

Chapter 18

Analysis of Barriers and Enablers of Sustainability Implementation in Healthcare Centers



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Abstract The objective of this chapter is to identify and analyze various barriers and enablers for implementing sustainability practices in healthcare centers in a district in an Indian state. The list of barriers and enablers are identified from an extensive literature review. From a pilot questionnaire survey, barriers and enablers are reduced for further analysis from experts' point of view. Decision-making trial and evaluation laboratory (DEMATEL) method is used to analyze the data. DEMATEL is used to first prioritize the importance of these criteria and then construct the causal relations among the criteria. The data for this study are collected from a questionnaire-based survey of hospitals. The decision makers in the top level management can use this model to recognize and prioritize the barriers and enablers which are dominant in the implementation of sustainable supply chain practices.

Keywords Healthcare · Sustainability · Enablers · Barriers · DEMATEL

Nomenclature

DEMATEL Decision-making trial and evaluation laboratory;
B & E Barriers and Enablers.

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18.1 Introduction

The economic performance indicator like gross domestic product (GDP) in the Indian economy is showing a growing tendency over a period of time even when the majority of the rest of the countries are showing a downward trend. Even with this better economic performance, the reports published by the United Nations show that the human development index (HDI) of the country is very low. This shows that if the country can reduce the HDI performance, and even better economic performance is easily achievable. When comparing with other nations, the infrastructure facilities and manpower resource strength are some of the major reasons for India's poor performance in HDI ranking. The HDI rankings published by the UN shows that between the periods 1990–2017, the HDI value has increased close to 50% to reach a value of 0.640 from 0.427. Studies conducted by various agencies show that there is no significant increment in the gross domestic product (GDP) share for healthcare expenditure in India. This means that the GDP share for healthcare expenditure is lesser relative to the high population of the country. To provide quality healthcare facilities to people in the urban as well as rural areas of the country, infrastructure facilities, human resource strength, insurance to meet healthcare expenses and implementation of sustainable practices are essential. Healthcare institutions are planning to improve the overall patient experience by improving the overall efficiency of healthcare delivery, at the same time cutting down the overall expense. The implementation of sustainable practices in hospitals and its supply chains is one of the methods to achieve this objective.

Hospital is a place in which the health concept is strongly intertwined with well-being, ethics, and environmental aspects. It is a complex system in which all the aspects addressed by the World Health Organization (WHO) come to life: “health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. UN Global Compact in 2015 defined sustainability as “Management of environmental, social and economic impacts and the encouragement of good governance practices throughout the lifecycle of goods and services”. Despite the fact that sustainability principles and feasible improvement are incorporated within the business models of numerous associations, healthcare organizations have faced the implementation of sustainability issues only recently. Also, there are some factors that help to fulfill sustainability.

The objectives of this chapter are (i) to model and analyze the inter-relationships among the enablers for implementing the sustainable practices in the healthcare centers considered for the study and (ii) to model and analyze the barriers for implementing sustainable practices in the healthcare centers considered for the study. The knowledge about the inter-relationships among the enablers as well as between the barriers will help the managers in the healthcare centers to identify the significant enabling factors in the process of sustainable practice implementation in their healthcare centers. Similarly, the present study will also help the managerial people to identify the significant barriers in implementing sustainable practices in their centers. The rest of the chapter is organized as follows: Sect. 18.2 provides a review of the

relevant literature while Sect. 18.3 concludes the outcomes of the literature review. Section 18.4 describes the methodology adopted for the present study. Section 18.5 explains the modeling of the enablers as well as the barriers considered in this study. Section 18.6 discusses the results obtained from the modeling and Sect. 18.7 provides the conclusions of the present work.

18.2 Literature Review

The structured review is very useful for managing the assorted information base for an academic purpose. It allows us to explain the summary of the literature review. As highlighted by Beske et al. [2], “the literature review demonstrates the essential theories, arguments and controversies in the field and highlights the ways in which research in the area has been undertaken by others”.

Figure 18.1 shows the process of literature review. It starts from how to search potential papers by using keywords. It is followed by analyzing and categorizing the content.

The implementation of sustainable practices in hospitals provides diverse advantages to the organization. The successful implementation helps to achieve a much healthier hospital environment. This leads to improvement in the public perception and the corporate social responsibility of hospitals. Generally, organizations follow the economic component of sustainability, while the social component and the environmental component are not considered by many researchers.

