Justification of synergistic implementation of TQM-SCM using fuzzy-based simulation model

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Abstract

Purpose – The purpose of this paper is to evaluate the contribution of significant factors in the success of supply chain management (SCM) implementation and in synergistic approach (SCM-TQM) terms of business performance of Indian medium- and large-scale manufacturing industry.

Design/methodology/approach – This research paper deploys the fuzzy inference system (fuzzy logic tool box) to evaluate the success of SCM and synergistic approach's implementation. For this purpose, significant factors for each SCM approach as well as synergistic approach are identified from relevant literature and validated by industry experts.

Findings – The results of fuzzy rule viewer and surface view tool of fuzzy tool box in MATLAB have highlighted that synergistic approach is better as compared to SCM approach. Furthermore, top management support and leadership role, SCM issues and total quality management (TQM) issues have emerged as significant predictor variables for successful synergistic implementation of TQM-SCM in Indian industries.

Originality/value – TQM and SCM are considered as performance improvement techniques by the manufacturing organizations. The present research work establishes that combined (TQM-SCM) initiatives have contributed more as compared to only SCM approach in the business performance of Indian manufacturing industry. So, the study stresses upon the need for improving coordination between various manufacturing parameters as well as competitive dimensions of TQM and SCM paradigms to enjoy higher potential of business performance.

Keywords Fuzzy inference system, Business performance parameters, SCM implementation, Synergistic implementation

Paper type Research paper

1. Introduction

Industries have played an important role in terms of the economic growth and national development. However, Indian manufacturing industries lack, because manufacturing in India is still a mere 16 percent of the country's GDP while it is 34 percent for China and 40 percent for Thailand (Gorane and Kant, 2017). In other words, till date, India's manufacturing sector has not performed well as compared to some other large emerging economies. Moreover, nowadays customers' major considerations are product quality and service quality; they want high quality products and fast delivery (Randhawa and Ahuja, 2018). As a result of this scenario, Indian organizations are under pressure to search new methods to enhance profitability and sustainability in today's market (Sundharam *et al.*, 2013; Govindan *et al.*, 2016). So to survive, manufacturing firms across the world has provided consistent impetus to introduce innovative

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manufacturing management approaches (Singh and Ahuja, 2014). Total quality management (TQM) and supply chain management (SCM) are innovative improvement approaches to seek improvement in business performance. Implementation of these strategies had helped organizations all over the world, in terms of attaining customer satisfaction, reliability, productivity, market share, timely delivery, profitability and even survival. Customer satisfaction in terms of product availability, delivery, innovation and quality dimensions can be achieved by the implementation of TQM and SCM strategies (Sharma and Modgil, 2015). Hence, organizations emphasized the importance of adopting different improvement strategies such as TQM and SCM on synergistic basis for boosting business performance (Kaur *et al.*, 2019).

In recent years, SCM has emerged as a major inter-organizational practice for gaining competitive advantage especially through networks with suppliers and customers (Janvier-James, 2012) to improve their performance (Ou *et al.*, 2010). Likewise, TQM is recognized as a key strategy to enhance performance of the firms (Mensah *et al.*, 2012) in terms of organizational excellence (Goetsch and Davis, 2013), and improves competitiveness in the global marketplace (Altayeb and Alhasanat, 2014) through reducing costs and increasing productivity (Psomas *et al.*, 2014) of the physical and human organizational assets (Silva *et al.*, 2014).

Furthermore, the literature reveals that a firm's quality management (QM) approaches and SCM practices complement each other and need to be integrated to achieve superior financial and business performance (Terziovski and Hermel, 2011). Therefore, keeping in view the literature and individual benefits of TQM and SCM approaches, researchers have diverted their energy on the synergies of QM and SCM in order to enhance supply chain performance (Robinson and Malhotra, 2005; Foster and Ogden, 2008; Kuei *et al.*, 2011; Quang *et al.*, 2016; Zhong *et al.*, 2016; Gu *et al.*, 2017; Fernandes *et al.*, 2017; Kaur *et al.*, 2019). This area has been formally termed as supply chain quality management (SCQM).

Furthermore, The mediating effect of integration of TQM and SCM is recognized in terms of enhanced supply chain integration (Mahdiraji *et al.*, 2012; Quang *et al.*, 2016; Zhong *et al.*, 2016; Gu *et al.*, 2017), improved customer satisfaction (Mahdiraji *et al.*, 2012; Sharma and Modgil, 2015; Quang *et al.*, 2016; Gu *et al.*, 2017), enhanced firm performance (Mahdiraji *et al.*, 2012; Quang *et al.*, 2016; Sharma and Modgil, 2015; Zhong *et al.*, 2016) and improved supply chain performance (Mahdiraji *et al.*, 2012; Zhong *et al.*, 2016). Therefore in practice, by getting inspiration from other globally leading organizations, Indian manufacturing organizations are likely to combine both TQM and SCM in order to enhance their business performance.

The paper is organized as follows. It starts with a review of the literature pertinent to SCM and synergistic approach's (TQM-SCM) significant factors. The next section discusses the adopted quantitative methodology followed by an analysis of the data by using fuzzy logic approach. The final section deals with conclusion of the study.

2. Literature review

This section presents a review of the literature on significant factors of SCM approach, synergistic approach (TQM-SCM), and fuzzy logic interface.

2.1 Business performance improvement by SCM: significant factors

As SCM is interdisciplinary by origin, it has various definitions. SCM concept is defined by Shimchi-Levi *et al.* (2000) and Park and Krishnan (2001) as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right location and at the right time, in order to minimize system-wide costs while satisfying service-level requirements.

SCM has been increasingly recognized as an important source of competitive advantage (Carter, 2011).

Furthermore, the literature reveals that the successful implementation of SCM strategy in the organizations has to consider number of success factors like customer relationship, strategic supplier partnership, corporate culture, material management, information and communication technologies and close supplier partnership (Talib *et al.*, 2011; Sundram *et al.*, 2011; Chong *et al.*, 2011; Kumar *et al.*, 2015; Shrikant and Kant, 2017; Kaur *et al.*, 2019) and the implementation of these factors contributes in the success of the SCM (Metilda and Vivekanandan, 2011).

