Driving sustainable healthcare service management in the hospital sector

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Abstract

Sustainability in service management is a crucial issue in today's competitive business environment. Previous researchers have conducted studies on healthcare sustainability from various areas, but none has been conducted on the assessment of driving factors to sustainable service management in the hospital sector. This study fills this research gap by identifying and assessing the driving factors behind sustainable service management in the hospital sector from an emerging economy context. The study does so by utilizing integrated qualitative and quantitative research methods. Primarily, the study performed a Delphi study to identify the most relevant driving factors and then utilized the integrated grey-based decision-making trial and evaluation laboratory (DEMATEL) model to aid the evaluation within the Bangladesh hospital sector. The study identified eleven factors as the cause and nine factors as effect group factors. Furthermore, the factor "Engaging experienced doctors in top management (D20)" was identified as the most prominent driving factor for sustainable hospital service management. The driving factor "Implementation of Public Health Policies (D18)" was identified as the topmost causal factor, and "Proper maintenance and monitoring of hospital support services (D9)" identified as the most influenced/impacted effect group driving factor. The study's findings have significant policy implications for service operations and managers in the hospital sectors. The service managers should give special attention to the causal group driving factors and invest heavily in them as that will help to ensure that the effect group factors are also improved within the system.

Keywords: Healthcare service management, Sustainable service, Triple bottom line (TBL), Delphi method, Grey DEMATEL

1. Introduction

As patients' satisfaction and loyalty reflect the quality of health service (Nguyen et al., 2021), all the stakeholders of the healthcare industry including health workers, managers, owners, community and regulators as well as researchers have set the common goal of ensuring safe and quality health services (Pasinringi et al., 2021). Promoting healthy life and - for all powell-beingpulations has also been ranked third among the seventeen Sustainable Development Goals (SDGs) declared by the United Nations (UN) to achieve under the 2030 Agenda (D'Adamo et al., 2021; Skålén and Gummerus, 2022). Among all organizations in the healthcare industry, hospitals happen to be one of the most important players as they play key roles in maintaining and promoting public health (Bastani et al., 2021). Therefore, hospitals pledge to provide services with quality, proficiency, and viability (Yucesan & Gul, 2020). The service quality of hospitals can be improved by providing a sense of contentment to the patients achieved through ensuring the empathy of the service provider in a reformed organizational setup (Karltun et al., 2020). One such refurbishment can be value co-creation culture favoring the participative mentality of customers while receiving the service (Helkkula et al., 2022; Sandvin Olsson et al., 2020). Engaging experienced physicians as strategic decision makers (Kosherbayeva et al., 2020) or recruiting employees who graduated in health service management (Bastani et al., 2021) have paved the way to incorporating sustainability in service management. Managing hospital service in an effective way leads to a new organizational culture empowering the staff, and, in turn, enhances the quality and safety of the service (Lee & Lee, 2022). However, as a growing service sector in developing countries, hospitals are facing the challenge of striking a balance between the affordability of service and performance efficiency (Berry, 2020). Service expectancy of the patients coupled with technological innovation give rise to increased healthcare expenditure (van Vooren et al., 2020). To stay competitive in this dynamic service market, it is obligatory not only to manage the rising costs of healthcare, but also to function by complying with the environmental laws (Field et al., 2021; Gustafsson et al., 2020)**.** These challenges demand that the hospitals operate in a waste-free environment maintaining the expected environmental standards and improve their efficacy by being competitive and profitable (Tushar et al., 2023)**.**

Practitioners, politicians, and scientists concur that the modern healthcare service structure is not sustainable in emerging economies (Moshood et al., 2022). In line with this call and as acknowledged in the recent era globally, more efforts are required to achieve sustainable

improvement in hospital service management (Shortell et al., 2021). There is a dearth of current work to consider the overall scenario of the hospital service management. To mention, Amos et al. (2020) only established key performance metrics under the umbrellas of quality, finance, learning and growth, and international business to enable facilities management in public hospitals, while Tortorella et al. (2022) advocated for the adoption of healthcare 4.0 emphasizing the need to facilitate collaboration between individuals and healthcare providers, enhance professional skills, incorporate technology into organizational reforms, and empower personnel in decision-making processes, all of which will contribute to the sustainable development of healthcare. Digitalizing the service delivery process is one example of such innovative trategy that can improve patients' satisfaction, loyalty, and the organization's reputation (Lamperti et al., 2023). Again, Sassanelli et al. (2018) proposed incorporating lean design principles into the caregiving process to ease service seekers. To increase the accessibility of high-quality service to the public, Tilhou et al. (2020) also proposed enacting an affordable legislation in hospital services. The system could only be sustainable if stakeholders can meet the required system standards against the affordability index. Hospitals are complex systems (Manning & Islam, 2023) and due to social and economic obstacles, implementation of sustainable service management is far-fetched in developing countries (Aslam et al., 2022). In these circumstances, it is necessary to integrate the sustainability concept into the hospital operations that will benefit the stakeholders from social, economic, and environmental perspectives.

Bangladesh's government is dedicated to strengthening healthcare systems and enhancing care quality. Over the last two decades, Bangladesh's public health has significantly improved in terms of decline in childhood and maternal mortality and rise in life expectancy which helps achieve Millennium Development Goal 4 (MDG-4) (Niport et al., 2020). Nevertheless, despite the success, the healthcare sector consisting of government, private, NGOs and international development organizations is facing innumerable challenges. Bangladesh has a persistent scarcity of healthcare professionals with the necessary training, such as doctors, nurses, staff, and other workforces. Such a scarcity has to be viewed as a significant barrier for managing service in public hospitals (Rahman, 2019). Though doctors are stressed with a lot of patients beyond their capacity, about twenty percent posts are still vacant in government hospitals according to Directorate General of Health Services of Bangladesh (Niport et al., 2020). The ratio of hospital bed in Bangladesh and population is 1: 1667 which is seriously low (Fahim et al., 2019). Mohiuddin

(2020) investigated the major challenges in accessing hospital services, placing significant emphasis on currently available inferior resources leading to lack of proper services. Doctors are stressed with a huge number of patients over their capacity resulting in short appointment time and sometimes the wrong treatment. In addition, public doctors tend to see their patients in their private chambers for extra monetary benefits. Furthermore, very few hospitals (10%) are concerned about proper management of medical wastes (Mohiuddin, 2020). These wastes are collected with municipal waste and disposed of by open burning in unauthorized places. All these substantial challenges are affecting the patients' satisfaction with the service quality. As a result, Bangladeshis seeking quality service abroad are on an upward trend due to unsatisfactory service delivery system in local hospitals (Alauddin et al., 2021). Due to all of these problems, hospital service systems urgently need to incorporate sustainability into their system.

Although the sustainability concept has been well implemented in manufacturing organizations, the adoption of sustainability in service industries such as hospitals has not been thoroughly investigated (Tseng et al., 2020), particularly through the lens of the Triple Bottom Line (TBL hereafter) as defined by Elkington (1997). According to the concept of TBL, hospitals should transition toward sustainable service management which comprises of minimizing the expense of treatments while enhancing the system's efficiency, providing more equitable patient care, and reducing the negative environmental impact of hospital operations (Elkington, 2002). Thus, the focus should be on the economic aspect along with social and environmental aspects. Only limited research has taken a deeper look into hospital sustainable service management embracing TBL. A few studies have investigated healthcare sustainability including those by Mehra and Sharma (2021); Amos et al. (2020); Borges de Oliveira et al. (2021); Wagrell et al. (2022), but none has investigated the assessment of all driving factors to sustainable service management in the hospital sector. In addition to this gap most of the investigations on service management are concentrated on how the patients' satisfaction and environmental condition can be improved and measured (Peng et al., 2020; Wulandari et al., 2021). Other researchers have also accounted for the contribution of a single or multiple social or economic factors on long-term service management (Bastani et al., 2021; Chauhan et al., 2022). In light of these research gaps, this study has raised the following research questions **(RQs)**:

RQ1: What are the drivers to sustainable service management in hospitals?

***RQ2*:** How the most significant drivers are interrelated to each other?

***RQ3*:** How the research framework will help the practitioners and decision makers incorporating sustainability into the system?

To acknowledge the abovementioned RQs, this research examines the enablers of sustainable hospital service management and their interrelationships in the context of Bangladesh. Environmental factors are identified independently from existing literature and experts' opinion, while economic and social factors with the inputs from the perspectives of multi-stakeholders such as community, employee, management, and government. Thus, this research work will enrich two streams of the available literature including the hospital service management and sustainability through achieving the following research objectives **(ROs):**

RO1: Identify the drivers to the adoption of sustainable service management in the hospital sector

RO2: Propose a framework to examine and evaluate the drivers via the Delphi and grey DEMATEL approaches

RO3: Explore the interrelationship among the drivers and assist policy makers to formulate sustainability in hospital service management

To pursue the defined ROs, this study intends to apply an integrated method combining Delphi technique and grey decision-making trial and evaluation laboratory (DEMATEL) method to identify and model the driving factors to sustainable service management in hospital sector from the perspective of Bangladesh. There is no such research up to date study that has used the recommended methodology in the field of healthcare service management. Firstly, the Delphi technique provides an iterative way to acquire the most significant factors and carry out assessments to move to a consensus while utilizing standardized questions that solicit advice from experts through a series of sessions. Then, a combination of grey theory and DEMATEL method is applied to figure out the ranking and causal relationship among the factors. Though structural relationships can be achieved by traditional DEMATEL, this method is susceptible to data ambiguity, vagueness, and subjective bias. The grey DEMATEL provides a useful alternative to standard DEMATEL and fuzzy DEMATEL methodologies, especially in settings characterized by uncertainty, data constraints, complex calculation, challenging and reliable decision-making processes.

