Modelling enablers of efficiency and sustainability of health care: A m-TISM Approach

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Abstract

Purpose – It would not be an exaggeration to say that healthcare is the most crucial one in today's perspective. The health care sector, in general, is engaged in working on various dimensions simultaneously like the safety, care, quality, and cost of services, etc. Still, the desired outcomes from this sector are far away, and it becomes pertinent to address all such issues associated with healthcare on a priority basis for sustaining the outcomes in a long-term perspective. The present study aims to explore the healthcare sector and list out the directly associated enablers contributing to increasing the viability of the healthcare sector. Besides, the interrelationship among the enlisted enablers needs to be studied, which further helps in setting-out the priority to deal with individual enablers based on their impedance in the contribution towards viability increment.

Design/methodology/approach – The authors have done an extensive review to list out the enablers of the health care sector to perform efficiently and effectively. Further, the attempt has been made on the enablers to rank them by using the modified Total Interpretative Structure Modelling (m-TISM) approach. The validation of the study reveals the importance of enablers based on their position in the hierarchical structure. Further, the MICMAC analysis on the identified enabler is performed to categorize the identified enablers in the different clusters based on their driving power and dependence.

Findings – The research tries to envisage the importance of the healthcare sector and its contribution towards national development. The outcomes of the m-TISM model in the present study reveal the noteworthy contribution of the organizational structure in managing the healthcare facilities and represented it as the perspective of future growth. The well-designed organizational structure in the healthcare industry helps in establishing better employee-employer cooperation, workforce coordination, and inter-department cooperation.

Research limitations/implications – Every research work has limitations. Likewise, the present research work also has limitations, i.e. input taken for developing the models are from very few experts that may not reflect the opinion of the whole sector.

Practical implications- The healthcare sector is the growing sector in the present-day scenario, and it is essential to keep the quality of treatment in check along with the quantity. The present study has laid down the practical foundations for improvement in the healthcare sector viability. Besides, the study emphasized on accountability of the healthcare sector officials to go with the enablers having the strong driving power for effective utilization of all the resources. This would further help them in customer (patients) satisfaction.

Originality/value – Despite an increase in demand for good quality healthcare facilities worldwide, the growth of this sector is bounded by the economic, demographic, cultural, and environmental concerns, etc. The present study proposed a unique framework that provides a better understanding of the enablers. It would further help in playing a key role in increasing the viability of the healthcare sector. The hierarchy developed with the help of m-TISM and

MICMAC analysis will help the viewers to recognize the important enablers based on their contribution to the viability improvement of the healthcare sector.

Keywords: Healthcare Sector; Facility Improvement; Modified-Total Interpretative Structure Modelling Approach; Quality Services, Patient Care

1. Introduction

Uniqueness in delivering the services to the consumers who are striving from any physical/mental disorders kept the health care sector at the priority for all the nations *(Liaaen and Vik, 2019; Ertz and Patrick, 2020)*. In general, it is tough to understand the formation and structure of the healthcare industry as reported under the service sector *(Dixit et al., 2019; Nour et al., 2020)*. Further, it has a dependency on the manufacturing sector to serve the patients *(De-Konning et al., 2006; Karamat et al., 2019a)*. For the treatment of the patients, the medicines, diagnosis tools/machines, and surgery equipment, etc. are being purchased from the various manufacturing industries *(Eisenberg, 1997; Azam et al., 2017)*. This sector contributes to the well-being of humans in living a healthier life and has the intention to serve all kinds of creatures *(Sabella et al., 2014)*. The economists consider the health of the population as the capital to which a nation can capitalize for the economic growth purpose in future reference *(Chakraborty and Kalepu, 2019)*. According to them, for maintaining and sustaining the healthcare sector performance, it is pertinent to invest the bigger portions of the national economy to build and maintain this sector healthy in a long-term perspective *(Bedir, 2016; Al-Balas, 2020)*. This investment in the healthcare sector will help in finding the solutions for improving the future of healthcare systems *(Braithwaite, 2018)*.

Till today, the quality of services offered in the healthcare sector has remained one of the most crucial issues because human beings wish to avail safe and reliable services *(Otani et al., 2011; Sherman et al., 2020)*. The extensive review on earlier published literature also confirms that the quality of healthcare services still being offered to the people is not as desired *(Mohammad Mosadeghrad, 2013; Mandal, 2020)*. The stats related to healthcare facilities reveals about 7% peoples may get infected during availing the services from the hospitals in the countries with higher income per person rate and the situation becomes more drastic in the low and middle-income countries where it is around 10-15% *(Schoen et al., 2008)*. Here the quality in services means to the attributes related to this sector such as the proper diagnosis of disease, medication, appropriate treatment, adequate clinical facilities, fair practices, and the adequacy in the skillset of the service providers, etc. *(Ayimbillah Atinga et al., 2011;Jani et al., 2018; Khamis et al., 2019)*. As, this sector has a direct impact on the national population, it is pertinent to every nation to build and develop this sector in such a manner that it will grow rapidly *(McMenamin & Mannion, 2020)*. The earlier researches on this sector also reveal the negative aspects if not organized and structured well *(Otani et al., 2003; Henke et al., 2004)*.

In addition, from the beginning of 2020, the spreading of 'Novel Coronavirus' worldwide caused and cramped the health care sector. Even, unleashes the false claims/commitments of this sector. The crises during the COVID-19 situation reveal the necessity for drastic changes in the health care sector. That's why it becomes paramount to enhance the services in this sector so that humans can avail these services and feel safe during the treatment journey *(Ford et al., 1997;*

Stelson et al., 2017; Harvey et al., 2019). A lot of research work is already carried out on the healthcare industries and points out the suggestions for improving the healthcare facilities. Still, there is a consequence on the priority set-out for the facility improvements *(Vasighnavi et al., 2018 & 2019)*. The present work aims to address the research gaps in the literature and aims to highlights the importance of the health care sector with the help of hierarchical model that can be understood easily. For this, m-TISM approach is used which is the advancement in the TISM model. The TISM model reveals the hierarchy of the identified factors/enablers based on the interrelationship among them. The reachability matrix and partitioning of the elements is done as in the traditional ISM model. Besides, the interpretation of each identified factor/variable with others is done through iterative process and systematically represented in the digraph. In m-TISM, the steps are merged for pair-wise comparison and the transitivity checks which results in reduction of expert-based comparisons. *(Sushil, 2012)*. The prime objectives of the present study are listed as follows:

- To list out the various important enablers that can directly contribute to the improvements of the health care sector from the existing literature
- To analyze the identified enablers for setting out their priority of each enabler using TISM and M-TISM approaches.
- To recommend the relative significance of each enabler in managing and improving the health care facilities based on the research outcomes that will further help the institutions/professionals to understand.

To accomplish the aforementioned objectives, the general healthcare system services are summarized and related to the importance of the nation grew in *Section 1: Introduction*. The *section-2* of the paper will provide the list of enablers in the healthcare sector that help improve the services of this sector based on their appearances in the earlier research published. The present work is based on an exploratory qualitative analysis in which the literature is reviewed systematically and thoroughly *(Drohomeretski et al., 2013; Sangwa & Sangwan, 2018)*. Further, to confirm and validate the purpose of these enablers, the authors have deeply discussed (fuzzy Delphi approach) with the experts in the health sector and explores this with an insight vision. The *section-3* of the study will review the application of TISM and MICMAC analysis, which is generally applied for improving the decisions based on multiple criteria available. The TISM model is developed based on the interrelationship between these identified enablers to reveal the priority of these enablers. In *Section-4* of the study, the findings of the study are discussed with the help of TISM and the MICMAC analysis model diagrams. Finally, the conclusions of the study which reveal the inputs for future researchers are drawn in *section-5* of the study. Also, the limitations and future research opportunities are examined and notified in this section.