The literature review has shown that there exist several types of obstacles or barriers in implementing sustainable practices in a healthcare center. Walker et al. [17] established the barriers for sustainability practices experienced by the healthcare centers after a structured analysis and review. It includes both internal as well as external barriers. Analytical hierarchy process methodology was used to prioritize the identified barriers based upon the judgments of hospital administration. Muduli and Barve [10] have identified various barriers in adopting green practices in the healthcare waste sector from an Indian perspective. The researchers have shortlisted ten significant barriers and modeled the inter-relationship among them using interpretive structural modeling methodology. Muduli et al. [11] have identified various factors and sub-factors hindering green supply chain management practices in the mining industry. Dixit et al. [4], Dubey et al. [5] and Tobescu and Seuring [16] have

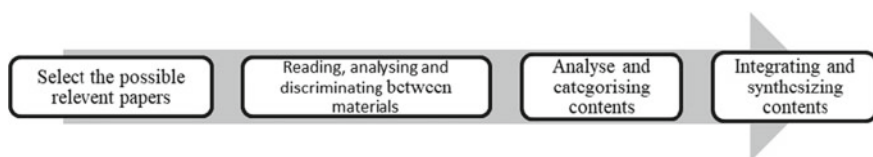


Fig. 18.1 Process of literature review

identified different types of enablers on the basis of a questionnaire-based survey and applied different techniques to analyze the collected data.

DEMATEL method is a well-known method used for the constructing relationship among the criteria for decision-making. Various researchers have used this technique for decision-making purposes. Shieh et al. [15] in 2010 have used DEMATEL to identify the importance of success factors of hospital service quality. Seker [14] adopted DEMATEL method for analyzing occupational risks in construction sites in Turkey.

18.3 Outcome of the Literature Review

From the review of the literature, major barriers and enablers in implementing sustainability practices in healthcare centers are identified as described in the following sub-sections.

18.3.1 Enablers

The adoption of SSCM practices in the manufacturing sector all over the world has got wider acceptance due to the intervention of various international agencies and other stakeholders. The implementation of SSCM practices in the service sectors is slowly getting momentum and one of the significant service sectors which is a major contributor to environmental pollution, energy consumption, water consumption, and hazardous as well as municipal waste generation source is healthcare sector. Recently, the healthcare sector institutions in various countries have started to follow sustainable practices throughout their supply chains. The healthcare institutions in India are very slow in adopting sustainable practices in their premises and supply chains. Hence, some external motivators are required to successfully implement the SSCM practices in the healthcare sector.

Currently, due to government regulations and environmental conscious public, the healthcare institutions have started to adopt implement the SSCM practices in their premises. Currently, the pollution of air, water and land as well as the consumption of resources such as energy and water by the healthcare sector is as equivalent to any other manufacturing sector organization. Hence, the identification of enablers in implementing SSCM practices in the healthcare sector is very important.

Diabat et al. [3] have analyzed the enablers in implementing sustainable practices in Indian industries. The objective of the study was to identify the enablers which have the most impact on SSCM implementation. The researchers have used interpretive structural modeling methodology to analyze the shortlisted enablers. Sajjad et al. [13] have performed an exploratory case study in New Zealand and identified various motivators and barriers in implementing SSCM practices in a supply chain. The researchers have shortlisted various motivators or enablers and barriers

Table 18.1 List of enablers for implementing SSCM practices in healthcare

Sl. No.	Barrier type	Source
E1	Economic advantages	Golinska and Romano [6], Grzybowska [7]
E2	Market demand	Dubey [5], Golinska and Romano [6]
E3	Motivation to suppliers and vendors toward sustainable practices	Golinska and Romano [6], Grzybowska [7]
E4	Commitment from top management	Dubey [5], Golinska and Romano [6]
E5	Decision-making strategies	Golinska and Romano [6]
E6	Government policies and supportive systems	Golinska and Romano [6]
E7	Customer satisfaction	Dubey [5], Golinska and Romano [6]
E8	Standards in human resources	Dubey [5], Grzybowska [7]
E9	Adoption of a cleaner technology	Golinska and Romano [6]
E10	Health and safety issues	Dubey [5], Grzybowska [7]

for implementing SSCM practices in a supply chain. In the present study, various enablers are identified through the review of research articles, and shortlisted enablers for further analysis after discussion with healthcare experts are shown in Table 18.1.