The merging of two modern tools, the Delphi technique and the grey DEMATEL method, to identify the most important driving factors to sustainable hospital service management forms the theoretical foundation of this study. The factors identified and analyzed incorporate all the perspectives of sustainability from the thoughts of all hospital stakeholders which is totally unique. The practical contribution of this research lies in providing deep insights about hospital's complex sustainability scenario to the policymakers. The outcomes of this research will assist in strategic planning to overhaul the hospital service system in a sustainable way.

The rest of the paper is set out as follows: Section 2 discusses the literature on hospital service management sustainability, the hospital service scenario in Bangladesh, current related works, research gaps, contributions and driving factors of sustainable hospital service management, and the methodology comprising of Delphi and grey DEMATEL is presented in Section 3. In Section 4, the case of the Bangladesh hospital sector is investigated, and the results/findings covering the cause group and effect group driving factors are discussed in Section 5. Implications are discussed in Section 6 and concluding remarks are presented in Section 7.

2. Literature Review

This section explores the body of research on sustainable hospital service management before going over Bangladesh's current situation. This section also delineates recent related works, pertinent research gaps, contributions of the study, and the significant key factors regarding the study.

2.1 Sustainable hospital service management

The World Commission on Environment and Development had delineated sustainability as developing and embracing business policy and procedures in a way that meet all the expectations of current generation taking into account no negative impact caused by the adopted action plan on the generations to come in terms of humane, economy and environment factors (WCED, 1987). The term 'triple bottom line' (TBL) was coined by Elkington (2002) to expatiate the background of long-term development, which incorporates environmental protection, social fairness, and economic prosperity. Integrating these three aspects assists in instituting sustainability in any system, whether manufacturing or service. According to the TBL concept, all

three dimensions are equally important, and, in order to attain sustainability, all three dimensions must be addressed at the same time (Gupta et al., 2020). Sustainable development satisfies current requirements while also taking into account the needs of future generations.

Sustainable healthcare, according to Osorio-González et al. (2020), is a system ensuring service to the customers that is viable, equitable and acceptable in terms of three pillars of sustainability. Thus, such a system safeguards the public health while guaranteeing no potential resource waste and no endangered environment. Sustainable hospital service management also places a premium on patient care while simultaneously considering economic and environmental concerns (Sassanelli et al., 2022). Sustainable hospital service management requires the collaboration of all the sectors in a hospital in order to create the best possible working conditions for patient care (Ferreira & Marques, 2021). The current financial and environmental sustainability of hospitals is uncertain. Maintaining service in hospitals incorporating the factors of sustainability is critical to market competitiveness, standardized system development, and continual drive for improved services, in addition to environmental conservation (Mousa & Othman, 2020). For this reason, it is necessary to identify the measures of sustainable service and formulate the strategies in hospitals by considering all the stakeholder demands.

In terms of the environmental dimension, hospital activities and services in comparison to other service areas require substantial quantities of resources (goods, energy, water, etc.) which produce significant environmental pollutant (Sassanelli et al., 2022). The environmental perspective of service sustainability aims to put an end to the environmental damage. The social sustainable performance of hospitals lies in the potentiality to take care of people's health and providing them with a sound life. Another perspective of the social dimension relates to occupational and institutional sustainability which favors the shift towards service sustainability by being supportive of changing hospital operations and management without jeopardizing the occupational health of the hospital's workforce (Osorio-González et al. (2020). There are also some issues in which the government should intervene to promote sustainability in the hospital service management. The economic dimension can be considered as a set of policies by which a hospital should be run to promote sustainable financial performance of the hospital, not at a sacrifice of the above obligations. The integrated approach combining all the three sustainability

aspects will help examine the hospital's care delivery performance and, thereby, help in making more strategic decisions.

2.2 Hospital Service Scenario of Bangladesh

Bangladesh has a properly structured healthcare system with clinics, health complexes, and hospitals in areas spanning from villages to district levels. The clinics and health complexes in rural areas are backed up by the district hospitals by providing advanced care. In addition, private hospitals and other non-government healthcare institutions are found in the country's vital cities. There are 5,622 private hospitals and clinics registered, as well as 9,123 private diagnostic centers (Niport et al., 2020). Still, these are not adequate in comparison to the population of the country. The public healthcare sector consumes a modest percentage of the country's GDP (3%), accounting for less than a third of the total. According to the World Health Organization (WHO), there are only five doctor available in Bangladesh for every 10000 individuals, ranking the country second from last in the south region of Asia (Islam et al., 2021). The findings of the report show that a notable number (more than 70%) of rural clinics do not have essential items for first aid like thermometers, stethoscopes, blood pressure gauges, infant and adult weighing scales, and torchlight. Only 58% of hospitals have an internet-connected computer while emergency transport is available in about 5% of hospitals. Public hospitals do not maintain any standard precaution for infection control. Basic diagnostic tests are available in only 5% of public hospitals and medical waste is a concern for less than 10% of hospitals in this country (Niport et al., 2020).

The primary healthcare monitoring tool uses average consultation length as a performance indicator. But, due to the huge load of patients, doctors cannot spend more than 60 seconds on average per patient (Alauddin et al., 2021)). Nurses are also suffering a great deal with the overflow of patients beyond their capability. There are not enough government staff quarters and no transportation facility in spite of staff doing night shifts. In addition, very slow career growth causes lack of motivation in the job which in turn affects the service quality (Akter et al., 2019). Bangladesh lacks recognized authority for resolving complaints about healthcare professionals. Again, there is little or no assessment system of the hospital's performance on service quality. Providing service without higher levels of medical knowledge and competence are making the patients victims to wrong treatment (Nuri et al., 2019). This is why violence against physicians has been escalated by the victims or their relatives, and the intensity has also increased (Islam et al.,

2022). Unavailability of doctors during working hour is a common scenario in public hospitals. There is no health insurance policy for the population from the government. Apart from all of the above-mentioned challenges, Razu et al. (2021) addressed some other challenges that the healthcare sector is facing. These include lack of coordination and management practice, impractical workload and mental stress, insufficient financial support and incentives, and lack of quality personal protective equipment, among others. As a result, people are less willing to receive service and care in local hospitals. Financially solvent patients are seeking better service quality in nearby countries and the count is rising every year. Under such circumstances, there is no alternative but to incorporate a sustainability agenda to improve the hospital service in Bangladesh so that it can better serve the population.

2.3 Related works, research gaps, and research contributions

The significance of integrating service sustainability in hospitals cannot be overlooked due to the growing recognition for reducing environmental impact, optimizing service cost while ensuring patient satisfaction, and enhancing reputation of the organization. The structural complexity of the hospital environment has made it challenging to design and implement sustainable changes that would provide reliable and affordable care with improved performance and efficiency of service providers. However, a lot of research has been undertaken to unlock the link between service sustainability and other variables associated with hospitals. Therefore, a systematic literature review has been conducted for this study from 2019 to 2022 about existing literature to comprehend the sustainable hospital service and identify its driving factors. This review has led to a research gap in this sector which provides the motivation for this study. This literature review process follows a research protocol incorporating databases, temporal resolution, keywords, inclusion, and exclusion criteria, as shown in Table 1.

Table 1. Details of research protocols for conducting the literature review

Research protocol	**Detail description**
Databases	Scopus, ScienceDirect, Web of Science, and Google Scholar
Language	English
Temporal resolution	2019 to 2023
Search terms and keywords	"Factors of hospital service management", "Drivers of health service", "Factors of health service", "Critical success factors of hospital service management", and "Critical success factors of health service management"

Inclusion criteria	(i) Articles relevant to RQ1, RQ2, and RQ3 that provide framework, models, tools, or techniques; (ii) Scientific reports highlighting the enablers, factors, or strategies to ensure sustainability regarding hospital service management
Exclusion criteria	(i) Articles that are not indexed in Scopus, ScienceDirect, Web of Science, and Google Scholar.; (ii) Articles emphasizing factors those are irrelevant for emerging economies and (iii) Articles that are published in other languages rather than English
Data extraction	The selected factors for the proposed framework are unique and relevant to the scope of the study

Borges de Oliveira et al. (2021) suggested few guidelines to institute energy management in hospitals with a view to achieving environmental sustainability and competitiveness in this service sector. Again, safe medical waste collection, transportation, and disposal will guarantee a quality hospital environment and protect the wellbeing of all stakeholders (Erdem, 2022). On the other hand, Amos et al. (2021) stressed the importance of strategic financial planning in the facilities management priority area as a component of economic sustainability, which is closely related to business, learning, and growth as well as service quality. A resource integration approach can also be utilized in hospital across different departments at different settings upon which the social and economic dimension of sustainability is highly dependent (Wagrell et al., 2022). (Hu et al., 2020) focused on behavioral aspects from patients' side as their no-show behavior during appointments impeding the provision of sustainable medical services. The rest of the relevant literature is summarized in Table A1 in Appendix A.

