierarchy (Figure 3). The strong dependence requires all other barriers to minimize the aftereffect of barriers in the TQM implementation process. Besides, handling these barriers, management must comprehend the dependence power of the barriers at the lower level. These barriers can produce a major impact on TQM implementation; because all other barriers strongly influence the bottom level barriers. Thus, managers must pay special attention to control these aforementioned barriers to reducing the chance of TQM failure. Moreover, lower level barriers strongly influence the middle-level barriers to identify the assurance of these barriers on the lower level of the integrated model.

Linkage barriers: The linkage barriers have both strong drive and dependence powers. Barriers associated with the cluster are not stable, because of variability and causal loop among themselves. In the ISM and fuzzy MICMAC model diagram, "Lack of teamwork" (B3), "Lack of benchmarking standard" (B7), "Lack of program implementation at the right time" (B11), and "Absence of planning" (B13) fall in this cluster groups which are middle-level barriers and they are highly unstable. The aforesaid middle-level barriers need continuous observation to influence top-level barriers.

Independent barriers: In this cluster, there is a strong drive but weak dependence power. The five barriers are identified namely "Lack of top management involvement" (B1), "Ineffective leadership" (B2), "Lack of teamwork" (B3), "Lack of proper training and education" (B4), "Absence of feedback system" (B9), and "Lack of coordination between departments" (B12) are at the bottom of the ISM hierarchy level and fuzzy MICMAC analysis. The barriers with very strong driving power in the independent cluster are called as "key barriers". These barriers are placed at the root level of the ISM hierarchy as shown in Figure 2. Thus, management should give a high priority to dealing with these barriers with maximum driving power and capability to affect other barriers. The lower level barriers are mainly responsible for increasing the barriers to the extent, which strongly influence the top-level barriers. These barriers influence other barriers and intensify the strength of impact on TQM implementation. Thus, the organization needs to concentrate on this cluster's barriers more carefully.

5.1 Managerial implications

Considering these nine human and five operational barriers in organizations will help to identify the key barriers and prevent them from obstructing TQM program implementation successfully in sustainable business improvement. Further, this research provides a way for managers and decision-makers to help analyze the human and operational focused barriers in TQM practices systematically and how to employ them in current businesses. Further, this work plays an important role in identifying the key barriers in the hierarchy level that could help current organizations in strategic planning that involves top to bottom relationship, which literature still lacks particularly on failure case-based research. Further, for the current organizations, this research gives support for sustainable development and creates new opportunities for growth in the future by avoiding these barriers. The focus on sustainable development with the goals of TQM practices in organizations could help researchers to close the theory and practice gap. This process of TQM with sustainability subsequently increases value-added activities through good quality of production and changes in new policy systems helps achieve competitive advantage and a positive impact on business performance.

The findings of this study suggest that "lack of top management involvement," "ineffective leadership," "the absence of the feedback system," and "lack of coordination between departments" are the most influential barriers and these barriers have a combined effect on the organizational performance and influence TQM implementation. Further, the study provides

important input for TQM practices and firms are better prepared to contribute to decision-making as well as more active in its implementation. As a result, the analysis can help top management to understand and evaluate the intensity of barriers, as well as implement an active strategy to manage these barriers and help to estimate possible challenges. In addition, the results of ISM and fuzzy MICMAC methods have been used to evaluate and identified the barriers to achieve higher quality and sustainable development goals. This model would help the managers to employ and determine the direct/indirect effects of one barrier to others and boost the business environment in learning and continuous improvement of the organizational strategy. The sustainable performance of the organizations with TQM provides high profitability, better management of resources, innovative and continuous improvement. Further, sustainable development helps organizations achieve their corporate vision and build TQM competition to be better than others.