18.3.2 Barriers

Similar to the enablers, healthcare institutions are facing certain obstacles in implementing the SSCM practices. Some of the important barriers applicable to the healthcare sector are identified through the literature review and finalized the most significant barriers after discussion with experts from the healthcare sector institutions considered for the study. Narayanan et al. [12] have shortlisted, analyzed, and modeled the barriers in implementing SSCM practices in an Indian manufacturing sector environment. The researchers have used an integrated interpretive structural modeling and fuzzy analytic hierarchy process to find the inter-relationship among the barriers and to prioritize them based on an expert committee opinion. Gupta and Ramesh [8] have used interpretive structural modeling tools to analyze various barriers of healthcare supply chain in an Indian scenario. The researchers have used twelve important interacting factors that are affecting the Indian healthcare supply chain operations. Zaabi et al. [19] have identified different barriers in implementing SSCM and classified the barriers based on their impact on SSCM implementation process. Using interpretive structural modeling the researchers have analyzed the inter-relationship between the barriers. The major barriers applicable to the present study are provided in Table 18.2.

Table 18.2 List of barriers for implementing SSCM practices in healthcare

Sl. No.	Barrier type	Source
B1	Limited availability of resources	Ansari et al. [1], Mathiyazhagan [9]
B2	Financial constraints	Mathiyazhagan [9], Muduli and Barve [10]
B3	Need for extra human resources	Mathiyazhagan [9], Narayanan et al. [12]
B4	Problem in maintaining environmental suppliers	Ansari et al. [1], Mathiyazhagan [9]
B5	Lack of environmental knowledge	Mathiyazhagan [9], Muduli and Barve [10]
B6	Inhibits innovation	Ansari et al. [1], Muduli and Barve [10]
B7	Lack of corporate social responsibility	Mathiyazhagan [9], Muduli and Barve [10]
B8	Lack of segregation practices knowledge	Ansari et al. [1], Muduli and Barve [10]
B9	Inadequate awareness and training programs	Ansari et al. [1], Muduli and Barve [10]
B10	High cost of hazardous waste disposal	Ansari et al. [1], Mathiyazhagan [9]

18.4 Methodology

In the present chapter, decision-making trial and evaluation laboratory (DEMATEL) method is used for identifying the causal relationships among the elements. DEMATEL method is a renowned and wide-ranging method to prioritize the importance of the criterion and to build the casual relationships between complex real-world criterion (Wu and Tsai [18]). The difference between DEMATEL method and other traditional methods is that DEMATEL method considers the factors which are independent in nature of system to build the casual diagram (Shieh et al. [15]).

In this study, a pilot survey is conducted on the basis of a questionnaire-based survey from the experts' point of view. In this scenario, hospitals' administrative people are experts in this field. A five-point scale is provided to the respondents for specifying the importance of the B & E for implementing sustainability in health care centers. All the experts have more than five years of experience. Seven experts were requested to fill the survey and to rate their opinion with 1 as the least score and 5 as the highest score. From the above survey, the most seven important barriers and enablers are selected. For these barriers and enablers, mean and standard deviation of the score is calculated. Based on this analysis, the first seven barriers and enablers shown in Sects. 18.3.1 and 18.3.2 are selected for further study. After the seven key barriers and enablers are selected, the second questionnaire is developed for DEMATEL method to assign rank to the criteria and then to develop causal relationship among the criteria.

18.5 Modeling

Notations used for this method:

- x^i Influence matrix of i th respondent
- T Total relation matrix
- A Average matrix
- D Normalized initial direct-relation matrix
- r_i row sum of matrix “ T ”
- c_j Column matrix of matrix “ T ”.

The steps involved in DEMATEL are as follows:

- Step 1 Influence matrix is developed from an experts point of view. The development of influence matrix is explained in Sect. 18.5.1
- Step 2 Calculate the average matrix. Average matrix is constructed by taking average of each cell of all influence matrix as $A = (a_{ij})$ where $a_{ij} = \frac{1}{H} \sum_{K=1}^H x_{ij}^K$
- Step 3 Average matrix is normalized by dividing the maximum of row sum is called normalized direct relation matrix (D). $D = A \times S$ where $S = \frac{1}{\max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}}$
- Step 4 Construct the total relationship matrix (T). Total relationship matrix can be calculated as $T = D \times (I - D)^{-1}$, where I is identity matrix of order n .
- Step 5 Set up the threshold value. Total relationship matrix T provides the information about one factor affecting another factor so it is necessary to set up threshold value. The threshold value will tell the effect of one factor on another. There are various methods are available to calculate the threshold value, but a very common way is by taking average of matrix T .
- Step 6 Plot the diagram. The diagram is also known as cause and effect diagram. It can be constructed by using co-ordinates $(x, y) \equiv (r_i + c_j), (r_i - c_j)$. $(r_i + c_j)$ gives the degree of importance of that criteria. $(r_i - c_j)$ provides the net effect that factor j contributes on the system.