2. Identification of factors (Enablers) contributing in increasing the viability of the health care industry

The true enablers are the resources/activities/policies/factors that directly contribute to the success/improvement in a system/project. Each enabler individually involves themselves not just in one project/activity but can contribute to improving the other allied systems/processes. The enablers can help/force/drive/compel the system to respond accordingly and continuously challenges by looking the ways to ensure the long-term success of the businesses. Further, it helps in building the block for the deployment of any advanced technique/tool in a system that aims to maximize the efficiency and effectiveness of the system. The identification of the

enablers is a complex task because if point out wrongly it can create a negative impact on a system under consideration *(Soti et al., 2010)*. To accomplish the task, the work published between 2005-20 by various researchers on the healthcare sector and its agility was extensively reviewed. It has been observed several factors that can contribute to increasing the viability of the healthcare sector. Since there was a gap in the earlier research i.e. the direct or indirect contribution of an individual factor in the healthcare sector and their contribution in the healthcare sector viability can be measured easily with the help of a predefined set of parameters. For this purpose, the Fuzzy-Delphi approach is used as the present work is focusing on the linguistic variables. This would help in determining the suitability of the identified enablers by establishing the fuzzy preference relation *(Tsai et al., 2020)*. The process of the Fuzzy-Delphi Approach is as shown in figure 1 below:

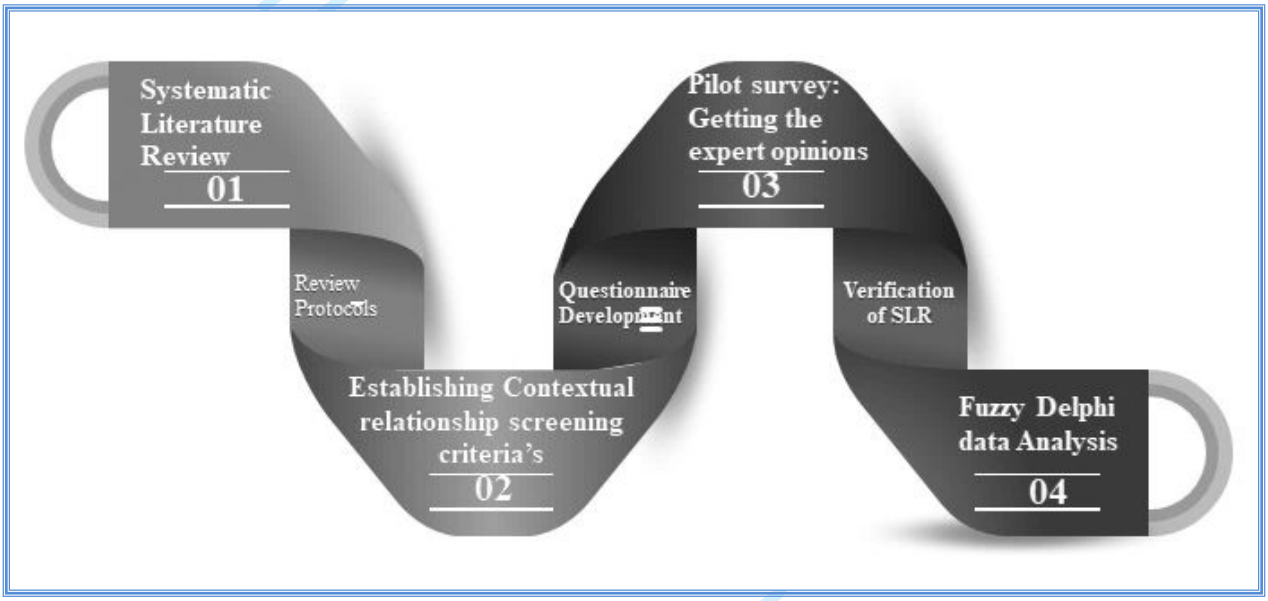

Figure 1: Fuzzy-Delphi Method Steps

For the sake of the best performance outcomes of the healthcare sector, the experts (doctors) were personally interviewed to list out the factors that contribute directly to increasing the viability of the healthcare sector. Finally, the ten numbers of enablers were identified and explained as below:

2.1 Well-designed organizational structure: The Organizational structure is complex in nature and has a direct impact on the outcomes *(Talib & Rehman, 2010; Talib et al., 2020)*. The organization is characterized as stable or unstable based on the environment either predictable or not (*Onday, 2016, Ahmady et al., 2016)*. In the healthcare sector, an organizational structure will further help in the delegation of authority and responsibility *(Dizon et al., 2017)*. It has been revealed that in the health care sector, the extreme level of dependence is designed which causes the organizational operations *(Kumar et al., 2014b)*. To avoid this kind of issues/causes, the organizational structure must be designed well which can help in creating an opportunity to increase the efficiency and efficacy of the sector *(Sherehiy et al., 2007)*.

2.2 Workforce commitment: Human resource is a very important one in the health care industry and performs a variety of tasks such as the data entry for the patient records, operators for

diagnosis machines, doctors for checking and prescription of medicines, nurses for in house patient cares, etc. *(Reeve et al., 2018; Karamat et al., 2019)*. The commitment among the workforce can motivate the workers to work flexibly to perform multi-tasks at a time in the team *(Sweis et al. 2013; Tan et al., 2013)*. Further, the committed workforce will contribute to improving the ability of the healthcare organization and quickly respond to any changes in demand that are faced by the organization in terms of both quantity and variety of cases *(Presseau et al., 2017; Mandal, 2020)*.

2.3 Employee-Employer Cooperation: Cooperation among the workforce and the management people is very important in the health care industry. An adequate communication channel is required to increase the cooperation that further contributes in improving the effectiveness of the health care facilities *(Sherehiy et al., 2007; Dixit et al., 2019)*. The formal, as well as informal relations among employee-employers, should be healthy enough and help in developing the pathway for innovations (new services/extensions of services) through the effective contribution of both *(Talib et al., 2011; Abraham, 2012; Wain, 2020)*.

2.4 Workforce coordination: In the health care sector, the time required to operate the patients varies from case to case. Therefore, it becomes paramount to deal with all the cases in such a manner that everyone who-so-ever is the part during the services to the patient would serve his/her duty in well planned manner *(Otani et al, 2005; Liaaen and Vik, 2019; Wain, 2020)*. This can be done only in the organization where, the coordination the workforce is more than the satisfactory level *(Abraham, 2012; Harvey et al., 2019)*. The interpersonal networks of employees greatly help in the overall performance enhancement of the organization *(Kumar et al., 2014a; Reeve et a.l, 2018; Tewari et al., 2019)*.

2.5 Inter-department cooperation: In the healthcare organization, there is a back-and-forth interdependence in the teams of a healthcare organization which makes them complex and very unique *(McMenamin & Mannion, 2017)*. Various teams are working simultaneously and are interdependent because the treatment of patients often requires inputs from multiple teams and support services *(Stelson et al., 2017; Liaaen and Vik, 2019)*. The members of a team must share their expertise, knowledge, and experiences with the members of other teams to find solutions to difficult problems, make diagnoses, and determine appropriate interventions for the patients. *(Sherehiy et al., 2007)*.

2.6 Skill-based trainings to the employees: The skill-based training helps an employee to remain in touch with the advanced technologies related to the health care sector *(Stelson et al., 2017, Kumar et al., 2018)*. In the training, the timing of the training plays an important role because if employees get trained well in advance, it would help them in new diagnosis tools/techniques which in turn facilitate the treatment of patients effectively *(Sweis et al. 2013; Presseau et al., 2017; Dixit et al., 2019)*.

2.7 Preferably flexible setups: Most healthcare organizations are rigid or in other words bound by the factors like cost, space, etc. These kinds of industries in the future fail to adapt to the advanced machines and techniques *(Pershad et al., 2018; Ertz & Patrick, 2020)*. Healthcare organizations need to have a highly flexible layout that can withstand difficult situations easily *(Vinodh et al., 2012; McMenamin & Mannion, 2017)*. This would further help in maintaining a healthy environment within the organization by improving their services and compete diligently with the competitors *(Alolayyan et al., 2011 & 2013; Talib et al., 2019)*.

2.8 Adoption of advanced technology: In the past few decades, technologies are changing rapidly. In the healthcare sector, it is necessary to go with advanced technology for better patient care *(Presseau et al., 2017; Pham et al., 2007)*. In this regard, technology up-gradation becomes a must for all health care service providers. The advanced health care facilities help in diagnosing the disease properly and also in the treatment of the patients *(Alolayyan et al., 2011; Willis et al., 2016; Karnouskos et al., 2020).*

2.9 Integration of an IT enabled system: The IT revolution plays an important role in the growth of the health care sector *(Khamis et al., 2019; Sherman et al., 2020)*. The IT-enabled systems help in the data management of the patients and also ensure the security of the data stored. It further helps in data retrieval of the patients from the records to study the propagation of disease to identify the appropriate cause of the disease *(Aravind Raj et al., 2013; Chakraborty and Kalepu, 2019)*.