6. Conclusions

The study identified key human and operational barriers in the implementation of the TQM for sustainable business development. The research aimed to develop a conceptual model considering various barriers using ISM and fuzzy MICMAC techniques in order to improve productivity and increase the competitive advantage. Moreover, the study involved the identification of TQM barriers and their interrelationships to make them effective using ISM and fuzzy MICMAC techniques, which are not apparent within the present literature. In order to develop ISM and fuzzy MICMAC analysis, the barriers "lack of top management involvement" and "ineffective leadership" take up the bottom level of ISM model while "unawareness of measuring quality and customer satisfaction level" and "employee's resistance to change" are the top level of barriers. Later, this approach has been used to divide the barriers into driving, dependent, linkage and autonomous barriers corresponding to their dependence and driving powers. It helps the current organizations to prevent these identified barriers to successful TQM implementation and to improve organizational performance. Thus, it boosts the organizations to build a path of excellence and long term business strategy and develop economic, social, environmental and political growth. It is necessary for all the organizations to survive in the current competitive environment so, they need to generate significant capabilities of adapting to changing opportunities. The organizations in developing countries are often not changing their dynamics of identifying barriers. Thus, these need to develop their learning experiences and more importantly, to capture changing opportunities as quickly as possible. The TQM practices in organizations help to improve firm performance and generate a sustainable competitive advantage. Further, TQM with sustainability helps to enhance the quality and reduce the cost of quality with the lesser rejection of product quality. This study also provides some insights into how TQM practices can lead to mainstream economic and industrial development.

The unique contributions of this research work are as follows:

(1) Develops the model-based barriers on TQM implementation which is extracted from the TQM failure cases; so this research might be helpful for the present organizations in performance improvement and in building the long term business strategy.

(2) The ISM and fuzzy MICMAC techniques portray the contextual relationships among the barriers, and identifying the shortcomings would help top management and TQM practitioners in decision making to better utilize the available organizational resources. In the hierarchy level, the organizations need to prevent the barriers from constraining the sustained long term performance improvement. However, it does not mean that they are leaving the bottom level barriers.

(3) This study also helps to discard these TQM barriers and find a new way to implement it in the current manufacturing firms that contribute towards the nation's economy, especially in developing countries. Further, this study will help in improving the performance, saving efforts and money of the current organizations that are facing challenges of quality improvement and eventually, this study contributes towards the economy of the nation.

It is also important to address the boundaries of this study. The research on cases was made with some constraints such as the available resources, number of companies, and industry sectors, where this research is carried out with the sustainable goal of TQM practices. Here, we have developed an ISM and fuzzy MICMAC based model based on the experts' opinion. This model can be tested in a real case scenario to measure the strength of barriers influencing sustainable development. As the TQM barriers are identified and derived from the various failure cases, this can help to consider other such failure cases and try to prevent the identified barriers from impacting on the successful implementation of TQM in further research. The various barriers need to be identified so as to effectively implement lean six sigma programs in the current organizations and gives insight for future research. The future scope of this study could use various modeling techniques such as the Bayesian belief networks into the TQM practices that could significantly increase the quality of production with various operations, productivity, and performance. Moreover, it provides an excellence path for other industries to execute their business plans in further research.

References

Alkhafaji, A.F. (2003), *Strategic Management: Formulation, Implementation, and Control in a Dynamic Environment*, The Haworth Press, Binghamton, NY, ISBN 0-7890-1810-1.

Aquilani, B., Silvestri, C., Ruggieri, A. and Gatti, C. (2017), "A systematic literature review on total quality management critical success factors and the identification of new avenues of research", *The TQM Journal*, Vol. 29 No. 1, pp. 184-213.

Attri, R. and Grover, S. (2018), "Analysis of quality enabled factors in the product design stage of a production system life cycle: a relationship modelling approach", *International Journal of Management Science and Engineering Management*, Vol. 13 No. 1, pp. 65-73.

Badiru, A.B. (1990), "A systems-approach to total quality management", *Industrial Engineering*, Vol. 22 No. 3, pp. 33-36.