Through conducting the rigorous literature review, the following research gaps have been addressed:

i. Though exploring the sustainability in hospital service management is an ongoing effort, very few studies have acknowledged the hospital service sustainability in the shed of TBL (Pederneiras et al., 2023; Tonjang & Thawesaengskulthai, 2022). However, these existing studies fall short of unveiling the multi stakeholders' perspective to develop deep insights.

ii. The focus of many studies is on unveiling the relationship between a single variable and sustainable service (Shortell et al., 2021; Nagariya et al., 2021). The existing literature, however, does not analyze the sustainability of hospital services from the perspective of a complex hospital environment integrating various factors.

iii. No study is found conducting such analysis accounting the scenario of emerging economies.

iv. The cause-effect relationship among the factors is a significant parameter which appears to be absent in the literature.

v. Another research gap is to unearth how the factors under TBL will assist policymakers and practitioners in achieving sustainable hospital service management.

Utilizing a hybrid strategy that combines and the Delphi technique and grey DEMATEL method, this study seeks to close bridge the aforementioned research gaps and provide valuable insights to deepen the understanding of hospital service management. The recommended framework, which is outlined with drivers from the TBL concept, will direct the policymakers to reconsider the service structure and create a sustainable and strategic service planning that takes the needs of all the stakeholders into account.

2.4 Drivers of sustainable hospital service management

The sustainability measures for hospital service management have been identified considering the environmental, economic, and social dimensions. Being a complex system and having people of different cross-functional areas, the social and economic drivers are formulated from the perspective of community, employee, management, and government. These driving factors are listed with the assistance of 20 experts in the Delphi study and the extant literature using various reputed scholarly databases such as Scopus, ScienceDirect, Web of Science, and Google Scholar. Again, snowball technique is also utilized to find out the related articles. Table 2 summarizes the factors and subfactors of the hospital sustainable service management with a brief description of each in Table A2 in Appendix A.

Table 2: Critical factors for sustainable hospital service management

Factors	***Sub Factors***	***References***
Environmental Perspective	Medical and solid waste management system	(Thakur, 2021; Tsai et al., 2021)
	Recycling of hospital wastewater	(Khan et al., 2021)
	Constructing green hospital building	(Chen et al., 2022)
	Adoption of lean management practice	(AlJaberi et al., 2020; Shortell et al., 2021)
	Proactive maintenance of all medical facilities	(Yousefli et al., 2020)
Community Perspective	Availability of advanced diagnosis technologies and up-to-date facilities	(Tortorella et al., 2021; Li et al., 2021)
	Diminishing the gap between the demand and availability of good doctors and staff	(Flaherty & Bartels, 2019)
	Empathy of doctors and staff	(van Vooren et al., 2020)
	Affordability and reliability of service	(Tilhou et al., 2020)
	Advanced information and communication technology	(Lolich et al., 2019; Wang et al., 2019)

	E-health Service	(Chauhan et al., 2022; Wang et al., 2020)
	Proper maintenance and monitoring of hospital supporting services	(Carino et al., 2021; Rambiritch et al., 2021)
Hospitals' Employees Perspective	Ensuring the quality of work life	(Francis et al., 2021)
	Motivation, training and development	(Tajeddini et al., 2020)
	Employee empowerment	(Satheesh Kumar & Abdul Sajld, 2019)
	Patients' positive and participative attitude	(Hu et al., 2020)
	Availability of protective resources for frontliners	(Hollander & Carr, 2020)
	Adoption of new practices	(Kraus et al., 2021)
Hospitals' Management Perspective	Effective supply chain management	(Elabed et al., 2021; Nagariya et al., 2021)
	Assessment system of hospital performance	(Moshood et al., 2022)
	Leadership and organizational commitment	(Shafi et al., 2020)
	Developing intellectual capital through knowledge management	(Karltun et al., 2020; Sassanelli et al., 2021)
	Benchmarking international best service practice	(Kakemam et al., 2022)
	Perceived reputation of the hospital	(Radu et al., 2022)
	Reforming organizational structure	(Bastani et al., 2021; Kosherbayeva et al., 2020)
	Collaboration with other hospitals	(Rodríguez et al., 2021)
	Support of trained volunteers	Expert opinion
Government Perspective	Implementation of public health policies	(Wong et al., 2022)
	Accreditation	(Greenfield et al., 2019; Pasinringi et al., 2021)
	Engaging experienced doctors in top management	(Kosherbayeva et al., 2020)
	Sustainable procurement	(Mehra & Sharma, 2021)
	Public-private partnership	(Basabih et al., 2022)
	Local production of medical equipment	Expert Opinion

3. Methodology

This research identifies and analyzes the factors driving hospital sustainable service management; hence a systematic methodology including Delphi and grey based DEMATEL methodology is adopted to aid the decision and draw conclusion of the study. The methodological framework of the study, which outlines the sequential procedures done in the research, is shown in Figure 1. Again, details of each of these methods are explained in the following sub-sections.

3.1 Delphi method

The Delphi technique is a structured research methodology that uses well-organized questionnaires to acquire data from a group of proficient, skilled and knowledgeable people experienced in the subject matter (Drumm et al., 2022; Jaam et al., 2022). In this method, through one or more rounds of discussion, the experts frankly and independently express their anonymous, but valuable opinion derived from their pragmatic knowledge and experience (Oteng et al., 2022). The process normally comes to a close after everyone has reached a mutual consensus on the

matter at hand to achieve the desired goal (Martin-Rios et al., 2022; Belshaw et al., 2019; Moktadir et al., 2019). Very few methods are used so widely as this one for finding and analysing problems including multiple criteria decision-making (MCDM). Integration of experts' knowledge, flexibility to reform their responses, and anonymity of responses have made the Delphi method advantageous over other MCDM methods (Bruttomesso et al., 2019; Debnath et al., 2023). Realizing the factors' complexity of our study, we employed a structured Delphi method to refine, focus, and identify the factors driving hospital sustainable service management, after we initially identified some potential factors as evidence in sub-section 2.3.

Although there are no definite rules for selecting the maximum (optimum) number of respondents in the data collection and evaluation process, Murry and Hammons (1995) recommended the use of 10 to 30 experts, whereas Okoli and Pawlowski (2004) recommended 10 to 18. This means that, in Delphi research, generally at least 10 experts are considered enough to ensure consistent and reliable results.

