Evaluation of Barriers in the Adoption of E-Commerce Technology in SMEs:
A Fuzzy DEMATEL Approach

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ABSTRACT

The main purpose of this study is to examine barriers towards e-commerce platforms in developing countries using specific analytic techniques. The present empirical analysis has its main objectives of detailed study of barriers that keep deferring them to adopt an e-commerce platform. To achieve this, the barriers were selected from an extensive literature review and expert advice from this field. Then the responses were studied using a fuzzy DEMATEL approach. The causal relationship graphs provide detailed structural interdependencies of the barriers. In this exploratory study, benchmarking has come out to be the most influential barrier that needs to be practiced while adopting an e-commerce platform. Furthermore, a lack of top management commitment has also been a significant barrier in the organization while initiating an online real-time business. The result also showed that higher turnover and poor planning are the most influenced barriers among the other parameters. The sensitivity analysis of the method is conducted to validate the robustness of the results.

KEYWORDS

B2C E-Commerce, Barriers, DEMATELE-Commerce, Fuzzy Set Theory

1. INTRODUCTION

The Internet has modernized the way people used to carry out business operations and provided a far-reaching platform to socialize with the real world. Information technology solutions can broadly be defined as a combination of software, hardware, telecommunication, and information management techniques and applications that can be used to create, produce, analyses, process, package, distribute, receive, retrieve, store and interpret information (Barba-Sánchez et al., 2007). E-commerce has created a new platform for organizations to spread awareness about their product and services. Organizations adopting e-commerce technologies have a competitive advantage over the market, making existing companies improve their strategies. E-commerce technology has become more popular in recent

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years, earning large revenues and better business opportunities. An organization must understand that the emerging era of e-commerce technology attracts a huge percentage of online users. Hence, E-commerce technology adoption can provide a potential profit for the organization to extend its boundaries beyond the traditional walls. In India electronic commerce can be broadly categorized as business-to-consumer (B2C) e-commerce, business-to-business (B2B) e-commerce, and consumer-to-consumer (C2C) e-commerce. The convenience of customers to shop 24×7 at home and availability of a wide variety of products with an accurate description with lower prices has provided a large interactive online market (Farag et al., 2007; Childers et al., 2001). Therefore, the implementation of the e-commerce platform involves significant decision-making for policymakers and higher-level management. This study examines the barriers or parameters and identifies the correlation among the parameters in adopting e-commerce technology in India, focusing on small and medium-sized enterprises.

Valmohammadi and Dashti (2016) showed that a "lack of awareness regarding the benefits and nature of e-commerce" is the most prominent barrier to e-commerce implementation. Studies have suggested further examine the dependency among the different barriers and interaction between them. It has been founded that limited research has been done regarding the interaction among the barriers. Therefore, the present study aims to fill the gap in the literature, offering a more comprehensive model determining the interaction between the barriers. An integrated fuzzy DEMATEL approach is employed to perform the qualitative analysis (Bashardoost et al., 2018). Mohan and Ali (2019) concluded that MSMEs plays an indispensable role in the economic development of the nation, and like SMEs, these dynamic business platforms can help the Indian economy to boom at a faster pace; hence existing literature has not led enough attention to the reasons behind Why Indian SMEs are lagging behind other developed economies in adopting digital platforms. Different studies conducted in this context incorporated different barriers in their studies. A total of 15 barrier have been identified in this proposed study. However, any inadequacy in understanding these barriers may also increase the complexity while executing the adoption of E-commerce in the Indian context. Researchers played a vital role in addressing various crucial barriers to evaluate and understand the nitty-gritty while proposing a framework to overcome this problem. The present research framework seeks to attain the objective mentioned as - Understanding and evaluating barriers in the adoption of E-commerce from the Indian perspective. The above mentioned objective has been designed based on the fact that the Indian SMEs are still lagging behind other developed economies in adopting digital platforms (National report on e-commerce development in India, 2019). Hence quite important for SMEs to incorporate E-commerce. Therefore, to resolve this difficulty in the adoption of eCommerce by SME (Indian context. This research raises two analysis questions, as follows:

- What are the barriers need to be considered in the successful adoption of E-commerce in SMEs from the Indian perspective.
- How the causal relations among the identified barriers in the successful adoption of E-commerce in SMEs should be determined?

The primary objective of this proposed research work is to build a framework to analyse and evaluate the barriers. This paper is structured as follows. Section 2 reviews the literature on the barriers resulting in the adoption of E-commerce in SMEs, the Indian context, combined with Fuzzy set theory and DEMATEL decision-making methods, concluding with the research objective. Problem description with the list of identified barriers and research framework is explained in Section 3. Solution methodology is described in Section 4. Section 5 presents the application of the framework, and Section 6 discusses the results. Section 7 points out some managerial implications of the study. In the last Section, final remarks, conclusions, and research limitations are drawn, and potential future work is discussed.