2.2 Synergistic approach (TQM-SCM) and its critical practices for manufacturing industry: a review

This synergy of TQM and SCM has been formally termed as SCQM (Lin and Gibson, 2011). As with all scholarly endeavors in other fields, a range of different definitions of SCQM has so far been offered by different authors. For example, Robinson and Malhotra (2005) defined SCQM as the formal coordination and integration of business processes involving all partner organization in the supply channel to measure, analyze and continually improve products, services, and processes in order to create value and achieve satisfaction of intermediate and final customers in the marketplace. Furthermore, Foster and Ogden (2008) view the SCQM to signal a more "systems-based and holistic approach to performance improvement which consider not only internal processes but also upstream and downstream processes and dynamics."

Furthermore, another important area in the literature of SCQM is a set of practices and critical factors that characterize the importance of SCQM in terms of organizations performance. A number of recent studies have pointed to the potential synergies between TQM and SCM (e.g. Sroufe and Curkovic, 2008; Foster and Ogden, 2008; Kuei *et al.*, 2011; Quang *et al.*, 2016; Zhong *et al.*, 2016; Gu *et al.*, 2017; Fernandes *et al.*, 2017) and provided a fertile area for elucidating SCQM practices. For example, Quang *et al.* (2016) proposed a structural model consisting of three factors as second-order latent constructs, namely, internal process, supplier management and information. These constructs are described as: internal process includes product/service design, process management, logistic; supplier management deals with supplier assessment and supplier QM; and information sharing, information quality, information management and information technology aspects are considered under information construct. Furthermore, Fernandes *et al.* (2017) have purposed a conceptual model in terms of five major practices, namely, leadership, management and strategic planning, stakeholders' involvement and commitment, information, continuous improvement and innovation, considered being of great importance for the integration of both TQM and SCM. More recently, Kaur *et al.* (2019) have purposed conceptual model on the basis of literature review and found that management support and commitment, customer focus, information, workforce development and supplier partnership are the most common factors found in both TQM and SCM practices for their synergistic benefits and issues related to integration of TQM and SCM throughout the supply chain has the strongest impact on the organizational performance.

From elaborated literature study, it is found that there are a large number of success factors for SCM approach and synergistic approach to ensure successful implementation. But this becomes a multi criteria decision-making problem for the various supply chain managers and quality control managers. So the current study makes an effort to seek the situation by the fuzzy logic tool box of MATLAB. Furthermore, the critical success factors considered for the current study in context of Indian manufacturing organizations have been evaluated through consultation of academicians, SCM practitioners, TQM consultants, HR executives from the various manufacturing industries and review of elaborated literature.

The most significant factor considered assessing the suitability through fuzzy-based simulation for SCM approach and synergistic approach are:

- Factors for SCM: top management support and leadership role (TMSLR), issues related to strategic supplier partnership (SSPI) and information technology issues (ITI).
- Factors for synergistic approach: TMSLR, SCM issues (SCMI) and TQM issues (TQMI).

Furthermore suitable success of SCM implementation and synergistic approach model is expressed by the following equations:

$$\text{SCM implementation} = f\{\text{TMSLR, SSPI, ITI}\}, \tag{1}$$

$$\text{Synergistic approach implementation} = f\{\text{TMSLR, SCMI, TQMI}\}. \tag{2}$$

2.3 Fuzzy inference system (FIS): brief introduction

Zadeh (1965) developed fuzzy logic technique in which different numbers of inputs are related with output with the help of certain rules. These rules represent the relationship between the considered inputs and outputs. FIS utilizes fuzzy logic to obtain the mapping from a given input to an output which helps in making basis on which the decision can be taken and pattern can be distinguished. The FIS description is presented in Figure 1. The fuzzy logic tool box consists of two FIS, namely, Mamdani type and Sugeno type.

Mamdani type developed by Mamdani and Assilian in 1975 is the most common methodology of fuzzy logic. This method is applied for capturing expert knowledge while Sugeno inference method is particularly used when the inputs are given by the machines or instruments. Furthermore, Mamdani-type FIS allows us to describe the expertise in more intuitive, more human-like manner (Wang, 2015) and due to this nature is widely used in particular for decision support applications. Even the current study has utilized Mamdani-type FIS to establish the significance of critical factors for the high success of SCM approach and synergistic approach in the Indian manufacturing organizations (Wang, 2015; Blej and Azizi, 2016; Randhawa and Ahuja, 2018).

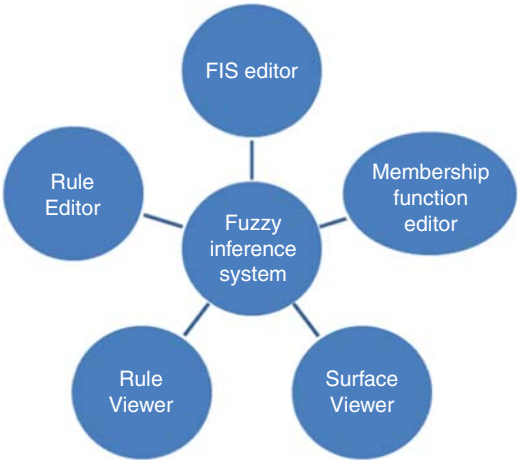

Figure 1.
FIS description

3. Research framework and methodology

In the current study, fuzzy logic software, technically known as Fuzzy inference system is utilized. In this technique different inputs are related with output by the formation of some if –then rules. The critical factors represented by Equation (1) act as the inputs to (FIS system) for SCM approach and factors presented in Equation (2) are inputs for FIS system in case of synergistic approach.

Furthermore, for each of these criteria linguistic variables are developed which are used for evaluating performance. The linguistic variables used are "low," "moderate" and "high" for the input factor TMSLR, and for the other input factors SSPI, ITI, SCMI and TQMI, five linguistic variables are considered which are termed as "very low," "low," "medium," "high" and "very high." For the output termed as "performance index" four linguistic variables are considered "Reject," "under consideration," "Acceptable" and "Optimum." The flowchart depicting the procedure of FIS deployed in the research study is shown in Figure 2.