2.10 Employee motivation: Empowerment enables employees to make decisions and come up with remedial actions quickly, hence saving the crucial time of treatment from being wasted by consulting from the senior professionals *(Sherehiy et al., 2007; Sweis et al. 2013)*. Speedy responses can have a significant impact on the treatment of critical cases hence saving many lives *(Sherman et al., 2020; Ertz and Patrick, 2020)*. Trained workers with high expertise lead to a higher innovation rate and at the same time boost the confidence of the workers (*Presseau et al., 2017; Zarei et al., 2018)*.

3. Methodology

The research methodology adopted here is beginning with identifying the healthcare enablers and then, modelling them with the MCDM approach. In the present study, the Modified Total Interpretive Structural Modelling (M-TISM) is used to develop the model. This approach is the upgraded version of TISM & ISM *(Rajan et al., 2020)*. The ISM is the qualitative analysis-based approach that provides the hierarchical model which generally referred as the well-defined model *(Warfield, 1977; Kumar et al., 2017)* where as in the TISM the interpretation is done for every identified variable that further present the model (digraph) based on iterations *(Mittal et al., 2016 & 2017; Sindhwani & Malhotra, 2017)*. In the ISM & TISM approach, the reachability matrix and the partitioning steps are same. The present research reported a list of important enablers identified from the extensive review of published literature which are also validated by the experts in the healthcare sector. The identified enablers then analyzed using the TISM and m-TISM for setting out their priority. The modified TISM steps are shown in figure 2 below.

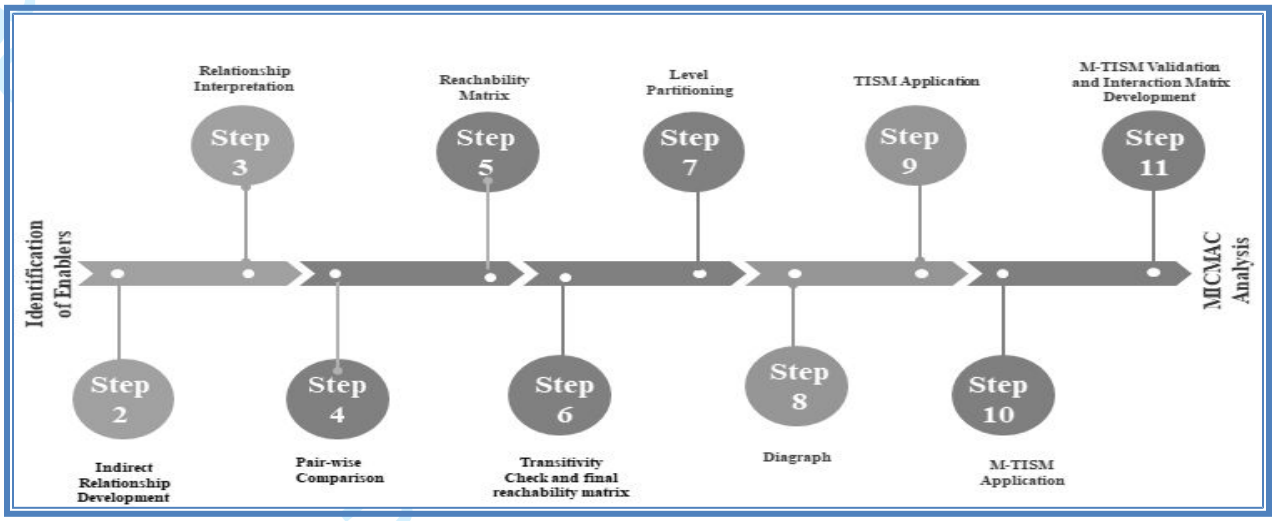

Figure 2: Step-wise flow diagram for M-TISM

3.1 Identification of Healthcare Enablers: The enabler identification work done scrupulously by referring the reputed journals and explained systematically in the section 2 of the study. The 13 Nos of enablers are listed in the Table 1 below:

Table 1: Health care enablers

Enabler No	Enabler Description	Enabler Dependency	References
E1	Well-designed organizational structure	Planning	*Sherehiy et al., 2007; Talib & Rehman, 2010; Krishnamurthy and Yauch, 2007; Onday, 2016; Ahmady et al., 2016; Dizon et al., 2017; Talib et al., 2020*
E2	Workforce commitment	Sourcing and hiring	*Sweis et al. 2013; Tan et al., 2013; Presseau et al., 2017; Reeve et al., 2018; Harvey et al., 2019; Karamat et al., 2019a; Mandal, 2020*
E3	Employee-Employer Cooperation	Working Culture	*Sherehiy et al., 2007; Talib et al., 2011; Abraham, 2012; Patri and Suresh, 2017; Dixit et al., 2019; Wain, 2020*
E4	Workforce coordination	Working Culture	*Otani et al, 2005; Talib et al. 2011; Abraham, 2012; Reeve et al., 2018; Tiwari et al, 2019; Liaaen and Vik, 2019; Harvey et al., 2019; Wain, 2020*
E5	Inter-department cooperation	Working Culture	*Sherehiy et al., 2007; Talib et al. 2011; McMenamin and Mannion, 2017; Stelson et al., 2017; Liaaen and Vik, 2019*
E6	Skill-based trainings to the employees	Training and Economic Considerations	*Alolayyan et al. 2011; Sweis et al. 2013; Presseau et al., 2017; Stelson et al., 2017; Dixit et al., 2019*

E7	Preferably flexible setups	Operational	*Alolayyan et al., 2011&2013; Vinodh et al., 2012; Patri and Suresh, 2017; McMenamin and Mannion, 2017; Pershad et al., 2018; Talib et al., 2019; Ertz and Patrick, 2020*
E8	Adoption of advanced technology	Operational	*Pham et al., 2007; Kitzmiller et al., 2016; Willis et al., 2016; Presseau et al., 2017; Karamat et al., 2019; Alolayyan et al., 2020; Karnouskos et al., 2020*
E9	Integration of an IT enabled system	Operational	*Vinodh et al., 2012, Aravind et al., 2013, Patri and Suresh, 2017; Khamis et al., 2019; Chakraborty and Kalepu, 2019; Sherman et al., 2020*
E10	Employee motivation	Working Culture	*Sherehiy et al., 2007; Sweis et al. 2013; Kitzmiller et al., 2016; Presseau et al., 2017; Zarei et al., 2018; Sherman et al., 2020; Ertz and Patrick, 2020*

3.2 Indirect relationship development: In the m-TISM, the indirect (contextual) relationship among the identified enablers plays an important role. The seriousness of this step can be gauged by the fact that a little confusion/mistake in establishing a relationship among enablers will cause all the modalities and on the final model as well. For establishing the relationship, the no of experts is interviewed individually and in groups. The one-to-one established relationship among variables is listed in *Appendix-1.*

3.3 Relationship interpretation: While establishing the indirect relationship among enablers, it is important to explain how exactly the enablers affect each other. This would further help in understanding the personal capability of the expert and his knowledge within the context. The relationship interpretation for the enablers is also discussed in *Appendix-1.*

3.4 Pair-wise comparison: In the m-TISM, the pair-wise comparison of enablers with each other is carried out to develop the Structural Self-Interactive Matrix. Table 2 reveals the SSIM matrix for the present study. The Y or N in the table reveals the pair-wise comparison based on the relationship established and interpreted in *Annexure 1.*

Table 2: Structural self-interactive matrix

Enablers	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	Y	Y	Y	Y	N	N	N	N	Y
E2	N	-	N	Y	Y	Y	Y	N	N	Y
E3	N	Y	-	Y	Y	Y	Y	N	N	Y
E4	N	N	N	-	Y	Y	Y	N	N	N
E5	N	N	N	N	-	Y	Y	Y	N	N
E6	N	N	N	N	N	-	Y	N	N	Y
E7	N	N	N	N	N	N	-	Y	N	N
E8	N	N	N	N	N	N	N	-	N	N
E9	N	N	N	N	N	N	N	Y	-	N

E10	N	N	N	N	N	N	N	N	N	-

3.5 Initial reachability matrix: As in the case of statistical analysis for quantitative inputs, the inputs are converted in the research formats. Like-wise, in the m-TISM the SSIM is converted to the Initial Reachability Matrix. This can be carried out by replacing the Y by numerical value 1 and N by the 0 in the respective box of SSIM table. The initial reachability matrix for the present study is shown in table 3.