Baidoun, S.D., Salem, M.Z. and Omran, O.A. (2018), "Assessment of TQM implementation level in Palestinian healthcare organizations: the case of Gaza strip hospitals", *The TQM Journal*, Vol. 30 No. 2, pp. 98-115.

Brown, M.G., Hitchcock, D.E. and Willard, M.L. (1994), *Why TQM Fails and what to Do about it*, Irwin, Burr Ridge, IL.

Bastas, A. and Liyanage, K. (2019), "Integrated quality and supply chain management business diagnostics for organizational sustainability improvement", *Sustainable Production and Consumption*, Vol. 17, pp. 11-30.

Bruun, P. and Mefford, R.N. (1996), "A framework for selecting and introducing appropriate production technology in developing countries", *International Journal of Production Economics*, Vol. 46, pp. 197-209.

Bou, J.C. and Beltrán, I. (2005), "Total quality management, high-commitment human resource strategy and firm performance: an empirical study", *Total Quality Management and Business Excellence*, Vol. 16 No. 1, pp. 71-86.

Castka, P., Bamber, C.J., Sharp, J.M. and Belohoubek, P. (2001), "Factors affecting successful implementation of high performance teams", *Team Performance Management: International Journal*, Vol. 7 Nos 7/8, pp. 123-134.

Chiarini, A. (2013), "Building a Six Sigma model for the Italian public healthcare sector using grounded theory", *International Journal of Services and Operations Management*, Vol. 14 No. 4, pp. 491-508.

Cho, Y.S. and Linderman, K. (2019), "Metacognition-based process improvement practices", *International Journal of Production Economics*, Vol. 211 No. 1, pp. 132-144.

Colenso, M. (2000), "Kaizen strategies for improving team performance", *Team Performance Management: International Journal*, Vol. 6 Nos 1/2, pp. 37-38.

Curry, A. and Kadasah, N. (2002), "Focusing on key elements of TQM–evaluation for sustainability", *The TQM Magazine*, Vol. 14 No. 4, pp. 207-216.

Demirbag, M., Tatoglu, E., Tekinkus, M. and Zaim, S. (2006), "An analysis of the relationship between TQM implementation and organizational performance: evidence from Turkish SMEs", *Journal of Manufacturing Technology Management,* Vol. 17 No. 6, pp. 829-847.

Dilawo, R.S. and Salimi, Z. (2019), "Understanding TQM implementation barriers involving construction companies in a difficult environment", *International Journal of Quality & Reliability Management*, Vol. 36 No. 7, pp. 1137-1158.

Dubey, R. and Singh, T. (2015), "Understanding complex relationship among JIT, lean behavior, TQM and their antecedents using interpretive structural modelling and fuzzy MICMAC analysis", *The TQM Journal*, Vol. 27 No. 1, pp. 42-62.

Duperrin, J.C. and Godet, M. (1973), *Methode de hierarchisation des elements d'un systeme*, Rapport Economique du CEA, Paris, p. R-45-41.

Elhuni, M.R. and Ahmad, M.M. (2014), "Achieve sustainability through TQM framework", *International Journal of Applied Science and Technology*, Vol. 4 No. 2, pp. 133-142.

Ellram, L. (1991), "Key success factors and barriers in international purchasing partnerships", *Management Decision*, Vol. 29 No. 7, pp. 38-44.

Farris, D.R. and Sage, A.P. (1975), "On the use of interpretive structural modeling for worth assessment", *Computers and Electrical Engineering*, Vol. 2 Nos 2/3, pp. 149-174.

Fernandes, A.C., Sampaio, P., Sameiro, M. and Truong, H.Q. (2017), "Supply chain management and quality management integration: a conceptual model proposal", *International Journal of Quality & Reliability Management*, Vol. 34 No. 1, pp. 53-67.

Ferris, S.P., Quint, R. and Sant, R. (1998), "Financial theory and practice in the application of TQM: the case of IBM Rochester", *Journal of Managerial Issues,* Vol. 10 No. 1, pp. 13-29.