4. Fuzzification of SCM

The empirical transfer function of SCM implementation is represented in Figure 3 on the basis of Equation (1). It is considered as fuzzy logic system having inputs and output being fuzzified with the help of suitable membership functions. The three input factors are

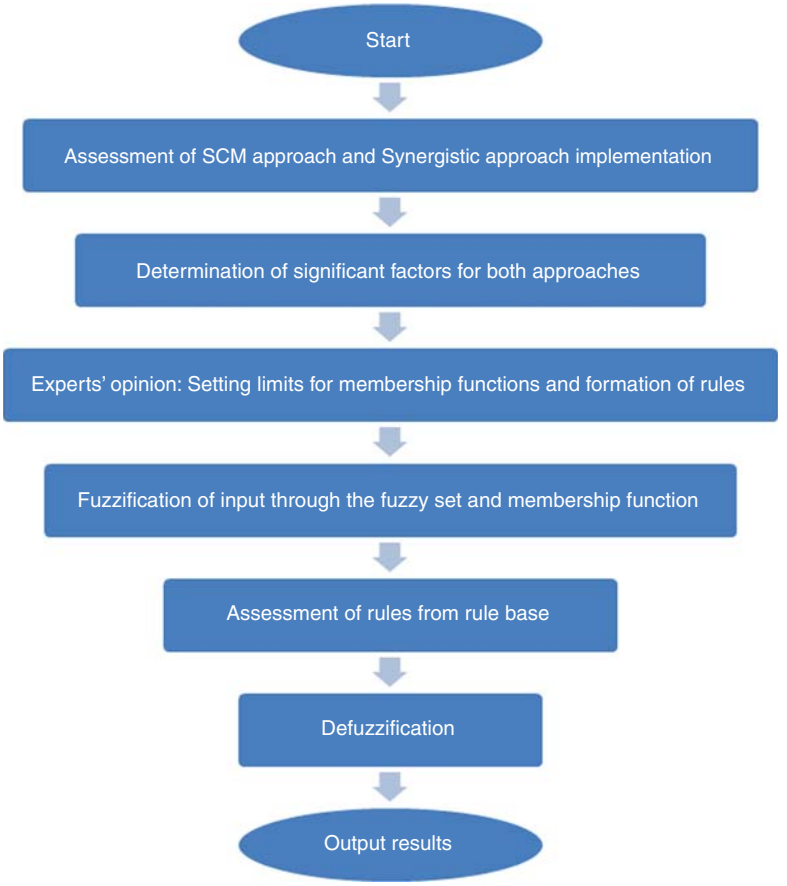

Figure 2.
FIS procedure adopted in present study

considered, namely, TMSLR, issues related to strategic supplier partnership (SSPI) and ITI. The result of output shows whether to select SCM approach or not in context of Indian manufacturing organizations. The following sections explain each component of the system.

4.1 Top management support and leadership role (TMSLR)

The role played by TMSLR in the successful implementation of SCM is measured in terms of improvement in the business performance. If the involvement of top management is between 0 and 0.33 then the success of SCM is low, if the value of TMSLR lies between 0.33 and 0.66 then the success of SCM is moderate and if the value lies between 0.66 and 1 then the success of SCM implementation is high as represented in Table I. The transfer function in the fuzzy format TMSLR is as shown in Figure 4.

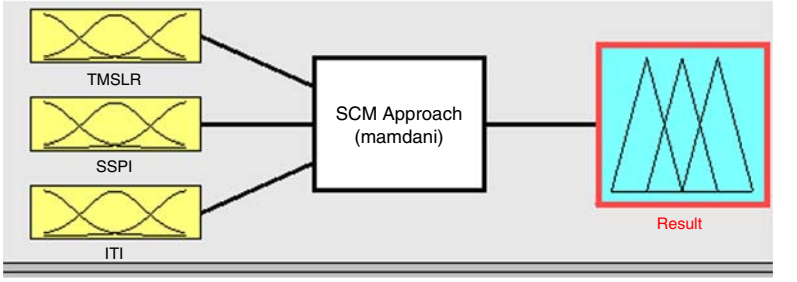

Figure 3.
Transfer function in fuzzy format of SCM approach

Note: See online version for colors

Fuzzy	Linguistic term	Range (proportion of TMSLR)
1	Low	0–0.33
2	Medium	0.33–0.66
3	High	0.66–1

Table I.
Range for TMSLR

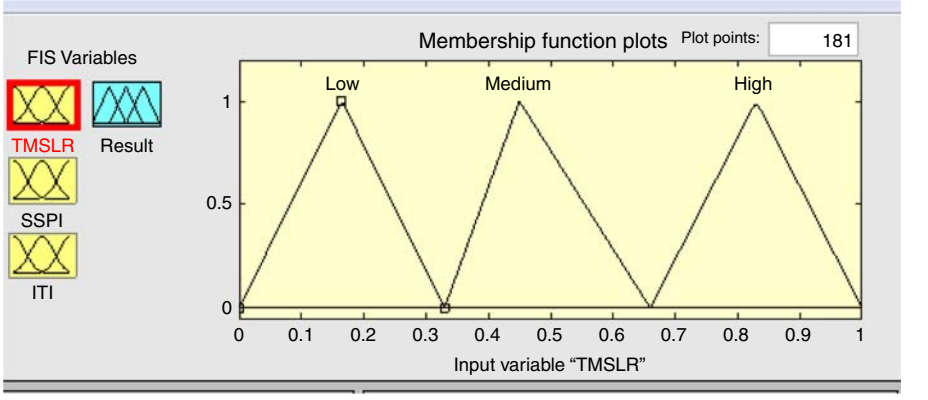

Figure 4.
Transfer function in fuzzy format of TMSLR

Note: See online version for colors

4.2 Issues related to strategic supplier partnership (SSPI)

The second input factor considered is the SSPI to measure the success of SCM implementation in Indian manufacturing organizations. If the range of SSPI is up to 20 percent, then the success of SCM implementation is very low, if it settled between 20 and 40 percent then the success of SCM approach is low, if range of settled issues is 40–60 percent then success of SCM approach is moderate, if it settled between 60 and 80 percent then the success of SCM approach is high and if it is settled between 80 and 100 percent then the success of SCM implementation is extremely high as represented in Table II and the transfer function in the fuzzy format of IRSSP is shown in Figure 5.

4.3 Information technology issues (ITI)

The third input factor is the ITI, they are carried to measure the role in the successful implementation of SCM in manufacturing organizations. The fuzzy set rules defined for ITI were set as if the ITI are settled up to 20 percent then the success of SCM is very low, if it settled between 20 and 30 percent then the success of this approach is low, if it settled between 30 and 60 percent then success of SCM approach is moderate, if this range is 60–80 percent then the success of SCM is high and if it is settled between 80 and 100 percent then the success of SCM implementation is extremely high as shown in Table III. The transfer function in the fuzzy format of ITI is shown in Figure 6.