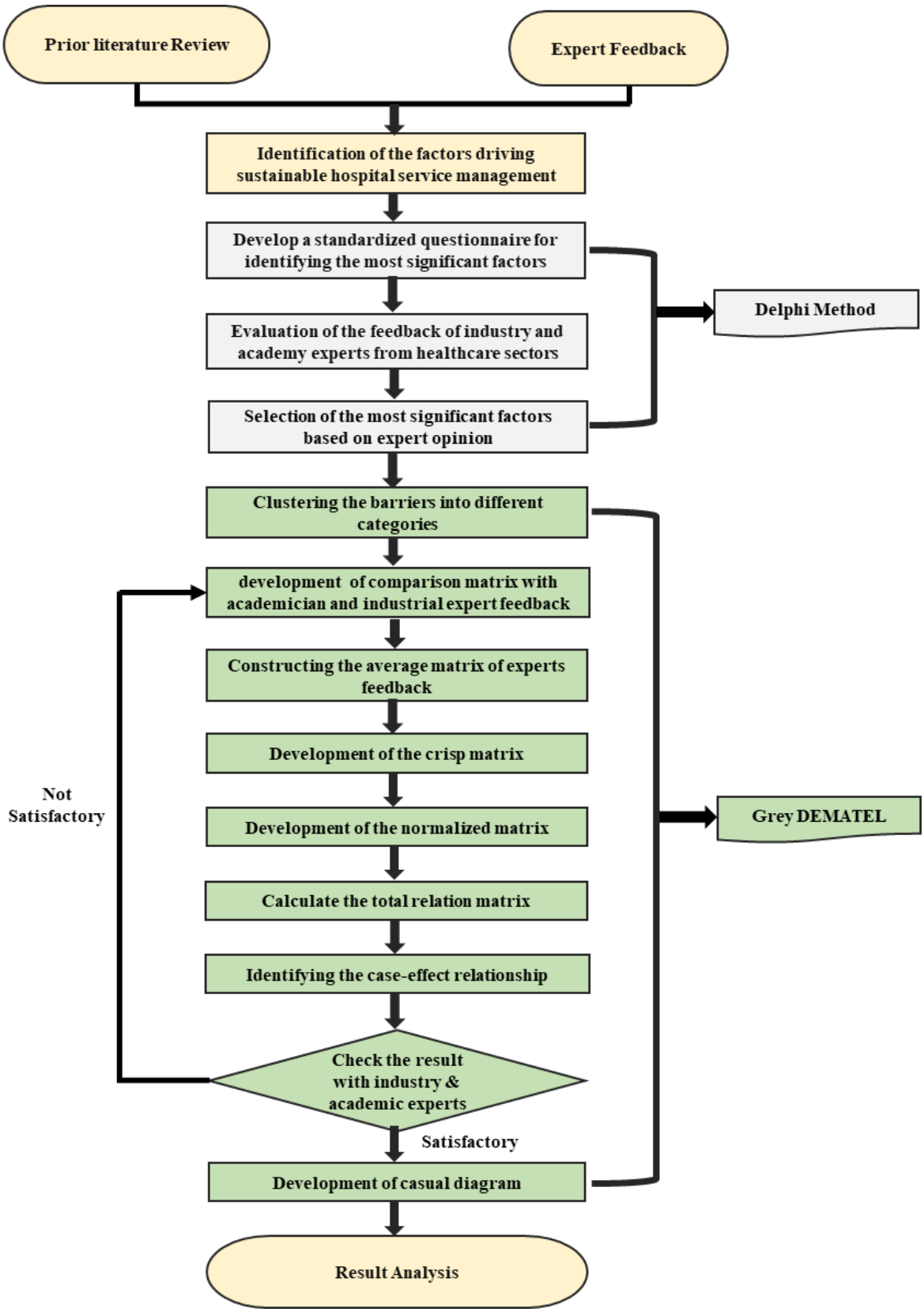

Figure 1. Proposed research framework of the study

3.2 Grey DEMATEL Method

The DEMATEL technique is a digraph-centric mapping approach that helps to figure out solutions by establishing the causal relationship between factors of entangled and complicated problems (Chowdhury & Paul, 2020; Yin et al., 2020). As stated, the identified factors are examined and formed into two groups – *cause* and *effect* groups – determining their level of interrelationships; furthermore, the resulting digraph can be used to simplify complicated systems. It also assists decision makers in identifying and comprehending essential factors for further analysis and formulation of strategies (Chen & Yang, 2019; Kumar & Anbanandam, 2020). However, human judgments and attitudes are very difficult to predict let alone interpret accurately. The Likert scale is divided into some numeric values corresponding to linguistic judgment providing different meanings to different experts, and assigning accurate quantitative value from this is difficult (Dutta et al., 2021; Garg, 2021). It results in ambiguity which has nothing to do with the DEMATEL method. This ambiguity can be addressed with the grey DEMATEL method. To deal with this, the research applied the grey DEMATEL to get the desired result. The concept of grey numbers is grounded on *grey theory* (Deng, 1982). Incomplete information, small sample size, and uncertain structure can be adjusted by this theory (Julong, 1989; Ngo et al., 2021). It helps decision makers cope with inconsistencies in their knowledge and information shared during the data collection period. It also aids in translating the uncertainty expressed in experts' subjective responses into quantitative values. Calculation and analysis are not difficult as converting grey numbers into crisp value is a simple three-step process (Deepu & Ravi, 2022) which is demonstrated step by step below.

The integrated grey DEMATEL technique has been utilized in the examination, development and assessment of various applications (Paul et al., 2021; Gan et al., 2022). Deepu and Ravi (2021) have explored the enablers to the replacement of existing practice with an interconnected logistics system and virtual modeling of systems and objects using the method whereas Liu et al. (2021) adopted the approach to examine the best interaction of the product-service system to promote value generation. In another study, Garg (2021) used the grey DEMATEL framework to investigate e-waste mitigation strategies. Soltanmohammadi et al. (2021) also made use of grey DEMATEL to prioritize factors critical to the integration of quality within the supply chain, while Dixit et al. (2022) utilized the same method to explore the

antecedents to the adoption of organic farming in India. Konstantinou & Gkritza (2023) adopted the integrated grey DEMATEL to apply it in transportation field and the barriers to the electric truck adoption were identified along with their ranking and causal relationship. However, Xing et al. (2023) used this hybrid method in construction to examine the variables influencing the hoisting quality of substantial offshore buildings. Table 3 demonstrates the recent works on the proposed methodology.

Table 3: Current literature on Delphi and grey DEMATEL methods

No	***Author & Year***	***Research objective***	***Applied tools***	***Application Area***
1	Debnath et al. (2023)	Examining the barriers to the sustainable waste management	Grey DEMATEL	Plastic-manufacturing industry
2	Tripathy et al. (2023)	Identifying the key drivers and their interrelated behavior for recycling the lithium-ion batteries to promote circular economy	Delphi and grey DEMATEL	Recycling industry
3	Rawat & Garg (2023)	Assessing the interrelationships among the natural gas business development strategies through cause effect analysis	Grey DEMATEL	Natural Gas Feld
4	Shao et al. (2023)	Investigating the drivers and barriers promoting circular business model implementation	Delphi and grey DEMATEL	Service Sector
5	Dixit et al. (2022)	Analyzing the barriers hindering the adoption of organic farming in developing countries	Grey DEMATEL	Agricultural Sector
6	Ardra & Barua (2022)	Figuring out the barriers and their interdependence to the way of implementing closed loop food supply chain	Grey DEMATEL	Food industry
7	Balouei Jamkhaneh et al. (2022)	Selecting the healthcare 4.0 digital technologies impacting the healthcare process	Grey DEMATEL	Healthcare industry
8	Faibil et al. (2022)	Analyzing the strategic and operational factors driving the extended producer responsibility to effective e-waste management	Delphi and grey DEMATEL	Waste Management
9	Kumar et al. (2022)	Exploring the crucial enabler engaging multi stakeholder's perspective to initiate sustainable waste electrical and electronic equipment management	Grey DEMATEL	Electrical Waste Management
10	Bhalaji et al. (2022)	Exploring the risks associated with collaborative supply chain	Delphi and grey DEMATEL	Medical equipment manufacturing industry
11	Majumdar et al. (2022)	Examining the barriers and their causal relationship to implement circularity in textile and clothing supply chain	Grey DEMATEL	Textile supply chain

Though there is ample research published in recent years with grey DEMATEL, this tool has rarely been employed in the research of sustainable service management in hospitals. In reference to the above research, it is no exaggeration to state that it has become popular among the researchers when the problems come up with complex systems of ambiguous relationships. The

detailed procedure of grey DEMATEL is illustrated step by step in the following based on the work of Sun *et al*. (2022), Kumar *et al*. (2022) and Tzeng *et al*. (2007).

Step 1*:* The first step consists of constructing a direct initial matrix from the rating of experts on a five-point Likert scale; '*K*' number of assigned experts are invited to provide rating on the '*n*' number of identified critical factors. They measure the comparative influence of a factor '*i*' over another factor '*j*' on a five-point Likert scale which is composed of 'Not influential', 'Slightly influential', 'Somewhat influential', 'Very influential', and 'Extremely influential'. As the grey approach is going to be implemented, these linguistic levels are converted into grey numbers denoting [0.00, 0.00], [0.00, 0.40], [0.20, 0.60], [0.40, 0.80], and [0.60, 1.00], respectively (Sun et al., 2022).

Step 2*:* The initially formed direct relationship matrix is then transformed into the grey relation matrix containing grey numbers as mentioned in the previous step. If an expert '*k*', for example, provides his opinion of being 'Very influential' of '*i*' factor over another factor '*j*', then the grey number corresponding to that linguistic level will be [0.40, 0.80]. This value indicates an upper value and a lower value for a specific grey number. The designation of a grey number is given below as Eqn. (1):

$$\otimes D_{ij}^{k} = \left(\underline{\otimes} D_{ij}^{k}, \overline{\otimes} D_{ij}^{k} \right), \tag{1}$$

where $1 \le k \le K; 1 \le i \le n\ ; 1 \le j \le n; \otimes D$ denotes a grey number, and $\underline{\otimes} D_{ij}^{k}$ and $\overline{\otimes} D_{ij}^{k}$ represent the lower value and upper value of a particular grey number. The above designation is displayed for only an expert '*k*'. As the study will aggregate the feedback of total '*K*' experts, the notation of all the grey numbers will follow the series $\left[\otimes D_{ij}^{1} \right], \left[\otimes D_{ij}^{2} \right], ..., \left[\otimes D_{ij}^{K} \right]$.

Step 3: The average grey relation matrix $\left[\otimes \tilde{D}_{ij} \right]$ is computed by aggregating the previously achieved K grey relationship matrix as per the following Eqn. (2).

$$\otimes \tilde{D}_{ij} = \left(\frac{\sum_{k} \underline{\otimes} D_{ij}^{k}}{K}, \frac{\sum_{k} \overline{\otimes} D_{ij}^{k}}{K} \right) \tag{2}$$

Step 4: It involves only three steps according to the CFCS method to convert the average grey relation to crisp relation matrix from the average grey relation matrix (Kumar et al., 2022).

a. The crisp numbers are determined by utilizing average grey values from Eqn. (2) and applying Eqns. (3) to (5).

$$\underline{\otimes} \bar{D}_{ij} = \left(\underline{\otimes} \tilde{D}_{ij} - \min_{j} \underline{\otimes} \tilde{D}_{ij} \right) / \Delta_{\min}^{\max} \tag{3}$$

where $\underline{\otimes} \bar{D}_{ij}$ represents the normalized lower limit value of the grey number $\otimes \tilde{D}_{ij}$

$$\overline{\otimes} \bar{D}_{ij} = \left(\overline{\otimes} \tilde{D}_{ij} - \min_{j} \overline{\otimes} \tilde{D}_{ij} \right) / \Delta_{\min}^{\max} \tag{4}$$

where $\overline{\otimes} \bar{D}_{ij}$ represents the normalized upper limit value of the grey number $\otimes \tilde{D}_{ij}$

$$\Delta_{\min}^{\max} = \max_{j} \overline{\otimes} D_{ij} - \min_{j} \underline{\otimes} D_{ij} \tag{5}$$

Here, $\otimes \bar{D}_{ij}$ represents the crisp value.

b. Total normalized crisp value is obtained using the following Eqn. (6).

$$v_{ij} = \left(\frac{\left(\underline{\otimes} \bar{D}_{ij} \left(1 - \underline{\otimes} \bar{D}_{ij} \right) \right) + \left(\overline{\otimes} \bar{D}_{ij} \times \overline{\otimes} \bar{D}_{ij} \right)}{\left(1 - \underline{\otimes} \bar{D}_{ij} + \overline{\otimes} \bar{D}_{ij} \right)} \right) \tag{6}$$

c. The final crisp value is calculated in this step using Eqns. (7) and (8).

$$v_{ij}^{*} = \left(\min_{j} \underline{\otimes} \tilde{D}_{ij} + \left(v_{ij} \times \Delta \max_{\min} \right) \right) \tag{7}$$

and $v = \left[v_{ij}^{*} \right]$

(8)

where *v* indicates the crisp initial relation matrix.