Table 3: Initial reachability matrix

Enablers	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	1	1	1	1	0	0	0	0	1
E2	0	-	0	1	1	1	1	0	0	1
E3	0	1	-	1	1	1	1	0	0	1
E4	0	0	0	-	1	1	1	0	0	0
E5	0	0	0	0	-	1	1	1	0	0
E6	0	0	0	0	0	-	1	0	0	1
E7	0	0	0	0	0	0	-	1	0	0
E8	0	0	0	0	0	0	0	-	0	0
E9	0	0	0	0	0	0	0	1	-	0
E10	0	0	0	0	0	0	0	0	0	-

3.6 Transitivity check and final reachability matrix: In the m-TISM approach, the initial reachability matrix is converted into the binary matrix. This is similar to the normalizing of data before going to apply any tool for further operations on data. This balancing process is done for the sake of desired outcomes by computing the impact/contribution of enablers with each other. The balancing process is termed the Transitivity and is very simple in computation. In this process it is assumed that if, variable A has the relation with B and variable B is related to C then variable A is also having a relationship with variable C (Haleem et al., 2012). In table 4, transitivity is introduced and the table is known as Final Reachability Matrix.

Table 4: Final reachability matrix

Enablers	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	1	1	1	1	1*	1*	1*	0	1
E2	0	-	0	1	1	1	1	1*	0	1
E3	0	1	-	1	1	1	1	1*	0	1
E4	0	0	0	-	1	1	1	1*	0	1*
E5	0	0	0	0	-	1	1	1	0	1*
E6	0	0	0	0	0	-	1	1*	0	1
E7	0	0	0	0	0	0	-	1	1	0
E8	0	0	0	0	0	0	0	-	0	1
E9	0	0	0	0	0	0	1	1	-	0
E10	0	0	0	0	0	0	0	1	0	-

3.7 Level partition in reachability matrix: The level partition in the TISM reveals the contribution/impact of individual variables (enabler in the present study) on the object consider under study. The various levels help the practitioners to set out the priority and the developing the action plan to address the issue which is at the top. For defining the various levels of the enablers, first, the antecedent and reachability sets are identified from table 5. The level is assigned to the enabler based on the intersection set of both the reachability and antecedent sets. The top-level in the hierarchy is occupied by the enablers whose reachability set is the same as their intersection set. In the level partition, it is assumed that any enablers once occupy the hierarchy do not include in the further calculations. The conclusion of iterations is shown in table 5.

Table 5: Levels Assignments to identified enablers

Factors	Reachability Set	Antecedent Set	Intersection Set	Level
E1	E1	E1	E1	VIII
E2	E2	E1, E2, E3	E2	VI
E3	E3	E1, E3	E3	VII
E4	E4	E1, E2, E3, E4	E4	V
E5	E5	E1, E2, E3, E4, E5	E5	IV
E6	E6	E1, E2, E3, E4, E5, E6	E6	III
E7	E7	E1, E2, E3, E4, E5, E6, E7	E7	II
E8	E8	E1, E2, E3, E4, E5, E6, E7, E8, E9	E8	I
E9	E9	E9	E9	II
E10	E10	E10	E10	I

In the present study, at the 8th level well-designed organizational structure is reported which is very important in the health care sector. It helps in executing all the activities such as diagnosing, analyzing & testing simultaneously. For the healthcare sector, it is important to design the organizational structure in such a manner that both the service provider (hospital staff) and the consumer (patients) will get satisfy. The published literature on organizational growth reported the importance of the employee-employer relationship. Similarly in the health care sector, this is very important that there is a healthy relationship among employees and employers to achieve the targeted goals and the patient's satisfaction. The study also confirms its importance in the healthcare sector and reported at the 7th level.

In an organization, workforce commitment is also important which further helps in coordination among other employees. In the present study, it is reported at the 6th level. As per the present study, this enabler is further helped in driving the other enablers. At the 5th level, the workforce coordination is reported which is dependent on various attributes like skill, availability &

commitment, etc. The study reported interdepartmental cooperation at the 4th level, which also has a dependence on various attributes. This enabler has a low impact on the health care sector growth. At the 3rd level, the skill-based training to the employees is reported. In the healthcare sector, skill-based training is important at the initial stage for the employees i.e. it is required before entering this profession. That's-why, this enabler needs less attention.

Further, in the health care sector, the setups are mostly fixed instead of flexible. The present study also confirms the impact of flexible setups on healthcare is not so much. In addition to this, in the Indian Context, a large no of hospitals are available at a small scale and almost all are hesitating to implement IT-enabled systems. The reason being is the cost structure which is to be incurred on the IT system. This enabler is reported at the 2nd level. Regardless of the kind of industry, employee motivation and the adaption of advanced technology are the factors to be considered for the industry growth. Employee motivation helps an organization to work more flexibly and strengthen manpower by adapting the advanced tools. As far as the health care sector is concerned, both the factors don't have much impact on the enhancement of the healthcare services because the proficiency among the employees means a lot rather than the motivation. Both the enablers are reported at the first level.

The level partition in TISM represents the complexity and uncertainty in the identified variables and their impact on the problem under study. Here the noteworthy point in the level partitioning is the variables are addressed in reverse chronological order. As in the present study, the enabler reported at the 8th level is the important one and needs more attention. As the level decrease in reverse chronology, the impact of the enabler reduced on the problem under study.

3.8 Development of diagraph: The level partition done earlier is summarized in Table 5, which is further used to develop the digraph as shown in Figure 3. In the digraph, there are two types of links are represented. The variables connected by the continuous thick line are representing the direct link among the variables. In simple, the variables consider under the study if having a direct impact on each other or affected by each other are joined with each other directly with a continuous thick line. Whereas, the variables which are not connected directly but at the same time connected with any common variable are joined together by a dotted line and known as transitive linkages