4.4 Results: checking the suitability of only SCM approach

The results help to decide whether to select SCM approach or not through the involvement of three critical input factors considered in the study. Result values in the range

Fuzzy	Linguistic term	Range (proportion of SSPI)
1	Very low	0–0.2
2	Low	0.2–0.4
3	Medium	0.4–0.6
4	High	0.6–0.8
5	Very high	0.8–1

Table II.
Range for SSPI

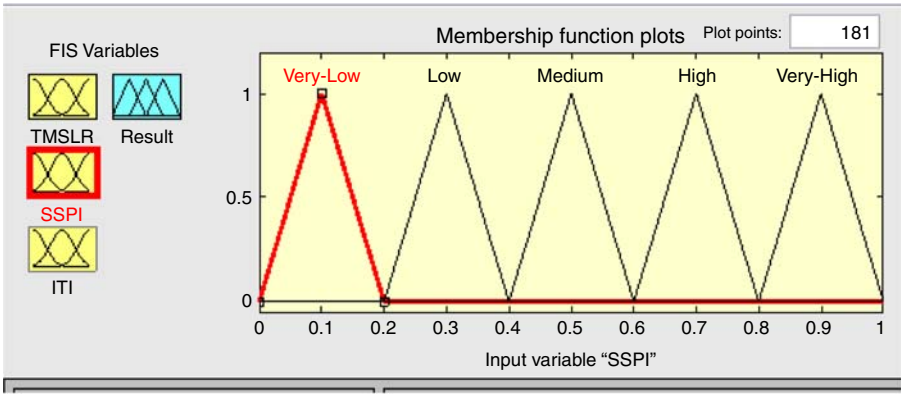

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Figure 5.
Transfer function in fuzzy format of SSPI

of 0–0.3 are considered as reject SCM success, between 0.3 and 0.6 are considered as poor (under consideration), between 0.6 and 0.8 are considered as acceptance of SCM approach and between 0.8 and 1 are considered as optimum approach as shown in Table IV. The transfer function in fuzzy format is depicted in Figure 7.

4.5 Fuzzy evaluation rules for SCM approach

After the membership functions (the triangular membership function for input and Gauss membership function for output) and linguistic variables for both input and output are entered, the rules are designated and written in MATLAB fuzzy tool box for evaluation of the system. Total 75 rules are developed with the help of expert's opinion, SCM managers and HR executive, and entered into MATLAB fuzzy tool box rule editor as shown in Figure 8. Here for an example of one rule if TMSLR is low and SSPI are settled very low and ITI are settled very low then SCM approach is rejected. Table V represents the rules considered for the system.

Table III.
Range for ITI

Fuzzy	Linguistic term	Range (proportion of ITI)
1	Very low	0–0.2
2	Low	0.2–0.3
3	Medium	0.3–0.6
4	High	0.6–0.8
5	Very high	0.8–1

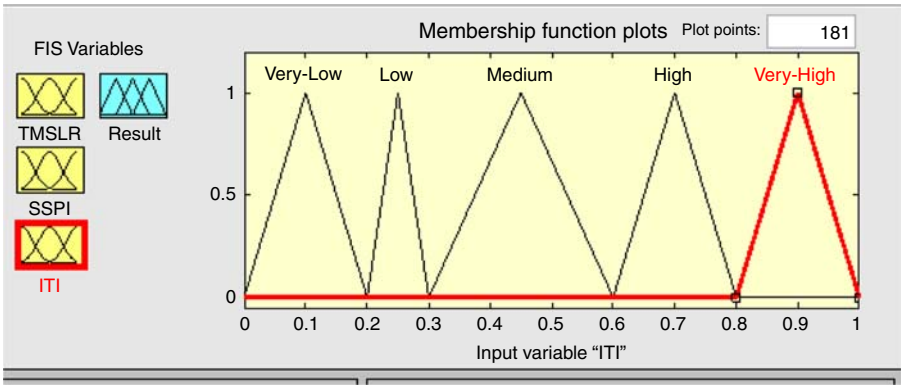

Figure 6.
Transfer function in fuzzy format of ITI

Note: See online version for colors

Table IV.
Range for successful SCM implementation

Fuzzy	Linguistic term	Range
1	Reject	0–0.3
2	Under consideration	0.3–0.6
3	Acceptable	0.6–0.8
4	Optimum	0.8–0.1

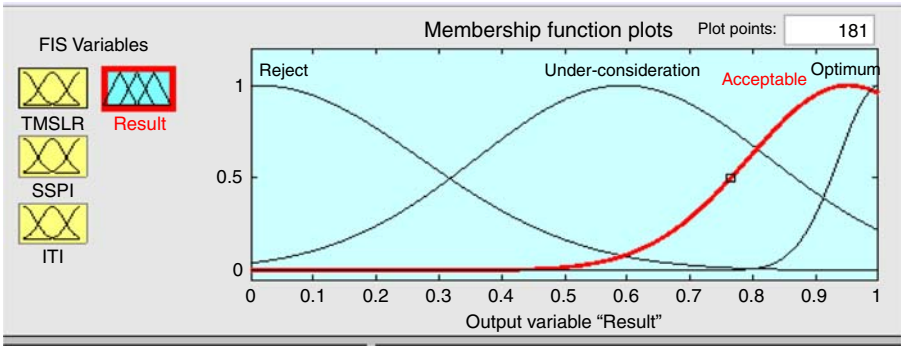

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Figure 7.
Transfer function in fuzzy format of suitability of SCM implementation