1.1. Overview of E-Commerce in India

India has a population of 1.37 billion in 2019, with an annual growth rate of 1.2 percent between 2010-2019, i.e., more than double the annual growth rate of China. The leading service industries in the country are telecommunication, IT, and software. The United Nations Conference on Trade and Development ranked India 73rd out of 153 countries in 2019 based on a business-to-consumer (B2C) e-commerce index. That shows a potential to grow in the digital economy. Adopting e-commerce technology allows a consumer greater choices and lower prices. The Indian e-commerce industry report submitted by the Indian brand equity foundation studied that the e-commerce market is expected to grow US$ 200 billion by 2026 from US$ 38.5 billion as of 2017. It is expected that the count of internet users will further increase, which eventually will help improve the digital market economy. The total wireless subscribers reported on Sep 19 is 1173.75 million, thereby registering a monthly growth rate of 0.23%. Digital India, initiated by the government, majorly focuses on digital economic growth providing better internet connectivity and infrastructure to drive growth in the ICT sector and to provide opportunities for Indian companies. The Information and Communication Technology (ICT) sector in India imparts 13 percent to Gross and Domestic Product (GDP). According to Vaithianathan (2010), an increased number of internet users in India will lead to internet-based e-commerce activities. He also concluded that organizations adopting e-commerce could achieve cost reduction, have profitable revenues, and attain maximum customer interaction. To have widespread adoption of e-commerce technology in India, the organization should understand the factors and issues affecting their transformation. In addition to various government initiatives, "Digital India" awareness should be spread, addressing the benefits of EC implementation. With the growing demand for customer needs, a better solution to streamline all business processes efficiently, e-commerce provides ample support for business, covering all the gaps that are left unseen. The national report on e-commerce by UNIDO (United Nations Industrial Development organization) surveyed 200 SMEs and concluded that 50% of SMEs are engaged in B2B e-commerce, and only 38% of SMEs were engaged in B2C. Also, it stated that persistent awareness and addressing in this area increase the adoption rate from both consumers and industries.

Furthermore, another report by NASSCOM predicted that the Indian e-commerce market could cross USD 200 Bn by 2030 mostly, driven by augmented transactional values, higher online shopping penetration, and increased data usage. Also, brick and mortar s res have started investing in e-commerce, providing a diverse platform for the market. Hence, e-commerce provides big support for businesses covering all the gaps that are left unseen.

2. LITERATURE REVIEW

2.1 Barriers Selection:

Many studies have been performed on the barriers and challenges faced by e-commerce platforms from developed countries. MacGregor and Vrazalic (2005) showed that "lack of technical knowledge, the complexity of e-commerce, investments, inadequate time and different e-commerce options" are the most prominent barriers when considering non-adopters' perception in Australian SMEs. However, the government organizations that are engaged in promoting e-commerce adoption also facilitates the potential adopters.

Researchers believe that the digital connectivity and e-commerce platform will connect SMEs to global markets enabling them to diversify their clients and accessing wide range of consumers. Presently in India, many government policies are initiated to support digitization and e-commerce platforms; therefore, the need to analyse the critical parameters responsible for e-commerce adoption is much needed (Majumdar et al. 2020). Despite many studies regarding e-commerce barriers, there is still a scarcity of literature giving in-depth information on adoption barriers in SMEs where they are comfortable with the traditional way of business platforms and hesitate to implement new