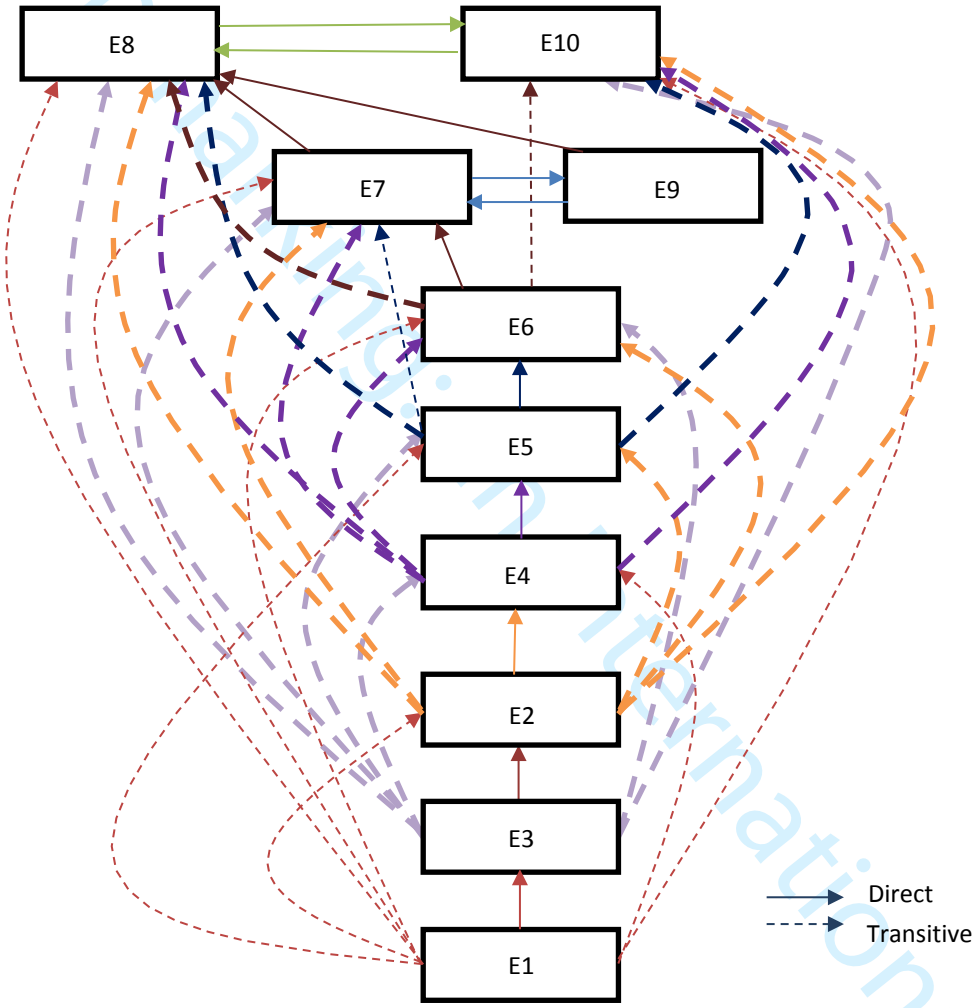

Figure 3: Diagraph of the present study

3.9 Total Interpretative Structural Modelling (TISM): Warfield in 1974 suggested interpretive structural modeling as one of the best approaches to develop the hierarchical structure among the set of variables consider related to any particular real-life subject. This approach was extended in 2012 and the extension was named TISM (*Sushil, 2012)*. The innovative approach deals generally with inter-relating the objects by transforming the poorly articulated mental models into the well-systematic form *(Dubey & Ali, 2014; Yeravdekar and Behl, 2018)*. In the present study, the TISM Diagram is designed based on the digraph and shown in figure 4.

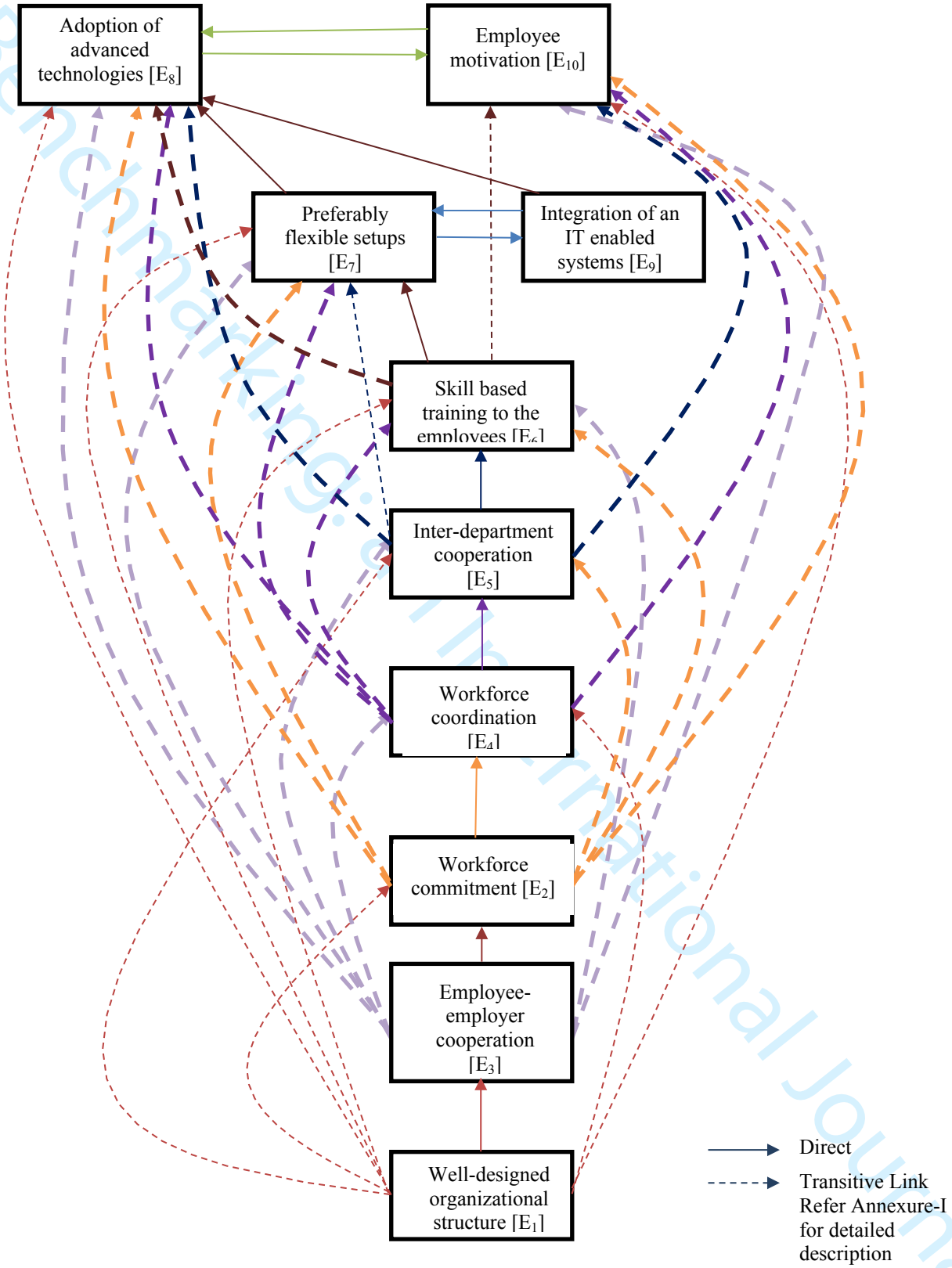

Figure 4: TISM Model for Present Study

3.10 Modified-Total Interpretative Structural Modelling (TISM): The m-TISM is the modified version of TISM. Earlier in 1974, the basic model named ISM was introduced and later it was updated and TISM. The commonality among the two models ISM & TISM is the fully transitive reachability matrix, which is achieved by, firstly, executing the comparisons of the factors selected in pairs, and, secondly, by practicing transitivity checks on them. The basic arithmetic formula is employed to compute the number of paired comparisons is {n * (n-1)/2}, where the "n" represents the number of variables considered for the study *(Bamel et al., 2019; Choudhury et al., 2021; Behl et al., 2018)*. While reviewing both the approaches, it was observed that transitivity checking is a cumbersome process and similar steps are repeated for all the variables which require more time to go the further steps. In Modified TISM, this inherent anomaly is undertaken and steps are merged i.e. operating concurrent steps of explicitly paired comparisons and transitivity checks. So the pairs with transitive links need not be further compared. With this step, there is a reduction of expert-based comparisons, and a fully transitive reachability matrix can be achieved in one step *(Sushil, 2012)*. In the M-TISM, the number of pair-wise comparisons is reduced by around 1/3rd and ensured conforming to time constraints by eliminating the prerequisite of comparison of pairs linked by transitivity logic *(Hasan et al., 2019; Dhir and Dhir, 2020; Singh et al., 2019; Yeravdekar and Behl, 2017)*.