Fok, L.Y., Hartman, S.J., Patti, A.L. and Razek, J.R. (2000), "Human factors affecting the acceptance of total quality management", *International Journal of Quality & Reliability Management*, Vol. 17 No. 7, pp. 714-729.

Gauttam, V. (2010), "Total quality management: a case study of IBM", *International Referred Research Journal*, ISSN- 0974-2832, Vol. 2 No. 21, pp. 59-62.

Garson, G.D. and Vasu, M.L. (1994), "Analysis of ethical dynamics in public personnel administration", *Review of Public Personnel Administration*, Vol. 14 No. 3, pp. 75-93.

Gittell, J.H., Weinberg, D., Pfefferle, S. and Bishop, C. (2008), "Impact of relational coordination on job satisfaction and quality outcomes: a study of nursing homes", *Human Resource Management Journal*, Vol. 18 No. 2, pp. 154-170.

Gorane, S.J. and Kant, R. (2013), "Supply chain management: modelling the enablers using ISM and fuzzy MICMAC approach", *International Journal of Logistics Systems and Management*, Vol. 16 No. 2, pp. 147-166.

Greenwald, J. (2001), "Tired of each other, time", *Time*, Vol. 157 No. 22, pp. 51-56.

Glover, J. (1993), "Achieving the organizational change necessary for successful TQM", *International Journal of Quality & Reliability Management,* Vol. 10 No. 6, pp. 47-64.

Grover, S., Agrawal, V.P. and Khan, I.A. (2006), "Role of human factors in TQM: a graph theoretic approach", *Benchmarking: An International Journal*, Vol. 13 No. 4, pp. 447-468.

Green, K.W., Inman, R.A., Sower, V.E. and Zelbst, P.J. (2019), "Impact of JIT, TQM and green supply chain practices on environmental sustainability", *Journal of Manufacturing Technology Management*, Vol. 30 No. 1, pp. 26-47.

Harris, R.H. (1990), "Five roads to excellence", *Journal for Quality and Participation*, Vol. 13 No. 4, pp. 54-58.

Hasan, I.U., Sohail, M.M., Piracha, J.L. and Ahmad, K. (2013), "Implementation status of TQM practices in textile and apparel industrial organization: a case study from Faisalabad, Pakistan", *British Journal of Economics, Management & Trade*, Vol. 3 No. 3, pp. 201-223.

Heizer, J. and Render, B. (2007), *Operations Management*, Prentice-Hall, London.

Ho, D.C., Duffy, V.G. and Shih, H.M. (1999), "An empirical analysis of effective TQM implementation in the Hong Kong electronics manufacturing industry", *Human Factors and Ergonomics in Manufacturing & Service Industries*, Vol. 9 No. 1, pp. 1-25.

Hong, P., James, J.R. and Rawski, G. (2012), "Benchmarking sustainability practices: evidence from manufacturing firms", *Benchmarking*, Vol. 19 Nos 4/5, pp. 634-648.

IEA – International Ergonomics Association's Executive Council (August, 2000), "IEA definitions of Ergonomics", in Karwowski, W. (Ed.), *International Encyclopedia of Ergonomics and Human Factors*, London and New York: Taylor & Francis, p. 102.

International Organization for Standardization. (1994), "ISO 8402: 1994: quality management and quality assurance-vocabulary", International Organization for Standardization.

Isaksson, R. (2006), "Total quality management for sustainable development: process based system models", *Business Process Management Journal*, Vol. 12 No. 5, pp. 632-645.

Jharkharia, S. and Shankar, R. (2005), "IT-enablement of supply chains: understanding the barriers", *Journal of Enterprise Information Management*, Vol. 18 No. 1, pp. 285-309.

Joiner, T.A. (2007), "Total quality management and performance: the role of organization support and co-worker support", *International Journal of Quality & Reliability Management*, Vol. 24 No. 6, pp. 617-627.