Table 1. Barriers for Adoption of Ecommerce in SME's

Barriers	Description	References
1. **Lack of top management commitment**	SMEs lack the capability to expand their IT resources. In addition, the perception of the manager's about security and accuracy feature while adopting a new platform for business is also a significant obstacle behind the negligence.	Nguyen, 2009; Modimogale and Kroeze (2011); Chibelushi and Costello (2009).
2. **No Benchmarking**	To accomplish the needs of SME's and have better guidelines, benchmarking can help themselves and their competitors. As benchmarking is referred to be a continuous process, it should be revised according to competitive landscape	Lim and Trakulmaykee (2018); Karim and Gide (2018); Alam and Khalid (2020).
3. **Ineffective measures of quality improvement**	Customers can easily switch between various competitors when not attaining quality; hence it makes quality measurements more critical in e-business. Ignorance in quality improvement methods can lead to the loss of a customer.	Mohanty et al. (2007); Di Fatta et al. (2018); Hussain and Raghavan (2017).
4. **Poor Planning**	Planning includes every part of a business structure when seen through a sales perspective. It includes answering customer queries, as well as giving proper attention to their queries. A well-planned e-commerce site is more likely to handle an increase in customer volume while maintaining its performance at the same time.	Zhuang and Lederer (2004); Alzahrani, 2018; Barroso et al. (2019); Wongkhamdi et at. (2020).
5. **Non-integration of the voice of supplier and customer**	Competitive advantage is not only selling products and services to the customer, but it is also about delivering high-class services and being more responsive to the customer's voice.	Payne and Frow (2004); Wong et al. (2011).
6.**Lack of proper training and education**	Lack of training is considered a major challenge when it comes to luring the customers when they are not prepared to handle online operations and are accustomed to following their traditional methods of buying products and services.	Marriott, 2004; Hastings et al. (2003); David et al. (2003); Rezaee et al. (2006).
7. **Attitude of employees towards quality**	When management initiates e-commerce adoption projects, quality improvement programs should also be added to employees' training to develop a positive attitude of employees towards new projects.	Karia and Asaari (2006); Raja et al. (2010); Keane and Richardson (2005).
8. **Lack of customer involvement**	Customer involvement ensures better satisfaction with online services, leading to trust and loyal behavior towards the company. Literature suggests high customer involvement strengthens the relationship and increases the overall loyalty.	Nisar and Prabhakar (2017); Pee, 2016; Sanchez-Franco, 2009.
9. **Inadequate use of empowerment and teamwork**	Employee empowerment can strengthen an employee's relationship with the firm. Empowerment has an indirect effect on privacy and trust. It was concluded that empowerment alleviates trust and privacy barriers, thus making the consumer more implied towards the secured environment	Midha, 2012; Cardosa, 2005.
10. **Higher Turnover at Management Level**	Larger organizations usually have the advantage of adopting e-commerce technology as they possess technical, human, and financial resources. However, it is different in the case of SMEs they have limited financial and human resources.	Ashrafi and Murtaza (2008); Jones et al. (2011); White et al. (2014); Awa et al. (2011); Colla and Lapoule (2012).
11. **Lack of Participative Decision Making**	To achieve a high-performance level and implement e-commerce technology, the organization should follow a decentralized decision-making structure. Trust should be built within an organization so that employees and managers can actively participate in decision-making.	Ke and Wei (2008); Pollard et al. (2008).
12. **Lack of continuous improvement culture**	The lead time (time between placing and delivering the product) is regarded as one of the critical factors for consumers while selecting different cross-channel retailers; hence, management needs to implement a continuous improvement environment to attain maximum customer satisfaction.	Dedhia, 2001; Gawor and Hoberg (2019).
13. **Non usage of advanced TQM tools**	The quality of an E-commerce website has a direct influence on the success of e-commerce. Therefore, in the initial stage of e-commerce implementation into an organization, website development is crucial.	Waterworth and Eldridge (2010); Ranaweera and Prabhu (2003); Jinling et al. (2009).
14. **Lack of co-ordination department**	Enhance coordination is viewed both as essential for enabling channel process innovation and as a capability to discover another opportunity for joint productivity or service improvement.	Lee et al. (2003); Wang, 2009.
15. **Employee's Resistance to change**	Employees' resistance to change is a crucial variable that imposes a risk effect on the implementation process. E-commerce can cause a substantial and dynamic change in the way business is executed. Therefore, resistance to accepting the changes can be experienced by employees, vendors, and customers.	Vajjhala and Thandekkattu (2017); Khoo et al. (2018).

technologies to perform business deals. In India, the adoption rate of e-commerce platforms is still at a slower pace, especially among SMEs segments, the counted reasons, including lack of expertise, lack of knowledgeable staff, and limited funds, can be some potent reasons behind the non-adoption of e-commerce which require further improvement. E-commerce adoption has always been a challenging area for studies in many countries as the potential of the platform is identified, and critical parameters need to be discussed with diverse visualization of the issues faced by the enterprises (Ajao et al., 2019; Chau et al., 2020; Govinnage & Sachitra, 2019; Katumba & Rukundo, 2020). Moreover, Table 1 provides detailed insight regarding the barrier selection from the extensive literature review.

Therefore, foreseeing the future of business models, the present study deals with the significant barriers in the adoption of e-commerce platforms in developing countries. Extensive literature work is studied, and fifteen barriers are identified and analysed. To extract the significant barrier towards e-commerce adoption in Indian SMEs, Proper interview and discussion has been conducted with all 4 experts who have vast experience in their fields. Out of the 3 Experts are from industry were as 1 expert is from an academic background and finally shortlisted and filtered out the relevant barriers to study. The selected barriers are discussed further and supported with relevant literature work studied during the analysis.