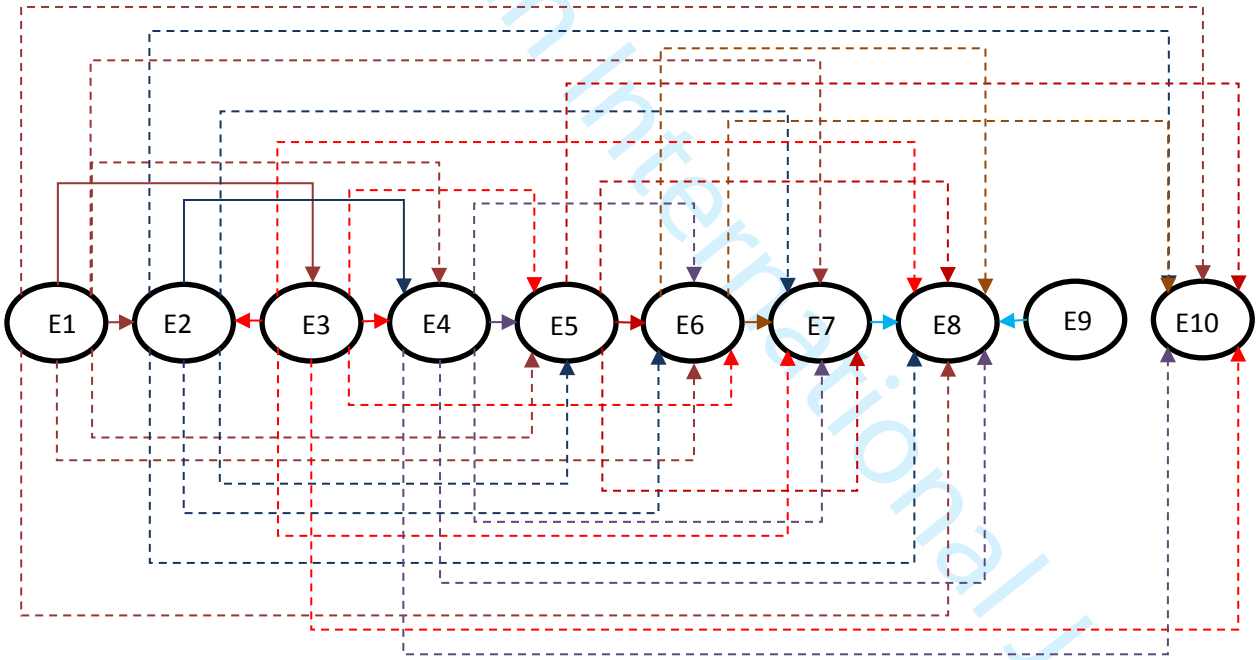

Figure 5: m-TISM

3.11 Modified TISM Validation and Interaction Matrix development: In m-TISM, the validation of the suggested model is necessary before drawing any conclusion. This validation is mainly based on the inputs by the experts and the skill set of the researcher/practitioner. For the validation purpose experts from the healthcare sector were approached and based on Fuzzy-Delphi approach their inputs were taken to go for further evaluation. The inputs taken from the experts based on Likert Scale (1-5) are shown in Table 6.

Table 6: M-TISM validation

Sr. No.	Comparison	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Average score for each link
1	Organizational structure influences Workforce	4	3	3	4	3	4	2	3	3.25 Accept the link
2	Organizational structure influences Management–employee cooperation	4	5	4	4	4	3	3	3	3.75 Accept the link
3	Organizational structure influences Workforce coordination	5	4	4	3	5	3	3	4	3.875 Accept the link
4	Organizational structure influences Interdepartmental cooperation	5	4	5	5	4	4	4	4	4.375 Accept the link
5	Organizational structure influences Training for the Workforce	4	3	4	4	3	3	4	2	3.375 Accept the link
6	Organizational structure influences Flexible setups	3	2	2	3	1	3	2	3	2.375 Reject the link
7	Organizational structure influences Enterprise-wide integration of learning	3	4	3	1	4	4	3	3	3.125 Accept the link
8	Organizational structure influences Employee empowerment	4	4	3	3	3	4	5	4	3.75 Accept the link
9	Management–employee cooperation influences Workforce	5	3	4	5	4	4	5	4	4.25 Accept the link
10	Management–employee cooperation influences Workforce coordination	2	4	2	3	4	4	3	4	3.25 Accept the link
11	Management–employee cooperation influences Interdepartmental cooperation	3	3	2	4	3	4	4	3	3.25 Accept the link
12	Management–employee cooperation influences Training for the Workforce	4	4	3	4	4	5	4	3	3.875 Accept the link
13	Management–employee cooperation influences Flexible setups	5	4	5	3	5	4	5	4	4.375 Accept the link
14	Management–employee cooperation influences Enterprise-wide integration of learning	4	3	2	4	4	3	3	2	3.125 Accept the link
15	Management–employee cooperation influences Employee empowerment	2	3	3	3	4	3	4	4	3.25 Accept the link
16	Workforce influences Workforce coordination	4	4	4	5	4	4	5	4	4.25 Accept the link
17	Workforce influences	3	2	2	4	3	4	4	4	3.25

	Interdepartmental cooperation									Accept the link
18	Workforce influences Training for the Workforce	4	3	2	4	3	2	4	3	3.125 Accept the link
19	Workforce influences Flexible setups	3	2	4	3	4	3	4	2	3.125 Accept the link
20	Workforce influences Enterprise-wide integration of learning	4	3	5	3	4	4	4	5	4 Accept the link
21	Workforce influences Employee empowerment	3	4	4	3	4	5	4	4	3.875 Accept the link
22	Workforce coordination influences Interdepartmental cooperation	4	5	3	2	5	1	3	3	3.25 Accept the link
23	Workforce coordination influences Training for the Workforce	3	5	4	4	5	3	5	4	4.125 Accept the link
24	Workforce coordination influences Flexible setups	4	4	5	3	5	4	4	4	4.125 Accept the link
25	Workforce coordination influences Enterprise-wide integration of learning	3	2	5	4	3	2	4	5	3.5 Accept the link
26	Workforce coordination influences Employee empowerment	1	2	3	3	1	3	2	2	2.125 Reject the link
27	Interdepartmental cooperation influences Training for the Workforce	3	2	4	2	4	5	3	3	3.25 Accept the link
28	Interdepartmental cooperation influences Flexible setups	4	4	3	3	5	3	3	4	3.625 Accept the link
29	Interdepartmental cooperation influences Enterprise-wide integration of learning	4	4	5	4	3	4	3	4	3.875 Accept the link
30	Interdepartmental cooperation influences Employee empowerment	5	4	4	3	4	4	5	4	4.125 Accept the link
31	Training for the Workforce influences Flexible setups	5	4	4	4	5	4	5	5	4.5 Accept the link
32	Training for the Workforce influences Enterprise-wide integration of learning	5	4	3	5	4	3	4	4	4 Accept the link
33	Training for the Workforce influences Employee empowerment	4	4	3	3	3	4	5	4	3.75 Accept the link
34	Flexible setups influences Enterprise-wide integration of learning	4	3	3	2	3	4	3	3	3.125 Accept the link
35	Adoption of IT Technologies influences Enterprise-wide integration of learning	5	3	2	3	1	4	5	4	3.375 Accept the link

For validating, the average score for each link beyond the numeric value 3 is accepted and less than 3 are rejected. As table 6, 33 numbers of links are accepted and two are rejected. Further, it is observed that the average for all the inputs is 3.589 that reveals the acceptance of the model. After validation, the interaction matrix is developed that is further used for the final model development. In the interaction matrix, all direct relations are represented by '1', and all other remaining entries are represented by '0'. The transitive links in the interaction Matrix are now

represented by the"*1"* (in italics). The interaction matrix for the present study is shown in table 7.

Table 7: Interaction matrix

Enablers	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	-	1	1	1	1	0	*1*	*1*	0	1
E2	0	-	0	1	1	1	1	*1*	0	1
E3	0	1	-	1	1	1	1	*1*	0	1
E4	0	0	0	-	1	1	1	*1*	0	0
E5	0	0	0	0	-	1	1	1	0	*1*
E6	0	0	0	0	0	-	1	*1*	0	1
E7	0	0	0	0	0	0	-	1	1	0
E8	0	0	0	0	0	0	0	-	0	1
E9	0	0	0	0	0	0	1	1	-	0
E10	0	0	0	0	0	0	0	1	0	-

3.12 MICMAC analysis: In the MCDM models, MICMAC analysis is very important. It generally discusses the nature of the variable in comparison with other related variables considered understudy whether it drives others or having the dependency on others. It involves the development of the graph having four quadrants (also known as clusters) named Autonomous, Dependent, Linkage and Driving *(Jayalakshmi & Pramod, 2014)*. The variables are divided into these quadrants based on their driving power and dependence. For building a grid, a summation of all the entries of the row for each enabler has been carried out for representation of the "Driving Power" of that enabler. Similarly, entries in the column of those enablers have also been summed up to showcase the "Dependence" of that enabler. Both the summations have been plotted in a grid where the x-axis denotes "Dependence" and the y-axis denotes "Driving Power". The MICMAC analysis for the present study is shown in Figure 5.