Kanji, G. (2012), *Total Quality Management: Proceedings of the First World Congress*, Springer Science & Business Media, Sheffield Hallam University, Sheffield.

Kelada, J.N. (1996), *Integrating Reengineering with Total Quality*, ASQ Quality Press, QSIC, Wisconsin.

Khan, B.A. and Naeem, H. (2018), "Measuring the impact of soft and hard quality practices on service innovation and organisational performance", *Total Quality Management and Business Excellence*, Vol. 29 Nos 11-12, pp. 1402-1426.

Khurshid, M.A., Amin, M. and Ismail, W.K.W. (2018), "Total quality and socially responsible management (TQSR-M) an integrated conceptual framework", *Benchmarking: An International Journal*, Vol. 25 No. 8, pp. 2566-2588.

Kufidu, S. and Vouzas, F. (1998), "Human resource aspects of quality management: evidence from MNEs operating in Greece", *International Journal of Human Resource Management*, Vol. 9 No. 5, pp. 818-830.

Kumar, V. and Sharma, R.R.K. (2015), "Identifying critical success & failure factors for TQM implementation: extract from real case studies", in *Industrial Engineering and Engineering Management (IEEM), 2015 IEEE International Conference*, pp. 16-20.

Kumar, V. and Sharma, R.R.K. (2017a), "Exploring critical success factors for TQM implementation using interpretive structural modeling approach: extract from case studies", *International Journal of Productivity and Quality Management*, Vol. 21 No. 2, pp. 203-228.

Kumar, V. and Sharma, R.R.K. (2018), "Leadership styles and their relationship with TQM focus for Indian firms: an empirical investigation", *International Journal of Productivity and Performance Management*, Vol. 67 No. 6, pp. 1063-1088.

Kumar, V. and Sharma, R.R.K. (2017b), "An empirical investigation of critical success factors influencing the successful TQM implementation for firms with different strategic orientation", *International Journal of Quality and Reliability Management*, Vol. 34 No. 9, pp. 1530-1550.

Kumar, V. and Sharma, R.R.K. (2017c), "Relating management problem solving styles of leaders to TQM focus: an empirical study", *The TQM Journal*, Vol. 29 No. 2, pp. 218-239.

Lagrosen, Y. and Lagrosen, S. (2019), "Creating a culture for sustainability and quality–a lean-inspired way of working", *Total Quality Management and Business Excellence*, pp. 1-15.

Lau, H.C. and Idris, M.A. (2001), "The soft foundation of the critical success factors on TQM implementation in Malaysia", *The TQM Magazine*, Vol. 13 No. 1, pp. 51-62.

Lawler, E.E., Mohrman, S.A. and Ledford, G.E. (1992), *Employee Involvement and Total Quality Management: Practices and Results in Fortune 1000 Companies*, Jossey-Bass, San Francisco, CA.

Lee, D.M. (1988), "Interpretive structural modeling (ISM)", available at: http://sorach.com/items/ismdlee.pdf (accessed 14 September, 2018).

Malone, T.W. (1987), "Modeling coordination in organizations and markets", *Management Science*, Vol. 33 No. 10, pp. 1317-1332.

Mamman, A. and Saffu, K. (1998), "Short-termism, control, quick-fix and bottom line: toward explaining the Western approach to management", *Journal of Managerial Psychology*, Vol. 13 Nos 5/6, pp. 291-308.

Management Case Study (2015), *Management Case Study Rubber Meets Road Total*, California, available at: http://www.essaytown.com/paper/management-case-study-rubber-meets-road-total-18280 (accessed 5 June 2018).

Mandal, A. and Deshmukh, S.G. (1994), "Vendor selection using interpretive structural modeling (ISM)", *International Journal of Operations & Production Management*, Vol. 14 No. 6, pp. 52-59.