3. METHODOLOGY

3.1. Model Selection

Human's judgments are often ambiguous, uncertain, and subjective, and estimating their exact numerical value is impossible. If uncertainty or fuzziness of human decision-making is not taken into care, the results of the outputs may be misleading (Shen et al., 2013). The concept of Fuzzy Set Theory was first introduced by Zadeh (1965) within decision-making to map linguistic variables to numerical variables. Moreover, Bellman and Zadeh (1970) presented fuzzy-MCDM methodology in their studies with manipulated fuzzy sets to determine the deficiency of accuracy in allocating weights and rating alternatives against evaluating criteria. The analytical tools on which the individuals rely are generally the outcome of bivalent logic, i.e. (yes/no or true/false). While the human's problems in a real-life situation and the human's approaches to approach to solve the problem and thoughts are of no means bivalent (Tong & Bonissone, 1980; Gupta et al., 2019). The present study uses dual-phase techniques to evaluate the factors towards taking up the e-commerce platform for Indian SMEs. In the first step, the barriers to the acceptance of e-commerce technology are identified by reviewing literature work.

The selected factors are confirmed through the expert's opinion by presenting the list of barriers in front of them and ask them to give their reviews on the provided list by adding or deleting the barriers according to their relevance. The factors selected can be termed barriers, too, hindering the Indian SMEs from adopting an e-commerce platform.

Next, the selected factors/barriers are examined using the FUZZY DEMATEL approach. This technique can be used to analyse the interdependent relationships between barriers in a complex system. Moreover, the DEMATEL method has several advantages over other MCDM techniques as they cannot determine the causal relationship among factors. Therefore, DEMATEL has been a preferred choice for developing a rank-based interdependence of the variables (Behl & Gupta,2019, Kazancoglu and Ozkan-Ozen, 2018). Finally, an integrated fuzzy DEMATEL approach is used; it mitigates the risk of having incomplete information. The advantage of using the integrated approach is that it can handle the data uncertainty when the number of samples and experts considered in the study is limited (Liu and Qiao, 2014). In addition, a significant benefit of using this integrated approach is handling human ambiguity in decision-making (Gupta and Barua, 2018).

3.2. Fuzzy DEMATEL Theory

To calculate the quantitative value, a schematic structural approach, DEMATEL, is considered. DEMATEL does not require extensive information and can determine the significant factor (barrier) affecting the other elements. Also, the DEMATEL approach is used to accomplish and visualize the complicated relationship between factors in the system. In addition, it's also a synthetic approach that is used to analyse and establish structural models that involve causal relationships among complicated criteria. (Wang et al., 2019; Song et al., 2020). The causal relationship among the barriers is hence obtained. To further test the robustness of the selected methodology, sensitivity analysis is performed. Figure (1) shows the proposed framework for this research study. For the present study, fuzzy DEMATEL methodology has been used to obtain solutions. Furthermore, in the present study, Triangular Fuzzy Numbers (TFNs) are considered due to ease of calculation and simple features.

During this study, a brief explanation of the methodology was provided to the expert's panel. The expert panel consists of four members. The members belong to top management from e-commerce industries in India. The participated experts have more than eight years of experience in the area of the e-commerce Industry. The barriers identified through the literature review are validated through the expert's opinion. Experts have given their responses by agreeing on the provided list with no deletions or additions. In this manner, fifteen significant barriers were selected to the adoption of e-commerce technology in SMEs. Further, the panel evaluated barriers using the linguistic scale over another based on their direct relationship. As fuzzy numbers can represent linguistic values, and linguistic term approach is a convenient way for decision-makers to express their assessments (Wu & Lee, 2007).

Figure 1. Proposed framework for evaluating the essential barriers in the adoption of E-commerce
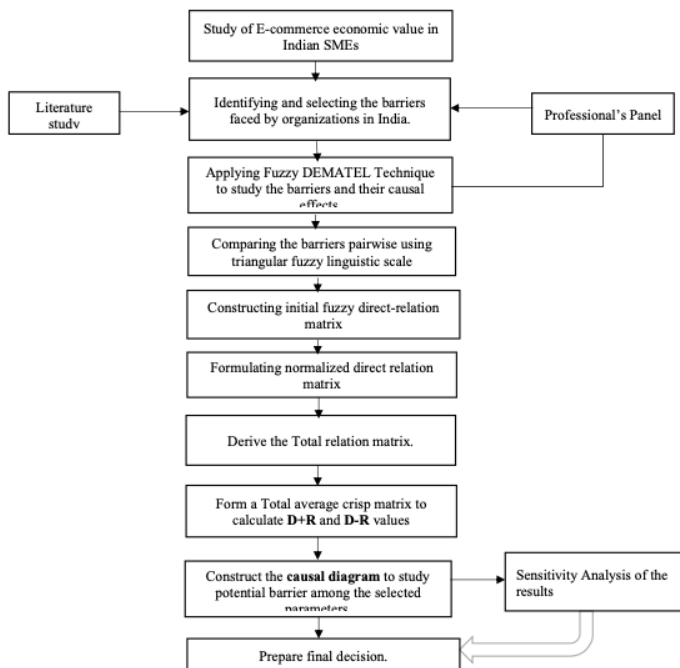
The equations are also used to evaluate the degree of significance among the barriers, to present the "net cause" and "net effect" in the system (Khan et al., 2019). The Fuzzy DEMATEL methodology is presented as follows:

Step 1: Formulate the linguistic assessment influence matrix

A fuzzy linguistic scale with five levels (Table 2) is considered to evaluate an influence matrix to avoid the vagueness and inaccuracy in human judgment. Professionals were asked to provide the data of direct influence by combining every two factors using the linguistic scale. The sign a_{nd} represents the influence of the ith factor on j[th]. The diagonal element where the values are zero represents the i=j condition of the direct influence matrix. A positive n×n matrix is constructed based on data obtained from each professional, i. e. $A^k = [a^k_{ij}]$ where k denotes the number of professionals (1<K<N). Therefore, the direct-relationship matrix, A, is obtained by combining N professional matrices (A^1, A^2, A^3…….A^N).

Step 2: Constructing the Fuzzy initial direct-relation matrix (B)

A fuzzy initial direct relationship matrix is obtained based on N expert's opinion. The derived fuzzy direct relation matrix $B = [b_{ij}]_{n \times n}$ can be represented from equation (1) $b_{ij} = (\sum_{k=1}^{N} a^k_{ij}) / N$) where a^k_{ij} correspond to the degree of significance of barrier "i" on barrier "j" when studied by the kth professional. To perform matrix operation, fuzzy numbers are not feasible. Therefore, these fuzzy numbers are at last transformed into crisp values by using defuzzification to derive the final results.

To perform defuzzification, the standard average method is applied for each element

Refer, equation (2)

Where l, m, n are the Triangular fuzzy number

Step 3: The normalized initial direct-relation matrix [X] is obtained as

$$[X]_{n \times n} = S \times [B]_{n \times n} \tag{3}$$

$$\text{where, } S = \min \left[\frac{1}{max \sum_{j=1}^{z} |b_{ij}|}, \frac{1}{max \sum_{i=1}^{z} |b_{ij}|} \right] \tag{4}$$

Each element of the normalized initial relation matrix [D] lies between zero and one.

Step 4: Total relation matrix "T_t" is derived through equation (5).

$$\left[T_t \right] = \left[X \right] . \left[I - X \right]^{-1} \tag{5}$$

where "I" is the identity matrix and $T_t = \left[t_{ij} \right]_{n \times n}$; i, j =1, 2, 3……n.

Step 5: The matrices related to causal factors, "D" and "R" are obtained as:

$$D = \left(d_i \right)_{n \times 1} = \left[\sum_{i=1}^{n} t_{ij} \right]_{n \times 1} \qquad \forall_j \qquad (6)$$

$$R = \left(r_j \right)_{1 \times n} = \left[\sum_{i=1}^{n} t_{ij} \right]_{1 \times n} \qquad \forall_i \qquad (7)$$

Where, d_i represents the sum of the i_{th} row of the matrix $[T_t]$ that is obtained by the sum of direct and indirect effects of factor/barrier "i" on the other factors/barriers. Accordingly, r_j represents the sum of jth column of the matrix $[T_t]$ that gives the sum of direct and indirect effects that factor/barrier "j" has obtained from the other factors/barriers.

Step 6: The graphical representation of the causal and effect is obtained using the calculated matrices having prominence (Pi) and net effect (Ei), which are expressed as equations (8) and (9):

$$P_i = d_i + r_j | i = j \qquad (8)$$

$$E_i = d_i - r_j | i = j \qquad (9)$$

The "$d_i + r_i$" represents the degree of significance that factor/barrier i plays in the whole system. A factor with a positive value of "$d_i - r_i$" is considered the net cause in the system, whereas if the value is negative, then it is the net result in a system.

4. RESULT

To apply fuzzy DEMATEL, a direct relation matrix is obtained from each expert (Table 3) (Appendix). Similar matrices are obtained following the same procedure, and then the elements of these matrixes are transformed into a fuzzy number using the linguistic scale to capture the vagueness in the system. Table 4 (Appendix) shows the fuzzy direct-relation matrix constructed based on one of the expert's responses (Expert no.1). In the same way, other matrices are converted into fuzzy direct-relation relation matrixes. The fuzzy number in each element is further transformed into a crisp number at the end by using equation (2).