Step 5: '*v*' is determined in the earlier step and multiplying it with B (computed following Eqns. 9 and 10) will result in the normalized direct crisp relation matrix *A*.

$$B = \frac{1}{\max\limits_{1 \le i \le n} \sum\limits_{j=1}^{n} v_{ij}^{*}} \tag{9}$$

and $\boldsymbol{A} = v \times B$ (10)

Step 6: The inverse of the difference between identity matrix, *I* and normalized direct crisp relation matrix, *A* will lead to total relation matrix ***L*** after being multiplied by *A*, using Eqn. (11).

$$L = A \times \left(I - A \right)^{-1} \tag{11}$$

Step 7: The interrelationships of the identified factors are now determined by going through the following two steps to identify the cause-and-effect parameters.

First, the sum of rows and columns (r_i and c_j) are evaluated from the total relationship matrix using Eqns. (12) and (13).

$$r_i = \left[\sum_{j=1}^{n} L_{ij} \right] \forall i \tag{12}$$

$$c_j = \left[\sum_{i=1}^{n} L_{ij} \right] \forall j \tag{13}$$

r_i represents the total influence of factor '*i*' on the entire system whereas c_j denotes the overall influence of all factors on '*j*'.

Second, the prominence and net effects of all the factors are calculated by using Eqns. (14) and (15).

$$M_i = \left[r_i + c_j \right] \quad \forall i = j \tag{14}$$

$$N_i = \left[r_i - c_j \right] \quad \forall i = j \tag{15}$$

The overall significance of a factor 's' relative to all other factors in the system is reflected by M_i. The larger value of M_i denotes the factor which is the most influential. On the other hand, the net effect that a factor causes in the entire system is represented by N_i. If the value of N_i is greater than zero, then factor '*i*' will fall in the net cause group which will have an influence on others. If N_i is less than zero, on the contrary, the factor '*j*' will be considered as the effect group depending on the accomplishment of other factors (Tzeng et al., 2007).

Step 8: For the last step, a threshold value is determined to avoid any complications while constructing the digraph. This value will only account for significant interrelationships among the factors as multiple possibilities may exist in the system. One way of computing this, as we did in this paper, was by determining the mean values l_{ij} from L and then adding one standard deviation with the value of the mean. Thus, only factors above this threshold values are captured and used for clarifying the identification of most significant factors. The dataset $\left(\left(r_i + c_j\right), \left(r_i - c_j\right)\right) \quad \forall i = j$, yielded a digraph depicting causal relationships over a calculated threshold value.

4. Case of the Bangladesh Hospital sector

The study identified the key factors of sustainable hospital service management via the Delphi study which was performed to help identify the key factors from a set of factors. The grey DEMATEL model was implemented to assess the interactions among factors. The sustainability of the Bangladesh hospital sector is crucial for the country's health service management. This sector has contributed immensely to the country's economy. As the sector is directly related to human life, it is crucial to improve the sector's service. The study focused on how to improve the sustainability of the emergency service of the hospital. The entire research has been performed in two phases.

Phase 1*: Hospital service management factor selection by conducting the Delphi study*

Initially, the driving factors were identified from the extensive literature review using mentioned keywords to search in scientific scholarly databases. The literature confirmed that the 10-30 experts' engagement in the Delphi study is enough. Hence, to identify and finalize the driving

factors, we acquired responses from 20 participants in different ways – i.e., taking interview, and scoring collection through Google in three sessions. A preliminary listing of driving factors of hospital sustainable service management was compiled in the first round through interviews. We then collected the rating scores in the second round to complete the final list of driving factors through Google form. The questionnaire used in the data collection is given in Appendix B. The experts rated the factors using the five-point Likert scale. The profiles of the sectors experts who participated in the study are provided in Table 4. To finalize the most relevant and crucial factors for hospital service management, an average value of each factor was calculated, and these are shown in Table 5. The feedback is given in Table B1 in Appendix B. The factors which received an average rating value of 4 or more were considered for the further assessment via grey DEMATEL. In the third round, we received the mutual consensus on the finalized list of driving factors from all respondents via personal interview. Finally, we arrived at 20 factors in this assessment process. The final list along with the notation of the selected factors are displayed in Table 5.

Table 4: Profiles of participants who took part in the Delphi study

Expert's Code	Job experience	Working area	Experts Code	Job experience	Working area
E1	20	Manager operations	E11	13	Doctor
E2	14	Doctor	E12	20	Logistics manager
E3	12	Logistics manager	E13	19	Service manager
E4	10	Service manager	E14	14	Logistics manager
E5	21	Manager (service)	E15	13	Doctor
E6	18	Manager (operations)	E16	16	Manager (Software)
E7	17	Logistics manager	E17	17	Manager (IT)
E8	15	Service manager	E18	18	Operations manager
E9	14	Doctor	E19	19	Service manager
E10	15	Doctor	E20	21	Service manager

Table 5: Average rating score of the sustainable service management in the hospital sector along with their notation

Sub Factors	Average	Notation
Medical and solid waste management system	4.10	D1
Recycling of hospital wastewater	4.00	D2
Constructing green hospital building	4.05	D3
Adoption of lean Management practice	4.00	D4
Proactive maintenance of all medical facilities	4.00	D5
Availability of advanced diagnosis technologies and up-to-date facilities	4.10	D6
Diminishing the gap between the demand and availability of good doctors and staff	3.50	Rejected
Empathy of doctors and staff	3.90	Rejected

Affordability and reliability of service	4.05	D7
Advanced information and communication technology	3.95	Rejected
E-health service	4.00	D8
Proper maintenance and monitoring of hospital support services	4.10	D9
Ensuring the quality of work life	3.85	Rejected
Motivation, training and development	4.00	D10
Employee empowerment	3.65	Rejected
Patients' positive and participative attitude	4.00	D11
Availability of protective resources for frontliners	4.10	D12
Adoption of new practices	3.70	Rejected
Effective supply chain management	3.95	Rejected
Assessment system of hospital performance	3.60	D13
Leadership and organizational Commitment	3.75	Rejected
Developing intellectual capital through knowledge management	4.10	D14
Benchmarking international best service practice	4.15	D15
Perceived reputation of the hospital	4.00	D16
Reforming organizational structure	3.65	Rejected
Collaboration with other hospitals	4.10	D17
Support of trained volunteers	3.65	Rejected
Implementation of public health policies	4.20	D18
Accreditation	4.05	D19
Engaging experienced doctors in top management	4.20	D20
Sustainable procurement	3.75	Rejected
Public-private partnership	3.85	Rejected
Local production of medical equipment	3.20	Rejected

Phase 2*: Assessing interactions using grey DEMATEL approach*

The interactions among selected factors were assessed using grey DEMATEL. The steps mentioned in the methodology section were followed to help identify the final results of the analysis. The assessment is explained as follows:

Step 1*:* In this step, a direct initial matrix was formed from the rating of experts on a five-point grey scale. In this step, we received initial relation matrices from the six most experienced experts. They rated the influence using grey scale. The profile of the most experienced experts who participated in the grey DEMATEL assessment process is provided in Table B2 in Appendix B.

Step 2*:* The six grey relation matrices $\left[\otimes D_{ij}^{1}\right],\left[\otimes D_{ij}^{2}\right],...,\left[\otimes D_{ij}^{6}\right]$ were constructed using Eqn. (1) and are presented in Tables B3-B8 in Appendix B.

Step 3*:* The average grey relation matrix $\left[\otimes\tilde{D}_{ij}\right]$ was computed by aggregating the previously achieved six grey relationship matrices using Eqn. (2) and provided in Table B9 in Appendix B.

Step 4: In this step, from the average grey relation matrix, the crisp relation matrix (*v*) was constructed using the three-step CFCS method with the assistance of Eqns. (3)-(8) and is shown in Table B10 in Appendix B.

Step 5: Using Eqns. (9) and (10), the normalized crisp relation matrix (***A***) was formed and shown in Table B11 in Appendix B.

Step 6: Using Eqn. (11), the total relation matrix (***L***) was formed and displayed in Table B12 in Appendix B.