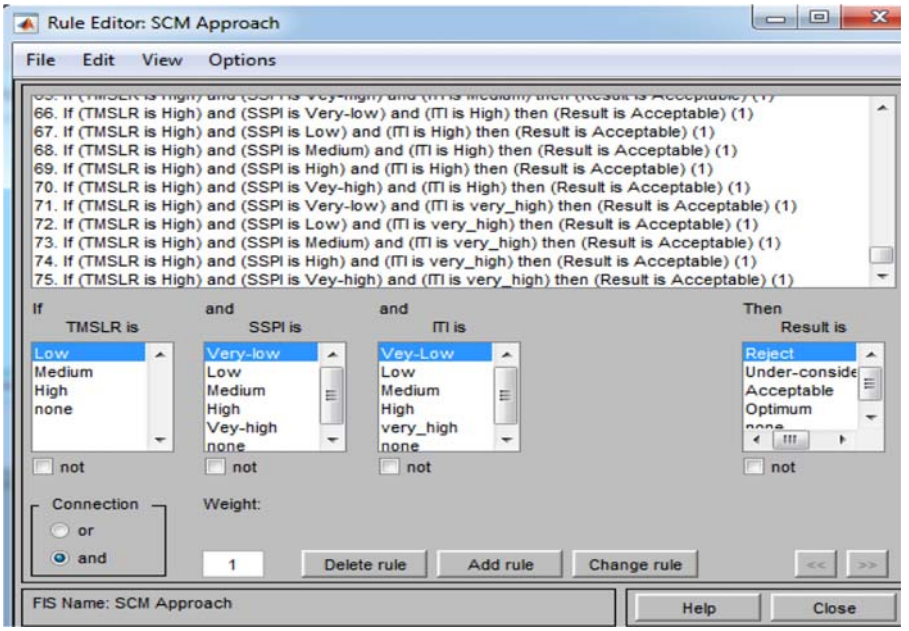

Figure 8.
Fuzzy evaluation rules for SCM approach

4.6 Fuzzy solution results for SCM approach

The rule viewer of fuzzy tool box of MATLAB is used to obtain fuzzy solutions for Condition (1) as represented in Figure 9. The rule viewer represents a guide of the entire fuzzy inference process and it depends on the fuzzy inference diagram. The rule viewer permits translating the whole fuzzy inference process at once. Furthermore, it indicates how the shape of MFs effect the general outcome as it plots all aspects of every rule. Each rule is a row of plots and each column is a variable. The rule numbers are represented on the left side of each rule. In order to view any rule, click on a rule number. Moving forward, the three inputs can be set within the upper and lower limits and the output reaction is observed as a score that can be converted into linguistic terms. In this case the output business

SSPI / ITI	Very low	Low	Medium	High	Very high
When top management support and leadership role (TMSLR) is low					
Very low	Reject	Reject	Reject	Accept	Accept
Low	Reject	Reject	Reject	Accept	Accept
Medium	Reject	Reject	Accept	Accept	Accept
High	Reject	Accept	Accept	Accept	Accept
Very high	Reject	Accept	Accept	Accept	Accept
When top management support and leadership role (TMSLR) is moderate					
Very low	Reject	Reject	Accept	Accept	Accept
Low	Reject	Reject	Accept	Accept	Accept
Medium	Accept	Accept	Accept	Accept	Accept
High	Accept	Accept	Accept	Accept	Accept
Very high	Accept	Accept	Accept	Accept	Accept
When top management support and leadership role (TMSLR) is high					
Very low	Reject	Accept	Accept	Accept	Accept
Low	Reject	Accept	Accept	Accept	Accept
Medium	Accept	Accept	Accept	Accept	Accept
High	Accept	Accept	Accept	Accept	Accept
Very high	Accept	Accept	Accept	Accept	Accept

Table V.
Rules for fuzzy evaluation of SCM approach

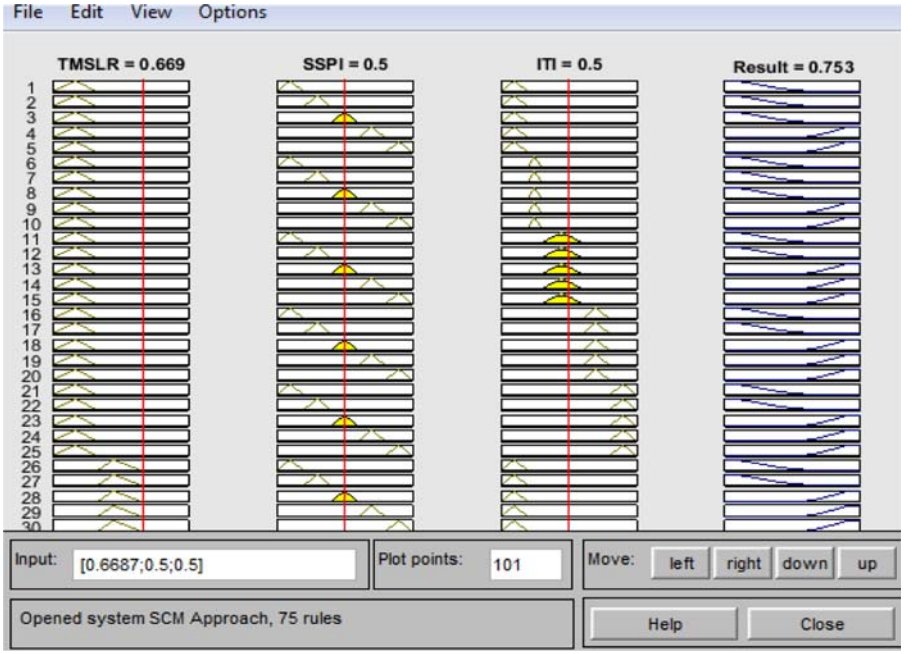

Figure 9.
Rule viewer for SCM implementation results

performance of 0.753 indicates "Acceptance of SCM approach" linguistically. The entire output surface of the framework – the entire traverse of the output set on the basis of the whole span of the input set – is depicted in Figures 10 and 11 by the surface viewer of FL tool box GUI tool.

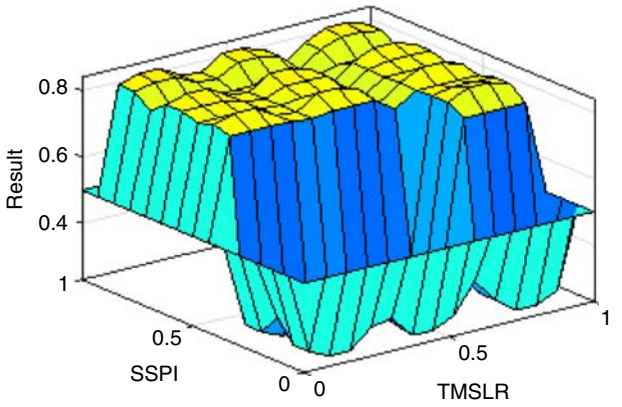

Figure 10.
Output surface viewer of fuzzy tool box (TMSLR:SSPI:Results)