Similarly, the normalized direct-relation matrix [X] is obtained by using equations (3) and (4), refer to Table 5 (Appendix). Further, this normalized direct relationship matrix [X] is transformed into the Total relation matrix [T_t] by applying equation (5), refer to Table 6 (Appendix). In the Total relation matrix, the result is obtained by applying summation in rows and columns and using these "D" and "R" values n equations(6) and (7), respectively. Thus, "D_i" represents the total impact of ith factor on other barriers, and "R_i" exhibits the net influence of jth factor/barrier received by other factors/barriers. Further, the "D" and "R" values for each row and column are used to derive the

prominence (P_I) and net effect (E_i) using equations (8) and (9). If the value of E_i is positive, then the factor is said to produce the net cause, whereas if the value is negative, then the barrier is said as a net effect. Refer to Table 7, where the cause and impact of the barrier in adopting e-commerce technology are shown. The D+R and D-R plots are shown graphically in Figure no. 2, which depicts the causal relationship among the barriers faced by Indian SMEs. The obtained results can be further discussed with experts to examine for further insights.

5.1. Sensitivity Analysis

Sensitivity analysis tests the method validity and robustness supporting the solution (Asjad & Khan, 2017). There are several methods provided in the literature to perform the sensitivity analysis. The sensitivity analysis implemented for the present DEMATEL method is carried out to check the robustness of the results obtained and justify the uncertainty of the expert's opinion. Four iterations are carried out in the present study by assigning different weights to Expert-1, as he dealt with exception and significance. Whereas other experts are assigned with the same weights. Similarly, different weight combinations or different iterations can be applied to expand the sensitivity analysis. In the sensitivity analysis for run 1; the weights are given equal importance to all experts, and further calculation is performed. Similarly, for remaining runs, the different weight value is given to Expert-1, and others had equal weight. Table 8 (Appendix). shows the weightage assigned in each iteration to the experts. For each run, a separate total relationship matrix (Tt) matrix is derived based on the weight of the expert's 1 direct relation matrix ([X]). For example, in run 2, the direct relationship matrix obtained by expert 1 is multiplied by its weight, i.e., 0.1, and direct relationship matrices obtained by remaining experts are multiplied by their corresponding weights, i.e., 1. Further, the obtained weighted matrix generates the overall direct relationship matrix, which is finally used to generate the total relationship matrix (Tt). Finally, the values of (D+R) and (D-R) are calculated for each run. The overall process has 5 iterations, and based on the final results obtained in each run; barriers were ranked. The result is presented in Table 9 (Appendix). Furthermore, the causal-effect diagram obtained for each Iteration is presented (Figure 3, Figure 4, Figure 5, Figure 6)(Appendix). A variation can be noticed in results that show robustness and flexibility concerning the decision maker's preferences. The results obtained also establishes that small variation in the relative importance of subjective weight represented the most influential barriers to be "Lack of Benchmarking (M2)" and "Lack of top management commitment (M1)". Similarly, "Non-integration of the voice of supplier and customer (M5)" remains to be the significant deferring barrier to overcome. From this analysis, it is noticed that no matter how the decision maker's perception changes, M2 remains to be the most influential barrier. It indicated that the results obtained for adopting e-commerce platforms by the proposed fuzzy-DEMATEL approach are effective.

6. DISCUSSION

The final result obtained by using the Fuzzy DEMATEL approach provides a wider perspective on e-commerce parameters and their relevance. The significance order of the barriers is represented as M5-M12-M4-M1-M10-M11-M7-M9-M13-M8-M15-M14-M2-M6-M3 obtained from D+R values (Figure 2). The selected barriers are further classified into two distinct groups based on D-R values. The positive values of D-R depict the influential (causal) parameters which influence the other factors/barriers. The negative values of D-R represent the affected (influenced) factors/barriers. The results obtained (refer to Table 7 and Figure 2) show the five barriers that belong to the influential group are M1-M2-M3-M14 arranging them into increasing order of the influence as "M2-M1-M14-M3". "No Benchmarking (M2)" has been the major barrier to the adoption of e- commerce technology. Benchmarking is defined as comparing one's practices and procedures against the other that is believed to be best in the industry. While initially benchmarking practices were mainly focused on manufacturing and logistics, but now the process has gain significance to encompass a wider array

Table 7. The value of Di and Ri, i.e. (D+R) and (D-R)