Step 7: In this step, Eqns. (12) and (13), r_i and c_j values were evaluated from the total relationship matrix. The overall importance M_i of the factors of sustainable service management and net effect N_i of a factor of sustainable service management were determined using Eqns. (14) and (15) and shown in Table 6.

Step 8*:* For the last step, a threshold 0.3352 value was determined to avoid any complications while constructing the digraph. The mean value of all factors in the total relation matrix (***L***) is 0.2985 and the standard deviation of these factors is 0.03673. The dataset $\left(\left(r_i + c_j\right), \left(r_i - c_j\right)\right)$ $\forall i = j$ yielded a digraph depicting causal relationships over a calculated threshold value and presented in Figure 2. In this figure, the dotted line indicates the two-way relationship, and the solid line represents the one-way relationship.

Table 6: The prominence and the net effect and cause effect groups of the factors

Factors	r_i	c_j	$M_i = \left[r_i + c_j \right]$	***Ranking***	$N_i = \left[r_i - c_j \right]$	***Effect/Cause***
D1	6.915	6.477	13.392	2	0.437	*Cause*
D2	5.537	6.174	11.711	13	-0.637	*Effect*
D3	5.966	6.393	12.360	6	-0.427	*Effect*
D4	6.475	5.983	12.459	5	0.492	*Cause*
D5	6.203	6.139	12.342	7	0.064	*Cause*
D6	6.714	5.862	12.576	4	0.852	*Cause*
D7	5.533	5.776	11.309	17	-0.244	*Effect*
D8	5.037	5.553	10.590	19	-0.516	*Effect*
D9	4.978	6.128	11.105	18	-1.150	*Effect*
D10	5.041	5.250	10.292	20	-0.209	*Effect*
D11	6.492	5.801	12.293	8	0.692	*Cause*
D12	6.075	5.882	11.957	10	0.193	*Cause*
D13	6.137	5.580	11.717	12	0.557	*Cause*
D14	5.879	5.800	11.680	14	0.079	*Cause*
D15	5.225	6.176	11.401	16	-0.950	*Effect*
D16	5.841	6.085	11.927	11	-0.244	*Effect*
D17	5.783	5.744	11.526	15	0.039	*Cause*
D18	6.902	5.805	12.707	3	1.096	*Cause*
D19	5.800	6.211	12.011	9	-0.410	*Effect*
D20	6.863	6.577	13.440	1	0.286	*Cause*

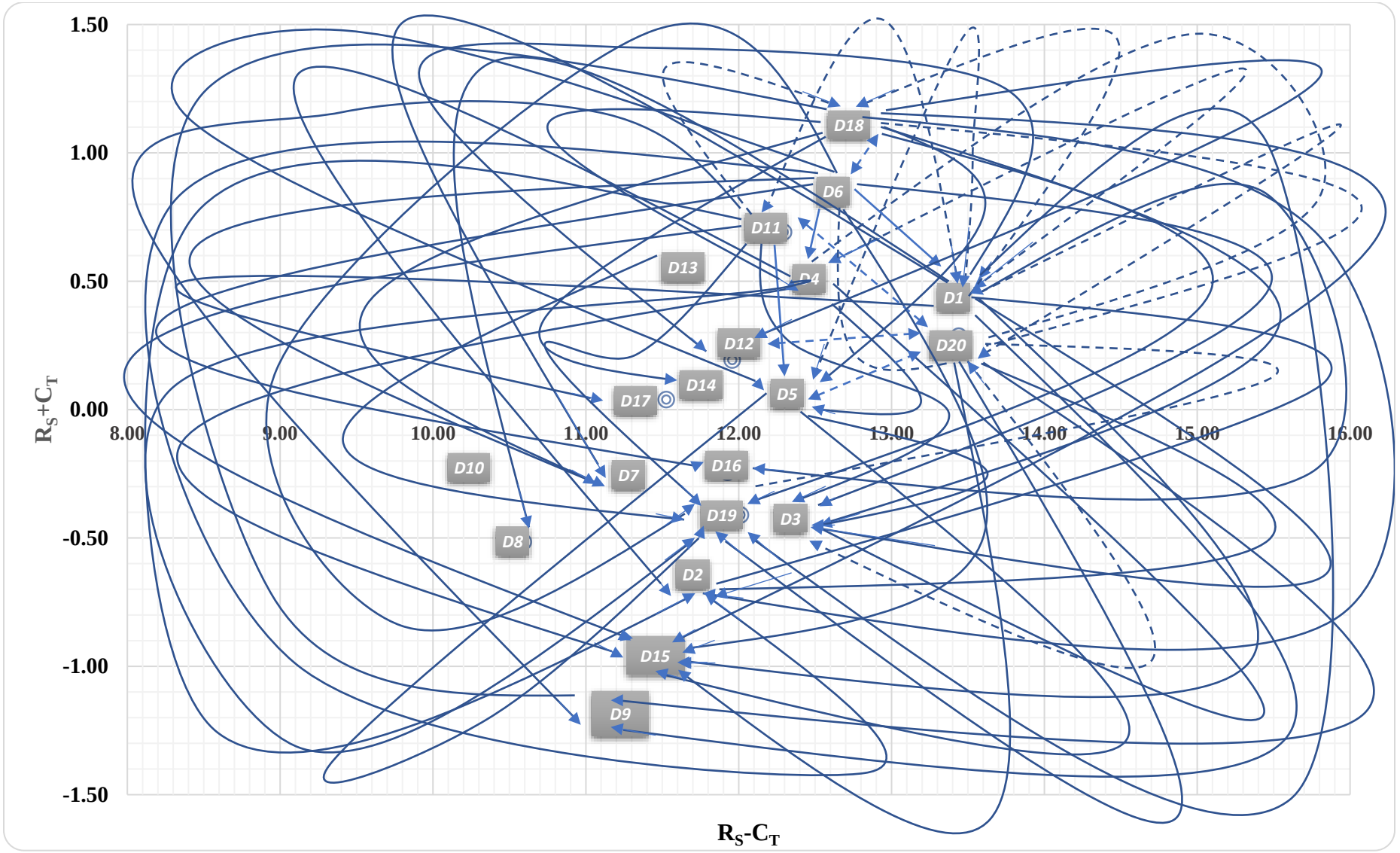

Figure 2: A Digraph depicting the causal relationship among the factors

5. Discussions of the findings

This section presents a comprehensive discussion of the findings that are obtained from the application of the grey DEMATEL approach. The value of $M_i = \left[r_i + c_j \right]$ of the driving factors of hospital service management showed the significance of the identified factors. Based on the grey DEMATEL analysis, the ranking of the factors was determined as follows: *D20>D1> D18> D6> D4> D3> D5> D11> D19> D12> D16> D13> D2> D14> D17> D15> D7> D9> D8> D10.*

The results of the driving factors demonstrated that, in terms of prominence, "Engaging experienced doctors in top management (D20)" appeared to the topmost significant factor in the pursuit of sustainability in hospital service management in Bangladesh. This can be attributed to the fact that utilizing their in-depth knowledge and expertise to guide strategic decision-making and resource allocation, and bring about positive organizational dynamics thorough influence, innovation and motivation, experienced doctors can effectively make sustainable transition towards hospital service management (Kosherbayeva et al., 2020; Bartram et al., 2020). Therefore, more efforts should be directed to design sustainable human resource planning to attract top physicians in hospital administration (Bhattacharya & Bhattacharya, 2023). Next, the factor, “Medical and solid waste management system (D1)” received the second highest weight to be the second most significant factor. Robust handling and disposal of medical waste enhance cleanliness and hygiene, creating a sound environment for patients, staff, and visitors, and positively impacting the overall quality of care delivery, patient satisfaction, and hospital’s reputation (Xu et al., 2021); thereby reinforcing the foundation for sustainable service management. Hence, it is imperative for the hospital authority to emphasize environmental sustainability of hospital service by establishing standardized practices throughout each stage of waste management (Chen et al., 2021). The five next most important driving factors are “Implementation of public health policies (D18)”, “Availability of advanced diagnosis technologies and up-to-date facilities (D6)”, “Adoption of lean management practice (D4)”, “Constructing green hospital building (D3)”, and “Proactive maintenance of all medical facilities (D5)”. The integration of public health policies into the hospital’s operation framework will enable the service seekers to know their rights and uphold the accountability of the service providers whether they are aligned with government goal (Bastani et al., 2021). Therefore, strong, and sustainable public health policies are crucial to safeguard the community and promote their engagement, implying a significant step towards achieving

sustainable service management. Accurate and timely diagnoses, good interdepartmental coordination and data exchange, easy access of information and the availability of all modern facilities in the hospital provide patients and their attendants with improved care (Tortorella et al., 2021). Unavailability of the advanced and latest diagnosis technologies will cause the hospitals to fall behind in the race of sustainability (Sassanelli & Terzi, 2022). Practicing lean management will outrun the traditional management in terms of streamlining the service process, lessening unnecessary delays, minimizing medication errors, process wastes and medical wastes and, moreover optimizing the performance by setting the goal of continuous improvement (Trakulsunti et al., 2021). That's why, adopting lean technologies will hasten the sustainability of service management within the hospital sector. Constructing green hospital building points out the importance of energy efficiency and sound environment as a driving factor for service sustainability. Attempts for green design will look for ways to reduce energy consumption (Cucchiella et al., 2018) and carbon footprint through increasing access to natural ventilation, sunlight, renewable energy, wastewater treatment and finally providing a comfortable environment and wellbeing of all the occupants (Dion et al., 2023). Without regular inspection, timely repair and proper proactive maintenance measures, unprecedented equipment downtime will cause service disruption leading to resource underutilization and discomfort to service seekers. Hence, the initiatives of the hospital management targeted on proactive maintenance of facilities will aid in delivering good quality services to patients and customers in the hospital (Rambiritch et al., 2021).