Mangla, S., Madaan, J., Sarma, P.R.S. and Gupta, M.P. (2014), "Multi-objective decision modelling using interpretive structural modelling for green supply chains", *International Journal of Logistics Systems and Management*, Vol. 17 No. 2, pp. 125-142.

McAdam, R., Miller, K. and McSorley, C. (2019), "Towards a contingency theory perspective of quality management in enabling strategic alignment", *International Journal of Production Economics*, Vol. 207 No. 1, pp. 195-209.

Mohammad, M.R.A. (2006), "The impact of organizational culture on the successful implementation of total quality management", *The TQM Magazine*, Vol. 18 No. 6, pp. 606-625.

Moktadir, M.A., Ali, S.M., Rajesh, R. and Paul, S.K. (2018), "Modeling the interrelationships among barriers to sustainable supply chain management in leather industry", *Journal of Cleaner Production*, Vol. 181, pp. 631-651.

Muruganantham, G., Vinodh, S., Arun, C.S. and Ramesh, K. (2018), "Application of interpretive structural modelling for analysing barriers to total quality management practices implementation in the automotive sector", *Total Quality Management and Business Excellence*, Vol. 29 Nos 5-6, pp. 524-545.

Newall, D. and Dale, B. (1990), "The introduction and development of a quality improvement process: a study", *International Journal of Production Research*, Vol. 29 No. 9, pp. 1747-1760.

Noggle, R. and Palmer, D.E. (2005), "Radials, rollovers and responsibility: an examination of the Ford-Firestone case", *Journal of Business Ethics*, Vol. 56 No. 2, pp. 185-204.

Padhi, N. and Palo, S. (2005), *Human Dimensions for Total Quality Management*, Atlantic Publishers & Dist, New Delhi.

Patri, R. and Suresh, M. (2018), "Factors influencing lean implementation in healthcare organizations: an ISM approach", *International Journal of Healthcare Management*, Vol. 11 No. 1, pp. 25-37.

Patrick Neumann, W. and Dul, J. (2010), "Human factors: spanning the gap between OM and HRM", *International Journal of Operations & Production Management*, Vol. 30 No. 9, pp. 923-950.

Patyal, V.S. and Koilakuntla, M. (2018), "Impact of organizational culture on quality management practices: an empirical investigation", *Benchmarking: An International Journal*, Vol. 25 No. 5, pp. 1406-1428.

Pickard, K.K. and Ermer, D.S. (1994), "Anticipating and overcoming resistance to TQM", in *Annual Quality Congress Proceedings-American Society for Quality Control*, p. 673.

Poister, T.H. and Harris, R.H. Jr (2000), "Building quality improvement over the long run: approaches, results, and lessons learned from the Penn DOT experience", *Public Performance and Management Review*, Vol. 24 No. 2, pp. 161-176.

Poonawalla, L. (1999), "Total quality through people participation", *Quality for Business Transformation, Challenges of Sustainable Excellence in the 21st Century, Institute of Directors*, New Delhi, pp. 85-90.

Porter, M. (1980), *Competitive Strategy*, Free Press, New York.

Potocki, K.A. and Brocato, R.C. (1995), "A system of management for organizational improvement", *Johns Hopkins apl technical digest*, Vol. 16 No. 4, pp. 402-412.

Prakash, A., Jha, S.K., Prasad, K.D. and Singh, A.K. (2017), "Productivity, quality and business performance: an empirical study", *International Journal of Productivity and Performance Management*, Vol. 66 No. 1, pp. 78-91.

Quality Management System (2011), "The greatest quality management system failures in history", *Quality Management System Education and Resources*, available at: http://qualitymanagementsystem.com/total-quality-management/the-greatest-quality-management-system-failures-in-history/ (accessed 10th June 2018).

Qubein, R.N. (2009), *Implementing Total Quality Management*, available at: http://www.personal-development.com/nido-qubein-articles/total-quality-management.htm (accessed 10 June 2018).