Barriers	(Di+Ri)	(Di-Ri)	Di+Ri	Di-Ri	Rank
M1	(2.23,6.9,53.54)	(-25.3,0.23,26)	14.76	0.22	4
M2	(2.04,6.49,50.65)	(-23.67,0.18,24.94)	14.01	0.27	13
M3	(1.87,6.11,50.53)	(-24.26,0.08,24.4)	13.68	0.05	15
M4	(2.29,7.03,53.57)	(-26,-0.27,25.28)	14.87	-0.26	3
M5	(2.37,7.2,54.27)	(-26.12,0.02,25.78)	15.10	-0.05	1
M6	(1.94,6.31,50.95)	(-23.94,0.17,25.08)	13.91	0.25	14
M7	(2.21,6.83,52.2)	(-25.07,-0.1,24.92)	14.51	-0.09	7
M8	(2.12,6.68,52.26)	(-25.24,-0.20,24.9)	14.40	-0.17	10
M9	(2.17,6.8,52.26)	(-25.18,-0.08,24.90)	14.49	-0.10	8
M10	(2.23,6.89,53.41)	(-26.01,-0.29,25.17)	14.73	-0.29	5
M11	(2.12,6.68,53.42)	(-25.75,0.04,25.55)	14.56	-0.01	6
M12	(2.27,7,53.89)	(-25.92,0.02,25.7)	14.89	-0.03	2
M13	(2.18,6.77,52.3)	(-25.29,0.04,24.83)	14.48	-0.05	9
M14	(1.98,6.4,52.15)	(-24.76,0.13,25.41)	14.15	0.16	12
M15	(2.02,6.46,51.91)	(-25.12,0.02,24.77)	14.17	-0.05	11

Figure 2. The causal diagram
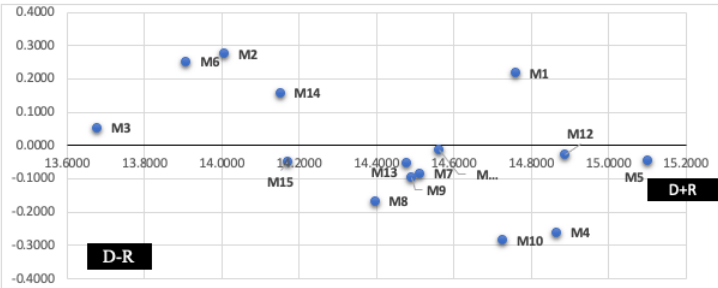
of activities, including export, quality goals in service systems, supply chain interface, employee practices, and brand management (Bommer et al., 2001). At the same time, the focus has shifted in comparison with direct competitors to learning about best practices and identifying possibilities (Smith, 2000). Benchmarking services towards consumer satisfaction over the internet has the potential for several reasons. The ever-changing and wide expanding array of digital services and the abundance of knowledge regarding the best practices have a significant role in improving customer services. Several studies and surveys have shown that benchmarking the services according to customers' needs can lead to long-term profits (Min & Min, 2011). The second significant barrier is the lack of top management commitment (M1). The top management decision is responsible for implementing and improving the services needed to adopt e-commerce technology. According to Matlay and Addis (2003) top management support and commitment can further ensure the proper adoption strategies and avoid uncertainty. Management decides to promote the idea of real-time business services in

the organization. This commitment is a critical barrier to e-commerce adoption. The next important barrier is the lack of coordination between departments (M14), which significantly impacts adoption strategies. Management should ensure that a structural approach should be implemented between departments to ensure proper coordination between them. Coordination between departments leads to proper implementation of services and mitigation of risks. Further, ineffective quality improvement measures (M3) for e-commerce adoption have the lowest importance among the other influential barriers. Quality improvement programs have proved to generate better long-term profits as well as increased customer satisfaction. Therefore, these programs must be incorporated for establishing a real-time business platform. The other ten factors/barriers belong to the influenced group according to the D-R values. The influenced barriers are arranged in increasing order as "M10-M4-M8-M9-M5-M13-M15M12-M11". These parameters have a significant effect on the acceptance of e-commerce technology. The most influenced barrier is higher turnover (M10) at the management level, which is highly affected by the other influential barriers. The higher turnover is the result of ignorance of benchmarked services and top management commitment. The next most influenced barrier is poor planning (M4) which should be done by management and proper planning strategies. The third influenced barrier is lack of customer involvement (M8) which can be mitigated by benchmarking services as customer-oriented and accounting customer perception. Management can also improve the business objective of fulfilling customer demand. The fourth influenced barrier is the inadequate use of empowerment and teamwork (M9) that can result from improper adopted methods and lack of coordination among departments. The fifth influenced barrier is the non-integration of the voice of supplier and customer (M5), which can be mitigated by making the supply chain more transparent and incorporating information technology. The integration of different agents in the supply chain leads to better profit-making and higher customer satisfaction. Further, influenced barriers are the non-usage of advanced TQM tools, employee's resistance to change, lack of continuous improvement culture, and lack of participative decision. All these barriers are dependent on the standard of services implemented and top management commitments. These effects can be minimized by benchmarking the services as keeping customer's needs and quality demand at a higher priority level. Management decisions influence all the other barriers as the commitment to adopting a new business platform is most important. Through a clear understanding of these cause and effect groups, an analyst can decide on the futon implementation of e-commerce technology. One of the limitations of selecting the barriers for e-commerce businesses is their selection solely through literature review. As literature review has been done only by studying high impact factor journals and standardized work, there may be some vagueness in the barriers list, which is frontwards SMEs in the Indian market.