The next 10 important driving factors are: "Patients' positive and participative attitude (D11)", "Accreditation (D19)", "Availability of protective resources for frontliners (D12)", "Perceived reputation of the hospital (D16)", "Assessment system of hospital performance (D13)", "Recycling of hospital waste water (D2)", "Developing intellectual capital through knowledge management (D14)", "Collaboration with other hospitals (D17)", "Benchmarking international best service practice (D15)", and "Affordability and reliability of service (D7)". To strengthen sustainability in the hospital service management, all are very crucial to ensure the long-term sustainability in the sector. To obtain better diagnosis and enhanced outcomes from hospital service, patients can also contribute by means of improved communication, exchange information, adherence to treatment plans and shared decision-making process. The sense of mutual empathy among the doctors and patients can ensure good service quality within the shortest consultation

time (Qudah et al., 2021). The importance of equipping frontliners with protective resources is based on what is learnt from COVID-19. In order to reduce the risk of infection transmission and safeguard frontline employees from disruptive effects, it is imperative that frontline workers have adequate access to personal protective equipment (PPE), such as masks, gloves, gowns, and face shields which may otherwise cause the downfall of service system (Yousefli et al., 2020). Attaining international accreditation on different metrices encompassing patient safety, clinical outcomes, environmental consideration, organizational governance will accelerate the reputation of the hospital, which in turn will influence the patients' trust and loyalty in the long run. In this regard, diligent monitoring and evaluation of performance against defined indices becomes imperative for hospitals to identify the areas weakness and room for improvement to ultimately achieve the sustainability goal (Pasinringi et al., 2021; Amos et al., 2021). In hospitals, huge amounts of wastewater may be produced during various operational activities and discharged untreated which may contain potential agent of infectious diseases. Therefore, it is essential to make sure that a proper management system is in place for wastewater treatment and that there are provisions for the use of treated waste water in order to maintain environmental sustainability (Rizzo et al., 2020).

Through effective knowledge sharing and management, hospitals can enrich their intellectual capital through data management and transmission, manage human resources successfully, finally leads to performance flexibility to run hospital service system sustainably. (Karltun et al., 2020). Additionally, hospitals can use collective expertise and experiences to increase operational efficiency, improve service quality, and improve patient outcomes by developing partnerships and exchanging resources, knowledge, and best practices with complementary ones (Rodríguez et al., 2021). Benchmarking of service quality by considering the best service practices in the world may bring potential benefits to ensure the best quality service in the hospital. Without affordability, it is impossible for poor people to access hospital services. Therefore, to ensure the best practices are implemented in the hospital, it is necessary to make the service charge affordable for poor patients (Mutyavaviri et al., 2021).

The next three important driving factors are "Proper maintenance and monitoring of hospital supporting services (D9)", "E-health Service (D8)", and "Motivation, training and development (D10)". Hospital support services like ambulances, blood bank, medicines, generator, boilers etc. are parallelly important to back up good hospital service. Therefore, proper maintenance and monitoring of the support services can enhance the service quality of the hospital

(Sohrabi et al., 2023). Hospitals can improve efficiency and sustainability of healthcare delivery by implementing e-health service utilizing digital technology like telemedicine, electronic health records, and remote patient monitoring (Wilson et al., 2021). Finally, adequate training, motivation, and development policies can bring about change in an organization and accommodate sustainability (Ravaghi et al., 2020). Therefore, to ensure good service and sustainability, it is imperative to arrange training for staff and doctors and design encouraging incentives for different roles.

5.1 Cause group driving factors

The grey DEMATEL analysis helped to identify the network of the driving factors under two groups - cause and effect groups. The cause group driving factors are those factors that can significantly influence the other factors known as the effect group factors. Based on the study findings, the ranking of the cause group is established based on the positive value of $N_i = \left[r_i - c_j \right]$ as in Table 6. The findings indicate that eleven among the twenty driving factors come under the cause group and are sorted as follows: *D18 > D6 > D11 > D13 > D4 > D1 > D20 > D12 > D14 > D5 > D17*.

The public health policies that consider sustainability as the central theme may influence the other effect group factors significantly to make the service delivery more sustainable. Public health policies are designed to cover the fundamental aspects of providing better care from hospital. Therefore, "Implementation of public health policies (D18)" will primarily trigger to ensure that the other measures are to be implemented to drive sustainability in the hospital service management (Vaish et al., 2016).

The next five most important causal driving factors are "Availability of advanced diagnosis technologies and up-to-date facilities (D6)", "Patients' positive and participative attitude (D11)", "Assessment system of hospital performance (D13)", "Adoption of lean management practice (D4)", and "Medical and solid waste management system (D1)". The hospital service of critical patients may improve by ensuring the availability of the advanced diagnosis technologies and up-to-date facilities (Pandya & Kumar, 2023). Their availability can improve patients' contentment and perceived reputation which can drive the sustainability of service management with the hospital (Vaish et al., 2016). The performance management system may help to establish

performance matrices against which performance will be monitored, recorded, and analyzed. Well performing hospitals will acquire sustainability by ensuring the accreditation of the hospital. Adoption of lean management policies can improve the patient's management procedure in a more sustainable way. Lean management can help to reduce the unnecessary service delay improving the response offered to the patients by hospital (AlJaberi et al., 2020; Shortell et al., 2021). Therefore, this creates a positive influence on the other effect group factors to improve the existing management policies. Medical and solid waste management facilities will drive the hospital to achieve a better service reputation among its patients. This can also reduce the environmental pollution and promote wastewater treatment caused by waste medical resources (Peng et al., 2020; Thakur, 2021). Therefore, the hospital management teams may concentrate on the above-mentioned causal driving factors to ensure sustainable service management facility in the hospitals.

The last five causal driving factors – "Engaging experienced doctors in top management (D20)", "Availability of protective resources for frontliners (D12)", "Developing intellectual capital through knowledge management (D14)", "Proactive maintenance of all medical facilities (D5)", and "Collaboration with other hospitals (D17)" which can influence the effect group driving factors as well. These factors can also ensure that sustainability of the hospital service management is achieved. Experienced doctors can help to implement the sustainable policies and the equipment necessary for service management (Kosherbayeva et al., 2020). Accordingly, this factor can influence many other effects group factors for proactive maintenance, benchmarking practice etc. (see Figure 2). Protective resources, intellectual capital, maintenance equipment, and collaboration can also ensure the sustainability of service management through influencing the effect group driving factors. Proactive resources will motivate the workforce for effective service delivery during crisis while proper maintenance of service facility will ensure affordable and reliable service. Therefore, the causal driving factors may motivate the hospital managers to adopt the latest state-of-the-art technologies and management policies. If introduced, the cause group driving factors may influence each other as well as the effect group driving factors, which can ensure the sustainability of the service management in the hospital.

5.2 Effect group driving factors

Based on the negative value of $N_i = \left[r_i - c_j \right]$, the effect group driving factors of hospital service management can be sorted as follows: *D10 > D7> D16> D19> D3> D8> D2> D15> D9*. The causal relationship among driving factors is plotted in Figure 2. The findings confirm that the nine driving factors come under the effect group; however, these factors are directly influenced by causal group driving factors.

The effect group driving factor "Proper maintenance and monitoring of hospital supporting services (D9)" is the most influenced/impacted effect group hospital sustainable service management driving factor. Lean management, hospital performance management, engaging experienced doctors and many other causal factors will significantly influence it. If the hospital service manager emphasizes the causal group driving factors, this one will be achieved very easily.

The eight next most influenced/impacted factors are "Benchmarking international best service practice (D15)", "Recycling of hospital wastewater (D2)", "E-health Service (D8)", "Constructing green hospital building (D3)", "Accreditation (D19)", "Perceived reputation of the hospital (D16)", "Affordability and reliability of service (D7)", and "Motivation, training and development (D10)". These driving factors are also influenced by the other causal group driving factors and will contribute to achieving sustainable service management in the hospital sector. Figure 2 shows that "Medical and solid waste management system (D1)", "Implementation of public health policies (D18)", "Engaging experienced doctors in top management (D20)" possess the strong correlation with most of these factors. Therefore, hospital service managers should give special attention to these cause group driving factors which can help in ensuring that the effect group driving factors are settled automatically. All the effect group driving factors can be automatically improved with the improvement of the cause group factors.