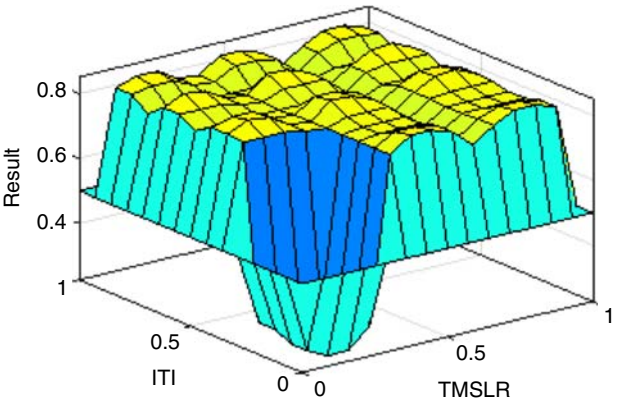

Figure 11.
Output surface viewer of fuzzy tool box (TMSLR: ITI: Results)

5. Fuzzification of synergistic approach (TQM-SCM)

The three input factors, namely, TMSLR, SCMI and TQMI are considered for the synergistic approach. Figure 12 represents the empirical transfer function of TQM-SCM implementation on the basis of Equation (2) as a FL system with inputs and output being fuzzfized using membership functions. The following sections narrate the remaining two components of system. As far as the fuzzy set rules for TMSLR is concerned they have been taken same as discussed earlier in Table I and its transfer function in fuzzy format is shown in Figure 13.

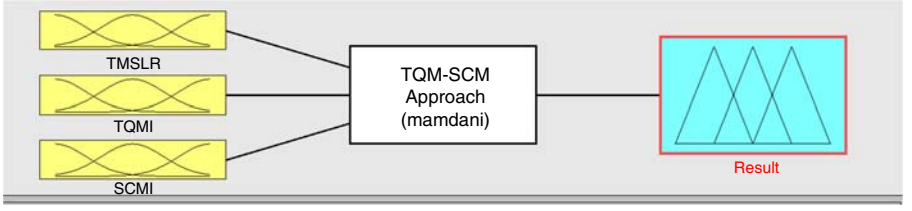

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Figure 12.
Transfer function in fuzzy format of TQM-SCM approach

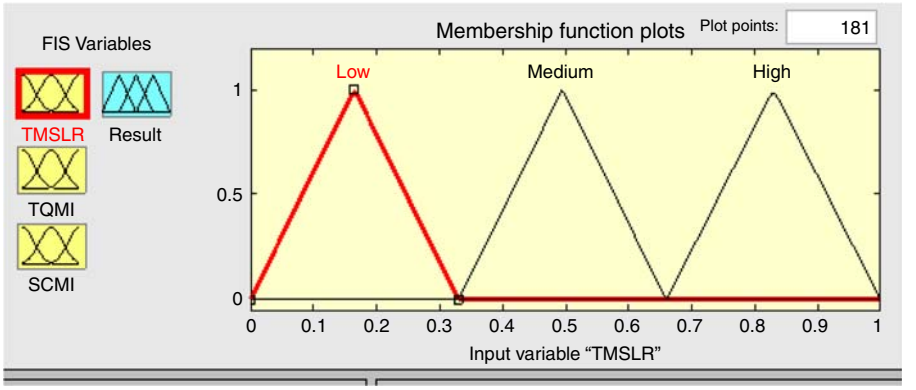

Figure 13.
Transfer function in fuzzy format of TMSLR

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5.1 Supply chain management issues (SCMI)

Second input factor considered is SCMI that basically covers completion of daily schedule as planned in order to achieve high rating of delivery throughout supply chain, material management issues and logistics issues. The fuzzy set rules defined for this issue were set as: if SCMI are settled up to 20 percent then the success of synergistic approach is very low, if it is settled between 20 and 40 percent then this approach's success is low, if it is settled between 40 and 60 percent then there is moderate success, if it is settled between 60 and 80 percent then the success of stated approach is high, if it is settled down between 80 and 100 percent then the success of implementation of synergistic approach is extremely high as shown in Table VI. The transfer function in the fuzzy format of stated issue is depicted in Figure 14.

Table VI.
Range for SCMI

Fuzzy	Linguistic term	Range (proportion of SCMI)
1	Very low	0–0.2
2	Low	0.2–0.4
3	Medium	0.4–0.6
4	High	0.6–0.8
5	Very high	0.8–1

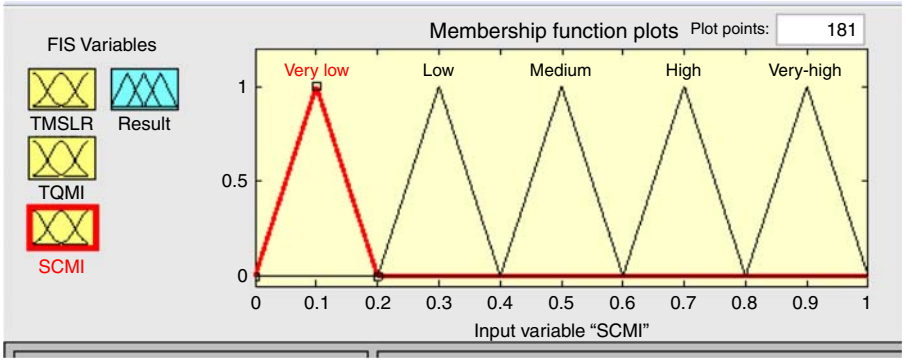


Figure 14.
Transfer function in fuzzy format of SCMI

Note: See online version for colors

5.2 Total quality management issues (TQMI)

Another important factor considered for successful implementation of synergistic approach in terms of business performance is TQMI. It deals with serious commitment of whole supply chain toward quality improvements, continuous improvement, informal benchmarking, etc. The linguistic terms established for this factor are that if the TQMI in the implementation of synergistic approach are settled up to 20 percent then the success of this program is very low, if it is settled between 20 and 40 percent then the program success is low, if it is settled between 40 and 60 percent then there is moderate success, if it settled between 60 and 80 percent then the success of program is high, if it is settled down between 80 and 100 percent then the success of synergistic approach implementation is extremely high as shown in Table VII. The transfer function in the fuzzy format of TQMI is depicted in Figure 15.