Rajesh, R. (2018), "On sustainability, resilience, and the sustainable–resilient supply networks", *Sustainable Production and Consumption*, Vol. 15, pp. 74-88.

Rajesh, R. (2019), "Social and environmental risk management in resilient supply chains: a periodical study by the Grey-Verhulst model", *International Journal of Production Research*, Vol. 57 No. 11, pp. 3748-3765.

Reed, R., Lemak, D.J. and Mero, N.P. (2000), "Total quality management and sustainable competitive advantage", *Journal of Quality Management*, Vol. 5 No. 1, pp. 5-26.

Rinehart, G.W. (2006), "How the Air Force embraced "partial quality" (and avoiding similar mistakes in new endeavors)", *Air & Space Power Journal*, Vol. 20 No. 4, pp. 34-44.

Sage, A.P. (1977), *Interpretive Structural Modelling: Methodology for Large-Scale Systems*, McGraw-Hill, New York.

Saleh, R.A., Sweis, R.J. and Mahmoud Saleh, F.I. (2018), "Investigation the impact of hard total quality management practices on operational performance in manufacturing organizations: evidence from Jordan", *Benchmarking: An International Journal*, Vol. 25 No. 7, pp. 2040-2064.

Scheiner, J.J. (1981), "Productivity improvement in the Pennsylvania department of transportation", *Public Productivity Review*, Vol. 5, pp. 14-20.

Schonberger, R.J. (1992), "Is strategy strategic? Impact of total quality management on strategy", *The Executive*, Vol. 6 No. 3, pp. 80-87.

Sharma, S. (1997), *TQM in Indian Engineering Industries*, Business Publications, Mumbai.

Sindhu, S., Nehra, V. and Luthra, S. (2016), "Identification and analysis of barriers in implementation of solar energy in Indian rural sector using integrated ISM and fuzzy MICMAC approach", *Renewable and Sustainable Energy Reviews*, Vol. 62, pp. 70-88.

Solomon, R.J. (1996), "Organization culture is the key to quality management", *American Medical News*, Vol. 39 No. 8, pp. 32-33.

Stringham, S.H. (2004), "Does quality management work in the public sector?", *Public Administration and Management: An Interactive Journal,* Vol. 9 No. 3, pp. 182-211.

Singh, R.K., Garg, S.K., Deshmukh, S.G. and Kumar, M. (2007), "Modelling of critical success factors for implementation of AMTs", *Journal of Modelling in Management*, Vol. 2 No. 3, pp. 232-250.

Sirvanci, M.B. (2004), "Critical issues for TQM implementation in higher education", *The TQM Magazine*, Vol. 16 No. 6, pp. 382-386.

Soltani, E., Lai, P. and Gharneh, N.S. (2005), "Breaking through barriers to TQM effectiveness: lack of commitment of upper-level management", *Total Quality Management*, Vol. 16 Nos 8-9, pp. 1009-1021.

Sweis, R.J., Elhawa, N.A. and Sweis, N.J. (2019), "Total quality management practices and their impact on performance: case study of Royal Jordanian airlines", *International Journal of Business Excellence*, Vol. 17 No. 2, pp. 245-263.

Talapatra, S. and Uddin, M.K. (2019), "Prioritizing the barriers of TQM implementation from the perspective of garment sector in developing countries", *Benchmarking: An International Journal*, Vol. 26 No. 7, pp. 2205-2224.

Talib, F., Rahman, Z. and Qureshi, M.N. (2011), "Analysis of interaction among the barriers to total quality management implementation using interpretive structural modeling approach", *Benchmarking: An International Journal*, Vol. 18 No. 4, pp. 563-587.

Taveira, A.D., James, C.A., Karsh, B.-T. and Sainfort, F. (2003), "Quality management and the work environment: an empirical investigation in a public sector organization", *Applied Ergonomics*, Vol. 34 No. 4, pp. 281-291.