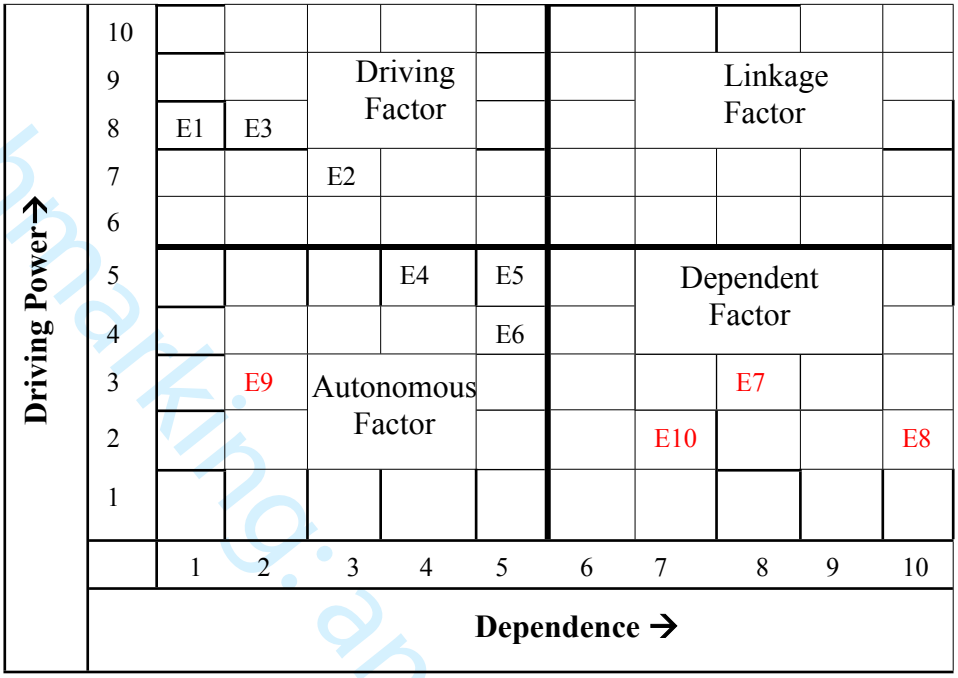

Figure 5: MICMAC Analysis

In figure 5, each cluster having a different purpose to define the nature of the variable as follows:

1st Cluster (Autonomous): The variables lying in this cluster are having weak dependence as well as driving power. This reveals that the variable is not directly linked with the other variables in the said. In the present case study, E4, E5, E6, and E9 are lying in this region. As far as their handling concern, these can be handled separately and if require then simultaneously because these are not interlinked.

2nd Cluster (Dependent): The dependence of these enablers is strong, but the driving power is weak. This kind of variable is always having their dependency on others. Hence, these variables are also of less importance because they contributed very low. In most of the studies, it is revealed that one or two variables lying in this cluster. In the present study E7, E8 and E10 are lying in this region.

3rd Cluster (Linkage): The variables lying under this cluster are having a strong dependence as well as driving power. The variables lying under this cluster mainly help in defining the cause because they generally act as both the driver and dependant factor. The present study reported no variable lying in this region.

4th Cluster (Driving): This cluster is of prime importance in the study as the variables lying in this cluster are having high driving power. The variables with high driving power further drive the other variables which means these variables are needed to be addressed first. Further, help in

defining the recommendations for the study under the consideration. In the present study, the enablers E1, E2, and E3 are lying in this region.

5. Discussion

For the sake of well-being of all humans, it is the prime objective of all the nations is to keep health and education at top priority. In addition, the healthcare sector must be improved continuously to survive in longer duration. This intended improvement could be in the facility or in operations of the healthcare industry/organization (Jani et al., 2018). Though, the continuous improvements may cause the healthcare industry performance because both the internal factors like skill, adoption of advanced tools and techniques; a standard operating procedure used in diagnostics systems; lack of coordination among service providers, etc.), and the external (like sudden environment change; Consumers: awareness, behavior & paying capability, etc.) can directly impacted through these improvements. Still, the improvement is much needed aspect.

While doing research, it is necessary to evolve 3W-H which generally provides the directions to the research work. This 3W-H approach clearly depicts the research background i.e. a. Why the work is done?; b. What would be the outcomes?; c. Who will be benefitted?; and How the research can be beneficial? *(Vasighnavi et al., 2018 & 2019).* The present research study is done to reveal the various enablers (Revealing the What) contributing to increasing the viability of the healthcare sector (Revealing the Why). In addition to this, the study also reveals how do the identified enablers interact with each other and contribute to increasing the viability of the health care system? In the research work, the illustrated models reveal the interrelationship of the identified enablers for the healthcare sector and also suggest the hierarchy to address all these enablers one by one to increase the viability of the sector. The mathematical model can help people identify ways to improve the current healthcare facilities available.

In the present study, the authors tried to expand the understanding of the healthcare sector and how the viability of this sector can be enhanced. In the present study, m-TISM approach is used to develop the mathematical model. The m-TISM is the advanced modeling approach of TISM and having the basic difference in is the merging of steps i.e. paired comparisons and transitivity checks in the m-TISM model. Earlier in TISM, the expert-based comparisons among the variable have to carry out which is around three times as in the case of m-TISM *(Sushil, 2012)*. In the M-TISM, the number of pair-wise comparisons is reduced by around 1/3rd and ensured conforming to time constraints by eliminating the prerequisite of comparison of pairs linked by transitivity logic *(Hasan et al., 2019; Dhir and Dhir, 2020; Singh et al., 2019)*. In the TISM model, the hierarchy among the enablers is reported which gives a better understanding of the enablers. The outcomes of the TISM model reported that the operating process design must be done in such a manner that it includes transparency and integration of all the departments concerned. It helps in increasing the efficiency of the industry by providing the scope/opportunity for continuous improvement to ensure the safety of the patients. Whereas, in the m-TISM the path of importance i.e. E1- E3- E4- E5- E6- E7- E8 to increase the viability of this sector is reported. The well-designed organizational structure in the healthcare industry helps in establishing better employee-employer cooperation, workforce coordination, and inter-department cooperation. Further, in the well-designed organizational structure, the perspective of future growth is concerned. That's why it helps in designing flexible setups to adopt advanced technologies. For these purposes, skill-based training for the employees is also preferred. The outcomes of the

research work will help to the healthcare industries to make use of the resources, both materialistic as well as human resources to help improve their facilities and increase efficiency.

6. Conclusion, limitation, and future scope

The healthcare sector is an integration of many sub-sectors that work within the bounds of the economic system and provide resources and facilities to the patients for their treatment. It is a growing sector and it is essential to keep the quality of treatment in check along with the quantity. The present study concludes that this sector has the requisition of innovations which is to be introduced to this sector at regular intervals to remain competitive, cost-efficient, and up to date. If the facilities that are provided to the patients are not changed for the better, then the patients would not receive the best possible treatment. The present research reported a list of important enablers identified from the extensive review of published literature which was also validated by the experts in the healthcare sector. The identified enablers then analyzed using the TISM and m-TISM for setting out their priority. For this, the interdependence among the enablers is examined based on the enabler's dependent and driving nature.

Besides discussing some of the key issues in the health care sector, the study has limitations. First, the feedback of the employees and the customer (patients) feedback is not considered as the input on variables. This is very important in the healthcare sector as the true opinion of a patient on the treatment given can help the organization to improve the experience of the patients and at the same time will also help the organization to analyze its working procedures. In the future, both the feedbacks must be incorporated to explore the other allied areas of the healthcare sector for the research work such as the sharing resources which are mostly known as a disruptive factor in the health care sector. The reason behind this is the economic considerations as most of the resources and technologies required for the treatment of some specific illnesses are very expensive so if the organizations share such resources then it would help them to cater to more types of illnesses.

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Appendix

S.No.	Enabler	Comparison of Enabler	Y/N	How will the enabler influence the other enabler
E1 Organization structure				
1	E1-E2	Organization structure influences the enabler workforce	Y	When workforce get a good organization structure then they get more motivated to work
2	E2-E1	Workforce influences the enabler organization structure	N	
3	E1-E3	Organization structure influences the enabler management-employee cooperation	Y	A poor organizational structure that demands a lot from employees would hinder the relations of employees with management
4	E3-E1	management-employee cooperation influences the enabler organization structure	N	
5	E1-E4	Organization structure influences the enabler workforce coordination	Y	It is important to remove communication gap between employees
6	E4-E1	Workforce coordination influences the enabler	N	
7	E1-E5	Organization structure influences the enabler interdepartmental cooperation	Y	If the organization structure is not will designed then it can cause clashes between departments
8	E5-E1	Interdepartmental cooperation influences the enabler organization structure	N	
9	E1-E6	Organization structure influences the enabler training for workforce	N	
10	E6-E1	Training for workforce influences the enabler organization structure	N	
11	E1-E7	Organization structure influences the enabler flexible setups	N	
12	E7-E1	Flexible setups influences the enabler organizational structure	N	
13	E1-E8	Organization structure influences the enabler enterprise-wide integration of learning	N	
14	E8-E1	Enterprise-wide integration of learning influences the enabler organization structure	N	
15	E1-E9	Organization structure influences the enabler adoption of IT technologies	N	
16	E9-E1	Adoption of IT technologies influences the enabler organization structure	N	
17	E1-E10	Organization structure influences the enabler employee empowerment	Y	Less control leads to more authority to employees to take self decisions
18	E10-E1	Employee empowerment influences the enabler organization structure	N	
E2 Workforce				
1	E2-E3	Workforce influences the enabler management-employee cooperation	N	
2	E3-E2	management-employee cooperation influences the enabler workforce	Y	More coordination leads to more motivated workforce
3	E2-E4	Workforce influences the enabler workforce coordination	Y	Flexible workforce will be able to be more informal
4	E4-E2	Workforce coordination influences the enabler workforce	N	