7. MANAGERIAL IMPLICATIONS

The present research results can enable stakeholders and investment firms to recognize and evaluate the barriers to e-commerce adoption. This research can add valuable input for small and medium enterprises to analyse and overcome the barriers to adopting a new business model. The causal relationship between barriers can guide the suppliers, manufacturers, and distributors for better decision-making and making the supply chain more responsive and transparent. Competitive advantage can be achieved by adopting new technologies and initiating online real-time business platforms. In the initial phase of implementation, the top management cannot focus on each barrier simultaneously; instead, they need to put down influential and influenced categories for simplifying the implementation process.

Furthermore, after categorizing the barriers, the management can focus on the most critical barrier that influences the most, hence mitigating the barrier in the early stage. Managers can use this proposed research work by identifying barriers towards e-commerce adoption and analyzing results through ranking the barriers according to their cause & effect characteristics. For continuous improvement, the causal group barriers should be mitigated to achieve the strategic goal in the

organization. Organizations or Managers can check causal and effect diagrams that can provide a transparent evaluation and help make further strategies for the successful implementation of e-commerce technology. Moreover, as a result of this study, Benchmarking the process and services is the major barrier; thus, management uses this result to focus and improve the existing procedures and methods, making them more customers oriented. The selected significant barriers will provide suitable guidance for the management to mitigate the barriers and adopt a new business platform to increase their customer interaction. Managers can get insight will decision making just by evaluating interdependency between the barriers.

7.1. Research Implications

This research can act as a building block to develop a framework for decision-making to accept the e-commerce platform from traditional business models. The present empirical study using the Fuzzy DEMATEL technique can be a unique addition to e-commerce technology adoption problems faced by Indian SMEs. The research intends to add an initial and significant attempt in establishing relationships among the barriers in adopting the real-time business platform. Also, the paper provides the direction to analyze the e-commerce deferring parameters in-depth as with the advent of digitalization; the dilemma increases in this area.

8. CONCLUSION

This exploratory study has made further observation into the field of non-adopters for e-commerce technology and their behavioral parameters by identifying the barriers that defer them from implementing online real-time platforms and studying the interdependency of these parameters. This is a relevant research topic as research on non-adoption parameters in Indian SMEs has been imperative in electronic commerce. In the present research study, fifteen most addressed barriers have been identified through extensive literature review and professional's opinion. After finalizing the barriers, a causal relationship between factors/barriers is developed using the fuzzy DEMATEL method. The method transforms the causal relationship among the barriers into the tangible structural model and helps to evaluate the relationship between complex factors/barriers (Nilashi et al., 2019).

Further, the methodology categorized the results into two groups named influential (cause) and influenced (effect). No benchmarking and lack of top management commitment are the most significant drivers in implementing e-commerce technology in Indian SMEs. Further, inadequate funds and poor planning are the most influenced barriers. Therefore, benchmarking services and procedures with strong management commitment can enable the adoption of e-commerce technology, providing organizations to adopt real-time business. Furthermore, the new spatial possibilities of internet-based technology offer a comprehensive platform for small and medium enterprises for innovative marketing strategies.

8.1. Limitation

This study can be further extended by inculcating novel factors resulting in a change in both uncertain and dynamic environments. The proposed research work can also be applied in other similar research fields like Oil & gas industry, Logistics & supply chain, Electronics, Humanitarian Supply chain, etc., to identify and test the factor's relationship or factor dependency on each other. Furthermore, proposed research work can be further extended by including more decision-makers and using different hybrid decision-making models like Grey-DEMATEL, etc., and in addition also by evolving new models like TOPSIS, VIKOR, and GRA under fuzzy environment. Limitation for this research work lies in the no. of criteria included in the limited system and cannot minimize the complexity, so more factors can also be a part to identify interdependency and influence of significant factor in the overall study viewpoint.

Compliance With Ethical Standards

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