Taylor, W. (1997), "Leadership challenges for smaller organizations: self perceptions of TQM implementation", *Omega, International Journal of Management Science*, Vol. 25 No. 5, pp. 567-579.

Teixeira, H., Lopes, I. and Sousa, S. (2015), "Prioritizing quality problems in SMEs: a methodology", *The TQM Journal*, Vol. 27 No. 1, pp. 2-21.

Tsironis, L.K. (2018), "Quality improvement calls data mining: the case of the 7 new quality tools", *Benchmarking: An International Journal, Benchmarking: An International Journal*, Vol. 25 No. 1, pp. 47-75.

Ugboro, I.O. and Obeng, K. (2000), "Top management leadership, employee empowerment, job satisfaction, and customer satisfaction in TQM organizations: an empirical study", *Journal of Quality Management*, Vol. 5 No. 2, pp. 247-272.

Voss, C.A., Chisea, V. and Coughlan, P. (1994), "Developing benchmarking and self-assessment frameworks in manufacturing", *International Journal of Operations & Production Management*, Vol. 14 No. 3, pp. 83-97.

Warfield, J.W. (1974), "Developing interconnected matrices in structural modelling", *IEEE Transcript on Systems, Men and Cybernetics*, Vol. 4 No. 1, pp. 81-87.

Wei, J.T., Chang, Y.W., Zhang, X., Wu, H.H. and Tang, Y.T. (2017), "Performance measurement systems, TQM and multi-level firm performance: a person–organisation fit perspective", *Total Quality Management & Business Excellence*, Vol. 30 Nos 15-16, pp. 1578-1595.

Wild, R. (1995), *Production and Operations Management: Text and Cases*, 5th ed., Cassell, London.

Yadav, G., Seth, D. and Desai, T.N. (2018), "Application of hybrid framework to facilitate lean six sigma implementation: a manufacturing company case experience", *Production Planning & Control*, Vol. 29 No. 3, pp. 185-201.

Zairi, M. (2002), "Beyond TQM implementation: the new paradigm of TQM sustainability", *Total Quality Management*, Vol. 13 No. 8, pp. 1161-1172.

Further reading

Eisenhardt, K.M. (1989), "Building theories from case study research", *Academic Management Review*, Vol. 14, pp. 532-550.

Graham, W. and Gray, R. (2006), "How the Air Force Embraced "partial quality" (and avoiding similar mistakes in new endeavors)", *Air & Space Power Journal- Winter*, Vol. 20 No. 4, pp. 34-43.

Jerry, G. (1996), "Achieving the organizational change necessary for successful TQM", *International Journal of Quality & Reliability Management*, Vol. 10 No. 6, pp. 47-64.

Ljungström, M. and Klefsjö, B. (2002), "Implementation obstacles for a work development-oriented TQM strategy", *Total Quality Management*, Vol. 13 No. 5, pp. 621-634.

Narula, S., Pal, S., Saini, V., Saxena, P., Goyal, A. and Yadav, M. (2018), "Role of TQM in sustained business performance in Indian automotive supply chain", in *Harnessing Human Capital Analytics for Competitive Advantage*, IGI Global, pp. 121-143.

Ravi, V. and Shankar, R. (2005), "Analysis of interactions among the barriers of reverse logistics", *Technological Forecasting and Social Change*, Vol. 72 No. 8, pp. 1011-1029.

Robert, N. and Daniel, E.P. (2005), "Radials, rollovers and responsibility: an examination of the ford-firestone case", *Journal of Business Ethics*, Vol. 56, pp. 185-204, Reprinted in Case Studies in Business Ethics, 5 ed., edited by Al Gini, Prentice Hall.

Saravanan, R. and Rao, K.S.P. (2006), "Development and validation of an instrument for measuring total quality service", *Total Quality Management and Business Excellence*, Vol. 17 No. 6, pp. 733-749.

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