5.3 Results: checking the suitability of synergistic (TQM-SCM) approach

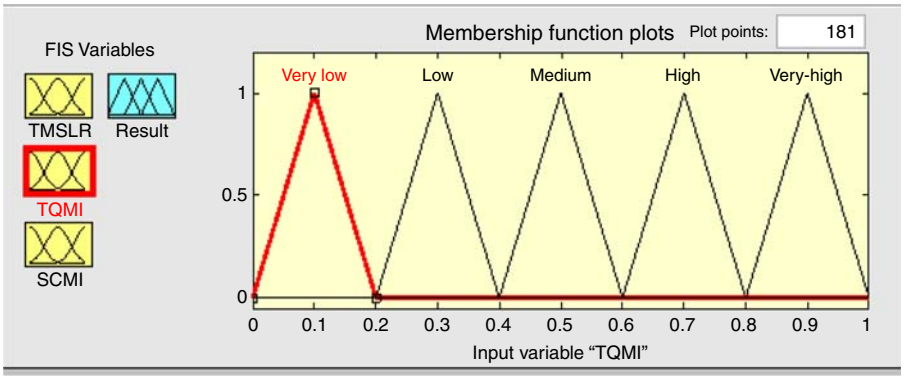
Here the analysis of result is carried out to decide whether to select synergistic approach or not. If the result values lie between 0 and 0.3 it is considered as reject approach, between 0.3 and 0.6 is considered as poor (under consideration), between 0.6 and 0.8 is considered as acceptance of synergistic approach and between 0.8 and 1 is considered as optimum approach as shown in Table VIII. The transfer function in fuzzy format is depicted in Figure 16.

5.4 Fuzzy evaluation rules for synergistic approach

The fuzzy rules considered to check the level of success of synergistic approach are shown in Table IX. In total, 75 rules are developed following the format corresponding to conditions of inputs: if (condition a) and (condition b) and (condition c) then (result). The fuzzy set rules

Fuzzy	Linguistic term	Range (proportion of TQMI)
1	Very low	0–0.2
2	Low	0.2–0.4
3	Medium	0.4–0.6
4	High	0.6–0.8
5	Very high	0.8–1

Table VII.
Range for TQMI



Note: See online version for colors

Figure 15.
Transfer function in fuzzy format of TQMI

have been formed considering three different cases of "Top management support and leadership role" between issues related to TMSLR, SCMI and TQMI, i.e. when TMSLR is low, optimum and high as shown in Figure 17.

5.5 Fuzzy solution results for synergistic approach

A continuum of fuzzy solutions for Condition (2) is shown in Figure 18 with the help of rule viewer of fuzzy tool box of MATLAB. Here, the limits of three inputs, namely, TMSLR, SCMI and TQMI can be set within the upper and lower limits and the output is recorded as a score that can be converted into linguistic terms. In this case, if the value of issues related to TMSLR is entered 0.5 (optimal value), SCMI 0.5 (optimal value) and TQMI 0.5 (optimal value), value of output comes to be 0.856 which specifies that synergistic approach is highly recommended (optimum approach). The entire output surface of the synergistic approach – the entire traverse of the output set on the basis of the whole span of the input set – is depicted in Figures 19 and 20. Hence, this paper attempts to prove that synergistic approach of TQM-SCM can improve business performance in better way than applying these drives on isolation basis in Indian manufacturing organizations.

6. Conclusion

The current study furnishes a creative effort to demonstrate a model to ascertain and measure the suitability of SCM approach and synergistic approach in Indian manufacturing organization through the involvement of significant factors in the study as described in Equations (1) and (2). Furthermore, the results indicated that although three factors, namely, TMSLR, SSPI and ITI have established significant effect on the success of SCM implementation program in the manufacturing organizations. But high level of success of manufacturing organizations is achieved through synergistic approach and through the

Table VIII. Range for successful TQM-SCM implementation

Fuzzy	Linguistic term	Range
1	Reject	0–0.3
2	Under consideration	0.3–0.6
3	Acceptable	0.6–0.8
4	Optimum	0.8–0.1

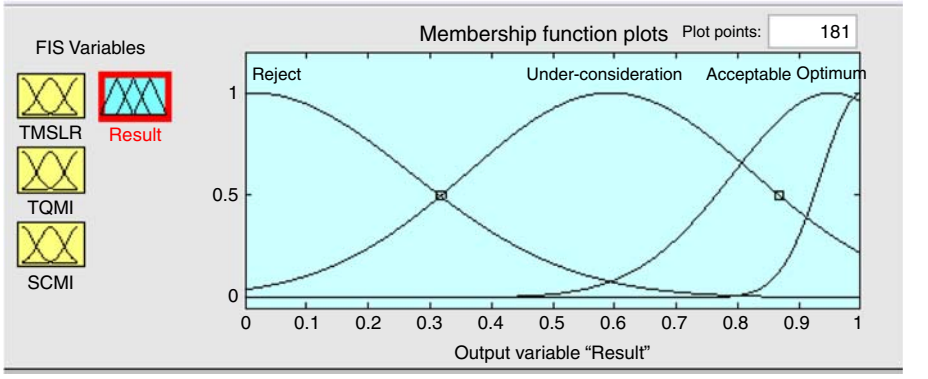


Figure 16. Transfer function in fuzzy format of suitability of TQM-SCM implementation

Note: See online version for colors

SCMI	TQMI Very low	Low	Medium	High	Very High
When Top Management Support and Leadership Role (TMSLR) is LOW					
Very low	Reject	Reject	Reject	Accept	Accept
Low	Reject	Reject	Reject	Accept	Accept
Medium	Reject	Reject	Accept	Accept	Accept
High	Reject	Reject	Accept	Accept	Accept
Very High	Reject	Reject	Accept	Accept	Accept
When Top Management Support and Leadership Role (TMSLR) is MODERATE					
Very low	Reject	Reject	Accept	Accept	Accept
Low	Reject	Reject	Accept	Accept	Accept
Medium	Reject	Reject	Accept	Accept	Accept
High	Reject	Reject	Accept	Accept	Accept
Very High	Reject	Accept	Accept	Accept	Accept
When Top Management Support and Leadership Role (TMSLR) is HIGH					
Very low	Reject	Reject	Accept	Accept	Accept
Low	Reject	Reject	Accept	Accept	Accept
Medium	Reject	Accept	Accept	Accept	Accept
High	Accept	Accept	Accept	Accept	Accept
Very High	Accept	Accept	Accept	Accept	Accept