18.5.1 Construction of Influence Matrix

Each respondent was requested to fill the questionnaire. They need to evaluate direct influences between two factors with a given score: 0—no influences, 1—low influence, 2—medium influence, 3—high influences. From the responses, 7×7 non-negative matrices are established as $x^k = [x_{ij}^k]$, where k is the number of respondents and n is number of factors. In this study, $n = 7$ and $k = 30$ for each enabler and barrier.

Non-negative 7×7 influence matrix of respondent 1 for barriers is shown below as an example.

$$x^1 = \begin{bmatrix} 0 & 3 & 3 & 3 & 3 & 3 & 3 \\ 2 & 0 & 2 & 2 & 2 & 2 & 1 \\ 2 & 2 & 0 & 2 & 3 & 3 & 2 \\ 1 & 1 & 2 & 0 & 2 & 2 & 1 \\ 3 & 2 & 3 & 2 & 0 & 3 & 1 \\ 3 & 2 & 3 & 2 & 3 & 0 & 1 \\ 1 & 2 & 2 & 1 & 2 & 2 & 0 \end{bmatrix}$$

18.6 Results

As described in Sect. 18.5.1, a questionnaire-based survey is conducted from administrative personnel as experts. With the responses obtained, the influence matrix is constructed. Each respondent will give one matrix for the enabler and one for the barrier. The total number of respondents involved in this survey is thirty. Hence, there are 30 influence matrices for barriers and 30 for enablers. After the construction of all the influence matrices, step by step calculation is done and results are tabulated. This process provides total relation matrix and diagraph.

18.6.1 Barriers

The total relation matrix (T) and diagraph for the barriers are given below:

$$T = \begin{bmatrix} 0.6891 & 0.8365 & 1.0704 & 0.9223 & 1.0558 & 1.0577 & 0.8075 \\ 0.8770 & 0.8192 & 1.1695 & 1.0261 & 1.1541 & 1.1664 & 0.9230 \\ 0.9442 & 0.9956 & 1.1051 & 1.0827 & 1.2666 & 1.2883 & 0.9913 \\ 0.8562 & 0.9674 & 1.1649 & 0.8793 & 1.1582 & 1.1704 & 0.90111 \\ 0.8409 & 0.8928 & 1.1278 & 0.9550 & 0.9701 & 1.1331 & 0.8553 \\ 0.8800 & 0.9172 & 1.1778 & 0.9993 & 1.1630 & 1.0237 & 0.9057 \\ 0.6256 & 0.7167 & 0.8927 & 0.7648 & 0.8880 & 0.9069 & 0.6051 \end{bmatrix}$$

The threshold value of the matrix is 0.97. This value is used to construct the relations among the barriers. From the matrix, any values higher than this threshold value means that the factor is affected by another factor. Consider cell 3×1 , this value is greater than threshold value, so barrier 3 is being affected by barrier 1.

In the diagraph, seven points shows barriers based on the $(r_i + c_j)$ value and $(r_i - c_j)$ value. Based on diagraph as shown in Fig. 18.2, the ranking of importance of criteria is 3-6-5-4-2-1-7 based on the $(r_i + c_j)$ value. The most important barrier is "Lack of top management commitment" with $(r_i + c_j)$ value of 15.42 and least important barrier is "inhibits Innovation" with $(r_i + c_j)$ value of 11.37. On the basis

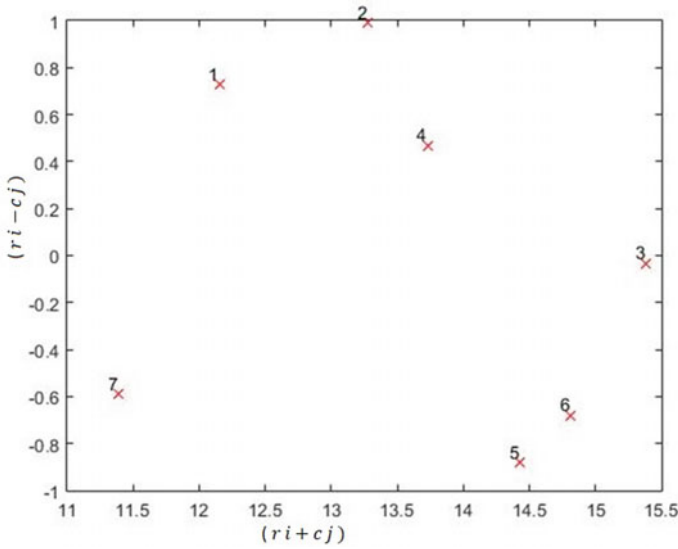


Fig. 18.2 Diagraph for barriers

of $(r_i - c_j)$ value, Financial constraints causing overall effect on the system. All positive $(r_i - c_j)$ values barriers will affect the system and negative $(r_i - c_j)$ values barriers will be affected.