5	E2-E5	Workforce influences the enabler interdepartmental cooperation	Y	Motivation leads to cooperation
6	E5-E2	Interdepartmental cooperation influences the enabler workforce	N	
7	E2-E6	Workforce influences the enabler training for workforce	Y	If the workforce is not motivated then they would be eager to learn new skills
8	E6-E2	Training for workforce influences the enabler workforce	N	
9	E2-E7	Workforce influences the enabler flexible setups	Y	Skilled workforce is required to use the SETUP
10	E7-E2	Flexible setups influences the enabler workforce	N	
11	E2-E8	Workforce influences the enabler enterprise-wide integration of learning	N	
12	E8-E2	Enterprise-wide integration of learning influences the enabler workforce	N	
13	E2-E9	Workforce influences the enabler adoption of IT technologies	N	
14	E9-E2	Adoption of IT technologies influences the enabler workforce	N	
15	E2-E10	Workforce influences the enabler employee empowerment	Y	Workforce should be qualified enough to take decision without consulting higher officials
16	E10-E2	Employee empowerment influences the enabler workforce	N	

E3 Management-employee cooperation

1	E3-E4	management-employee cooperation influences the enabler workforce coordination	Y	If employees get help from management then that boosts team spirit
2	E4-E3	Workforce coordination influences the enabler	N	
3	E3-E5	management-employee cooperation influences the enabler interdepartmental cooperation	Y	If management and employees will not have good relations then interdepartmental relations would be difficult
4	E5-E3	Interdepartmental cooperation influences the enabler management-employee cooperation	N	
5	E3-E6	management-employee cooperation influences the enabler training for workforce	Y	Better relations with management would open up new doors for training of employees
6	E6-E3	Training for workforce influences the enabler management-employee cooperation	N	
7	E3-E7	management-employee cooperation influences the enabler flexible setups	Y	Without cooperation from management, flexible setups would be difficult to get a hold of
8	E7-E3	Flexible setups influences the enabler management-employee cooperation	N	
9	E3-E8	management-employee cooperation influences the enabler enterprise-wide integration of learning	N	
10	E8-E3	Enterprise-wide integration of learning influences the enabler management-employee cooperation	N	
11	E3-E9	management-employee cooperation influences the enabler adoption of IT technologies	N	
12	E9-E3	Adoption of IT technologies influences the enabler management-employee cooperation	N	
13	E3-E10	management-employee cooperation influences the enabler employee empowerment	Y	More cooperation leads to more authority to employees

14	E10-E3	Employee empowerment influences the enabler management-employee cooperation	N	
E4 Workforce coordination				
1	E4-E5	Workforce coordination influences the enabler Interdepartmental cooperation	Y	Good relations within workforce will help them in their relations with other departments
2	E5-E4	Interdepartmental cooperation influences the enabler workforce coordination	N	
3	E4-E6	Workforce coordination influences the enabler training for workforce	Y	Good coordination between employees will help them learn new things faster
4	E6-E4	Training for workforce influences the enabler workforce coordination	N	
5	E4-E7	Workforce coordination influences the enabler flexible setups	Y	Flexible setups will not be feasible enough for a workforce that lacks coordination
6	E7-E4	Flexible setups influences the enabler workforce coordination	N	
7	E4-E8	Workforce coordination influences the enabler enterprise-wide integration of learning	N	
8	E8-E4	Enterprise-wide integration of learning influences the enabler workforce coordination	N	
9	E4-E9	Workforce coordination influences the enabler adoption of IT technologies	N	
10	E9-E4	Adoption of IT technologies influences the enabler workforce cooperation	N	
11	E4-E10	Workforce coordination influences the enabler employee empowerment	N	
12	E10-E4	Employee empowerment influences the enabler workforce coordination	N	
E5 Interdepartmental cooperation				
1	E5-E6	Interdepartmental cooperation influences the enabler training for workforce	Y	If employees work well together then they can train together more efficiently
2	E6-E5	Training for workforce influences the enabler interdepartmental cooperation	N	
3	E5-E7	Interdepartmental cooperation influences the enabler flexible setups	Y	If different departments can cooperate in using the flexible setups, then only they are feasible
4	E7-E5	Flexible setups influences the enabler interdepartmental cooperation	N	
5	E5-E8	Interdepartmental cooperation influences the enabler enterprise-wide integration of learning	N	Lack of cooperation would lead to difficulty in gaining more knowledge
6	E8-E5	Enterprise-wide integration of learning influences the enabler interdepartmental cooperation	N	
7	E5-E9	Interdepartmental cooperation influences the enabler adoption of IT technologies	N	
8	E9-E5	Adoption of IT technologies influences the enabler interdepartmental cooperation	N	
9	E5-E10	Interdepartmental cooperation influences the enabler employee empowerment	N	
10	E10-E5	Employee empowerment influences the enabler interdepartmental cooperation	N	

E6 Training for workforce				
1	E6-E7	Training for workforce influences the enabler flexible setups	Y	Only skilled labour will be able to use the setup
2	E7-E6	Flexible setups influences the enabler training for workforce	N	
3	E6-E8	Training for workforce influences the enabler enterprise-wide integration of learning	N	
4	E8-E6	Enterprise-wide integration of learning influences the enabler training for workforce	N	
5	E6-E9	Training for workforce influences the enabler adoption of IT technologies	N	
6	E9-E6	Adoption of IT technologies influences the enabler training for workforce	N	
7	E6-E10	Training for workforce influences the enabler employee empowerment	Y	If an employee is well trained then the decision making capability improves
8	E10-E6	Employee empowerment influences the enabler training for workforce	N	
E7 Flexible setups				
1	E7-E8	Flexible setups influences the enabler enterprise-wide integration of learning	Y	The technology help information to travel all over the organization
2	E8-E7	Enterprise-wide integration of learning influences the enabler flexible setups	N	
3	E7-E9	Flexible setups influences the enabler adoption of IT technologies	N	
4	E9-E7	Adoption of IT technologies influences the enabler flexible setups	N	
5	E7-E10	Flexible setups influences the enabler employee empowerment	N	
6	E10-E7	Employee empowerment influences the enabler flexible setups	N	
E8 Enterprise-wide integration of learning influences				
1	E8-E9	Enterprise-wide integration of learning influences the enabler adoption of IT technologies	N	
2	E9-E8	Adoption of IT technologies influences the enabler enterprise-wide integration of learning	Y	The advanced IT and multimedia technology plays an important in spreading information in the organisation
3	E8-E10	Enterprise-wide integration of learning influences the enabler employee empowerment	N	
4	E10-E8	Employee empowerment influences the enabler enterprise-wide integration of learning	N	
E9 Adoption of IT technologies				
1	E9-E10	Adoption of IT technologies influences the enabler employee empowerment	N	
2	E10-E9	Employee empowerment influences the enabler adoption of IT technologies influences	N	

Response to Associate Editor

We have modified the article as per comments given by Associate Editor.

Modification in the paper and comments as below:

Associate Editor Comments:

S. No.	AE Comments	Modified Comments	Page No.
1.	After careful evaluation, I found some issues with the TISM diagram. For instance, E7 and E9 and E8 and E10 are at the same level. Hence, there must be a bidirectional arrow between them. Accordingly, the final reachability matrix and the MICMAC diagram will change.	Thanks for your valuable comment, according to your suggestion we have corrected the changes in Table 4. Final Reachability matrix, Figure 3. Diagraph of the present study, Figure 4. TISM Model for the present study, Table 7. Interaction matrix and in Figure 5. MICMAC analysis. Again, thanks for your valuable suggestion.	10,12,13,17, and 18