Table IX.
Rules for fuzzy evaluation of TQM-SCM approach

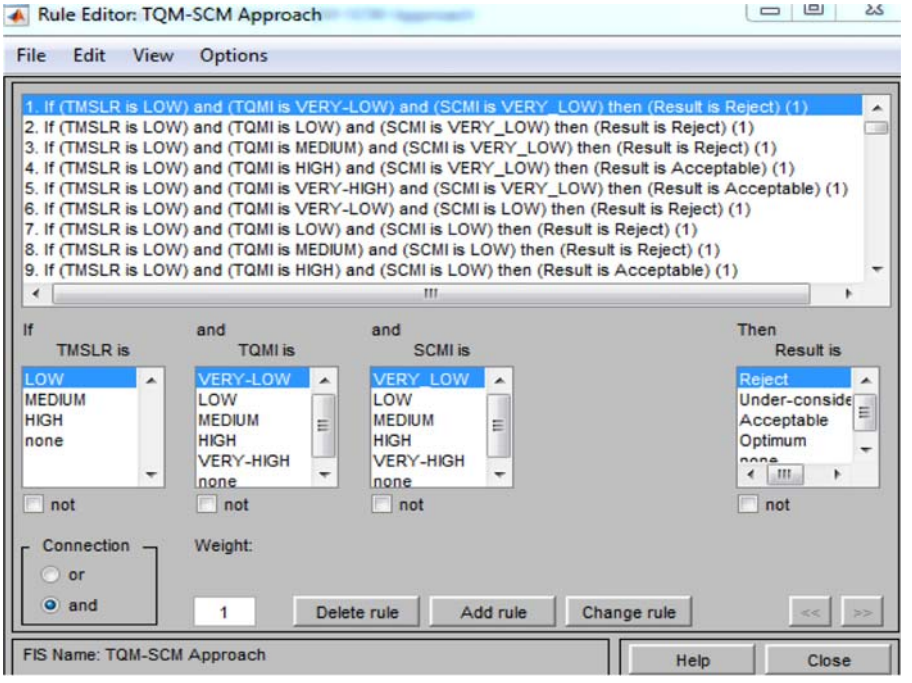


Figure 17.
Fuzzy evaluation rules

involvement of three significant factors, namely, TMSLR, SCMI and TQMI. Furthermore, the result also shows that high success of synergistic approach can meliorate the business performance as demonstrated by the fuzzy rule viewer and surface view tool of fuzzy tool box in MATLAB. This study promotes the knowledge of quality managers and supply

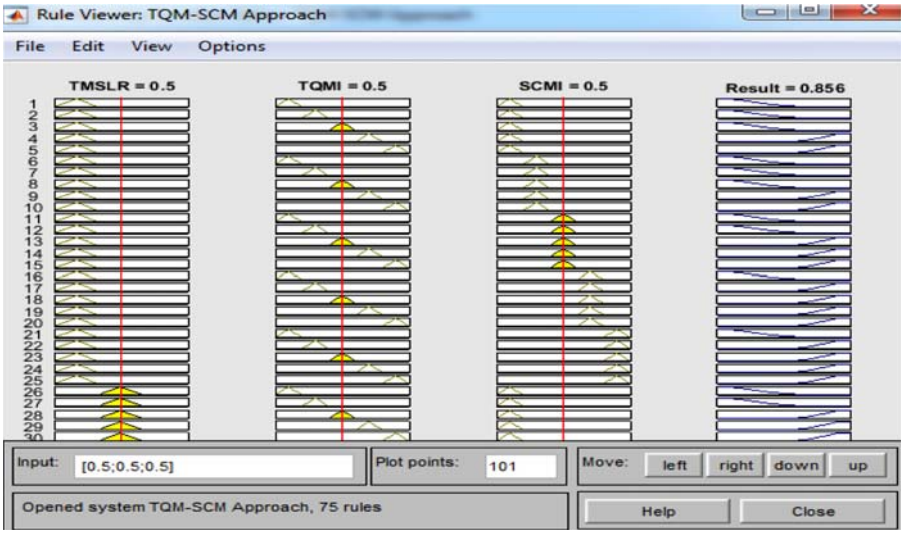


Figure 18.
Rule viewer for TQM-SCM implementation results

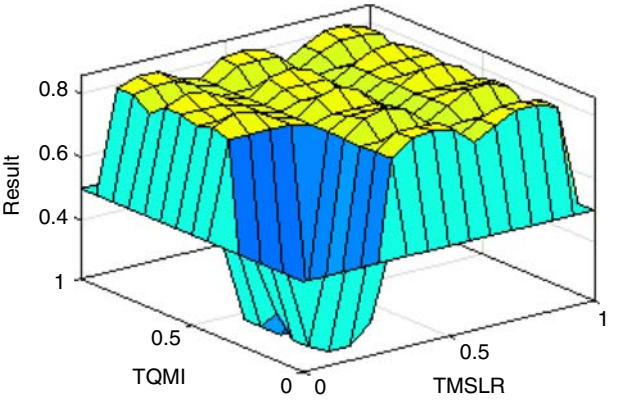


Figure 19.
Output surface viewer of fuzzy tool box (TMSLR: TQMI: Results)

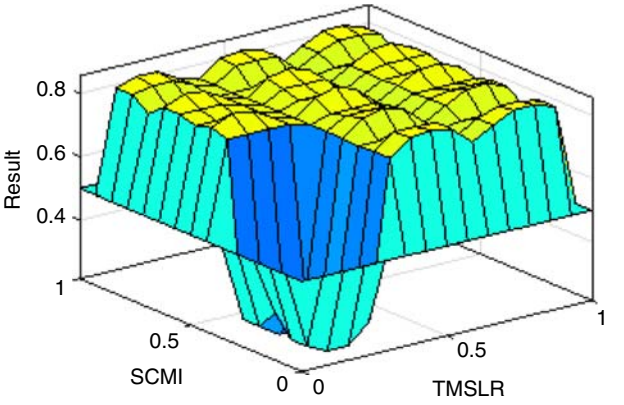


Figure 20.
Output surface viewer of fuzzy tool box (TMSLR: SCMI: Results)

chain managers of the different manufacturing organizations for the successful implementation and sustainability of synergistic approach so that they can reap the benefits for their organization. All in all, the results reflect that if TQM-SCM strategies are adopted together their synergistic effect can improve business performance in better way than applying these approaches on individual basis.

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