18.6.2 Enablers

The total relation matrix (T) and diagraph for the enablers are given below:

$$T = \begin{bmatrix} 0.6130 & 0.8704 & 0.9336 & 0.8462 & 1.0041 & 0.9317 & 0.6564 \\ 0.6666 & 0.7153 & 0.8825 & 0.8394 & 0.9672 & 0.9137 & 0.6143 \\ 0.8097 & 0.9675 & 0.8712 & 0.9401 & 1.1027 & 1.0587 & 0.7416 \\ 0.6286 & 0.8115 & 0.8541 & 0.6659 & 0.9279 & 0.8927 & 0.6117 \\ 0.7136 & 0.8507 & 0.9038 & 0.8114 & 0.8183 & 0.9179 & 0.6186 \\ 0.7596 & 0.8773 & 0.9165 & 0.8369 & 0.9949 & 0.8070 & 0.6551 \\ 0.5211 & 0.6757 & 0.7032 & 0.6408 & 0.7253 & 0.7132 & 0.4204 \end{bmatrix}$$

Figure 18.3 shows the diagraph for the enablers. The threshold value will be average of total relation matrix. Threshold value is 0.78. This value depicts the effect of enablers on each other. It is similar to the barriers. The effects include direct and indirect effects.

$(r_i + c_j)$ indicates the degree of importance that factor i plays in the entire system. On the contrary, the difference $(r_i - c_j)$ depicts the net effect that factor i contributes

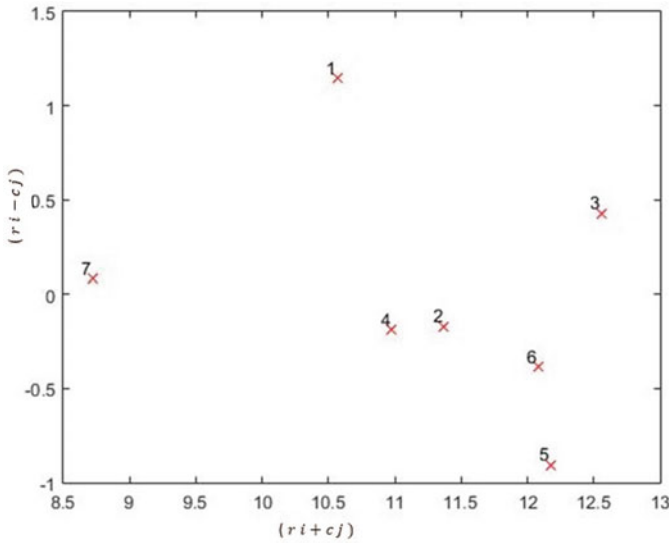


Fig. 18.3 Diagraph for enablers

to the system. In this case, the importance of criteria is ranked as 3-5-6-2-4-1-7. According to $(r_i + c_j)$ value, “Decision-making Strategies” is the most important enabler with value of 12.52 and the least important enabler is “Competitiveness of other centers” with value of 8.59. Based on diagraph, “Economic advantages” affects the system based on $(r_i - c_j)$ value.

18.7 Conclusion

DEMATEL method is a structured directional framework for analyzing the various data and provides a realistic picture. This method is used to determine the nature of barriers and enablers. DEMATEL method does not require any assumption. However, DEMATEL method requires experts opinion to construct the initial influence matrix. Because of this requirement, their preferences may involve bias; hence, it would affect the results. From this study, it is inferred that health care centers like hospitals appear to have various barriers and enablers to implement sustainability practices.

From the literature review, the list of 11 key barriers and 10 important enablers in implementing sustainability practices are identified. This study has explored that “Lack of Top Management Commitment” as the most important barrier and “Inhibits innovation” as the least important barrier. Also, among the enablers, “Decision-making strategies” and “Competitiveness of other centers” have the most and the least importance, respectively. This study reveals that the barrier “Financial Constraints”

causes overall effect on the system. The enabler “Decision-making Strategies” causes overall effect on the system.

The present study can be extended by analyzing the feedback received from the implementation of sustainability practices. Such a study will enable to identify the effect of barriers and enablers in the implementation of sustainability practices.

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