5.3 Potential difference with existing works

The findings of the study are notably different from the existing relevant studies that have examined sustainability in hospital service management. Kumar & Chaudhary (2021) evaluated only the environmental sustainability of hospitals from Bihar, India with the help of descriptive statistics. Resource conservation was found to be the most followed practice in this study. On the other hand, Valieva et al. (2021) investigate the financial sustainability of Russian underfunded hospitals. After revealed that no financial performance parameter was accounted for analysis, the author designed and set efficiency parameters for adjusting the funding and costing. Williams &

Radnor (2022) designed a service framework for healthcare professionals and made significant propositions. However, the propositions didn't account for economic sustainability in the sector. Pereno & Eriksson (2020) conducted a study based on Nordic countries involving the stakeholders for sustainable healthcare design. Innovative policy instruments were found prominent for sustainable innovations in the healthcare sector. Using data envelopment analysis, Pederneiras et al. (2023) attempted to assess the sustainability performance of Portuguese hospitals under TBL approach. The indicators defined under the concept are inadequate and don't reflect the scenario of emerging economy. On the contrary, the outcomes our study provided are significant from social, economic and environmental dimensions of sustainability. Importantly, the factors were formulated from different stakeholders' perspectives. Moreover, any particular country with emerging economy this study is completely unique in the context examined.

6. Implications

This section presents a comprehensive exploration of the study's theoretical, practical, and global implications, as well as the implications for SDG.

6.1 Theoretical Implications

This study offers several significant theoretical contributions to the existing literature by providing insightful theoretical perspectives that will enhance the implementation of sustainable management of hospital services in emerging economies. First, carefully conducted systematic and extant literature review results in a substantial body of knowledge about the current practices, impediments, and progresses towards sustainable hospital service management. The elucidation of an unexplored research void concerning the importance of sustainable hospital service in emerging economies serves as a compelling impetus that propels this study. Second, the Delphi technique allows the panel of experts to attain a consensus concerning the final determination of the most significant factors. Then, the grey DEMATEL tool is applied to further the factor analysis in terms of their interrelationships due to the inherent intricacies of hospital settings. This study has explicated the integrated approach in a meticulously outlined sequential process, thereby facilitating its easy reproducibility not only within a wide spectrum of service organizations but also encompassing manufacturing sectors on a global scale. However, the application of Delphi based grey DEMATEL in sustainability analysis of hospital service represents an entirely

distinctive and innovative approach. The outcomes thus obtained are readily interpretable and applicable by the policymakers. The findings will guide them to analyze the complex hospital system and formulate prioritized sustainable initiatives aligned with TBL concept. The theoretical framework will also instigate the researchers to delve deeper into the significant individual factor, thereby developing the insights required for day-to-day service operations planning in hospitals.

6.2 Practical Implications

This study has several practical implications that will be beneficial for the hospital owners, policymakers, and managers. The different stakeholders' perspective for sustainable service and cause-effect relationship of the factors helps them attain better understanding of hospitals' complex environment to draw the current scenario and decide on sustainable actions. The study has also highlighted the drivers that must be practically emphasized to achieve the goal of sustainable service.

The implementation of lean principles in hospitals appears to be an indispensable factor for ameliorating sustainable service quality through optimized resource allocation, minimizing process wastes and fostering continuous process improvement. Besides, hospitals must manage medical waste carefully, which is crucial to safeguard the healthy well-being of all the stakeholders in hospitals. The continuous pressure of achieving energy efficiency will call for the design and construction of green and sustainable hospital buildings. Additionally, the study underscores the importance of proactive and regular maintenance of healthcare infrastructure to ensure optimal equipment functionality. Another significant driver suggests encouraging the patient's participation for service value cocreation in hospitals. Furthermore, the study also sheds light on proper monitoring of the hospital support services to incorporate sustainability in hospitals. There is a dire need to integrate healthcare 4.0 technologies for accurate diagnosis of diseases and facilitation of data and information management. In response to the factor of assessing hospital performance, the authority needs to develop metrices for performance evaluation and benchmarking. Another implication for the policy makers is to design service systems to render it in an affordable and reliable way to the patients. Therefore, it will be no exaggeration to state that the findings of this study undoubtedly convey significant practical implications to the policymakers in the hospital sector.

6.3 Global Implications

The global community will also benefit from the fruitful outcomes of this research though many pertinent factors emerged in various prioritized positions due to analysis from emerging economy context. The global implications of this research are grounded in rethinking and refurbishing their health policies. Engaging experienced medical professional can bring about positive workplace innovation and structural dynamics of the organization for guaranteeing service quality. Thriving for accreditation on international standard practices will also draw the attention of hospital managers globally. The perceived reputation of hospitals is a paramount factor of providing sustainable service and promoting medical tourism. Investment for raising intellectual capital through systematic knowledge management as revealed by this study is expected to receive global prominence. Furthermore, as demanded by the customers this research will act as an indicator to render e-health service to the community. Lastly, the proposed methodology can be adapted by any researcher around the world for their endeavors.

6.4 Implications for SDG

The outcomes of the study necessitate the integration of most significant factors into hospital management for the provision of sustainable service. Developing nations are also in quest of providing the sustainable service to their citizens. If implemented properly by the policymakers, the factors hold the potential to contribute to the achievement of SDG-3, “Good health and wellbeing” in the form of sustainable hospital service management. Additionally, SDG-11, “Sustainable cities and communities” will be indirectly influenced in turn by the establishment of sustainable hospitals.

7. Conclusions

In response to the rising pressure of stakeholders’ expectation, technological progress, environmental concerns, regulatory and financial constraints, the recognition for sustainable service management is gaining prominence across the world to expedite the sustainable health and well-being system. The crisis for achieving safe and viable hospital services has been compounded in emerging economies characterized by limited resources, inefficient resource utilization, increasing demands, obsolete technologies and many more. However, public hospitals consume

the major resources from government and play the key role to promote and maintain a safe and sound public health. Again, from the perspective of competitive business environment there is no alternative but to implement sustainable practices in hospital service management. Though the interest of all the stakeholders combinedly determine the level of sustainable service, it is essential to amalgamate environmental, social, and economic dimensions of hospital service from the mutual interest of the stakeholders which no current literature has acknowledged. This study has tried to fill this research gap through employing Delphi integrated grey DEMATEL technique to figure out the driving factors and assess their interrelationships to draw sustainable implications from the findings.

The study primarily identified a set of driving factors of sustainable service management considering the hospital sector from comprehensive assessment of literature. Then, the Delphi technique involving twenty experts was conducted to determine and validate the most significant driving factors, resulting in the finalization of twenty factors for further analysis. To assess the cause-effect relationships among these factors, an integrated grey DEMATEL method was employed, leading to the categorization of eleven factors under cause group and nine factors under effect group in the context of sustainable hospital service management. “Engaging experienced doctors in top management (D20)” emerged as the most prominent driving factor for sustainable hospital service management followed by "Implementation of public health policies (D18)," "Availability of advanced diagnosis technologies and up-to-date facilities (D6)," "Patients' positive and participative attitude (D11)," "Assessment system of hospital performance (D13)," and "Adoption of lean management practice (D4)" as the subsequent top causal driving factors. These factors can be significantly influenced by other identified effect group factors towards achieving sustainability in the hospital service management. The most influenced three effect group driving factors were “Proper maintenance and monitoring of hospital supporting services (D9)”, “Benchmarking international best service practice (D15)”, and “Recycling of hospital wastewater (D2)”. The effect group driving factors may be addressed automatically if the causal group factors are addressed properly within the system. The implications derived from the study's findings bear significant and enduring consequences for theoretical advancements, managerial practices, and policy development in the context of hospital service operations. Through the depiction of a causal relationship framework, this study provides policymakers with a strategic framework to formulate

initiatives that accentuate the cause group factors, thus fostering the attainment of sustainable service within the hospital sector.

Like other studies, this study is also not exempt from limitations which requires future endeavor to conduct more precise investigations. The factors identified and analyzed possess the potential to introduce sustainable service in emerging economies. The scope of this research can be reverberated by utilizing the methodological framework in other economies. Again, the cause effect relationship resulted from the study lacks statistical validation, thereby necessitating the future research to be focused on statistical analysis with more sample data to avoid judgmental errors. Empirical results can also be obtained if the factors are implemented successfully and assessed with more practical data. To evaluate the hospital's service, performance metrices can also be determined against each significant factor with further research. The study falls short of detailing all factors to implement at operational level. For example, the study suggests adapting effective medical waste management; however more efforts should be directed to discern appropriate waste collection, storage, transportation, and disposal technique. To generate the direct-relation matrix for this study's twenty variables, each expert had to provide answers to many semi-structured questions, which is challenging for human decision-makers. Artificial intelligence (AI) and machine learning (ML) based models can be used by researchers to improve decision-making reliability and future study robustness. In that case, more variables can be accommodated to derive reliable results. Furthermore, knowledge graphs, DEMATEL and AI based models can be developed for future research where real data can be considered for evaluating the hospital service management performance.

Appendix-A

Table A1. Major studies on sustainable hospital service management in recent years

No	Author(s)	Research focus & objective	Major outcomes and insights	Applied tools
1	Carino et al. (2021)	Evaluating the perspective of hospital employees towards sustainable hospital food supply chain	Sustainable and unsustainable practices were revealed along with the enablers and barriers	Framework analysis
2	Borges de Oliveira & de Oliveira (2022)	Developing a framework by drivers to institute corporate sustainability in hospitals	Identified five drivers contribute to the development of managerial decision-making framework	Content analysis method
3	Nagariya et al. (2021)	Evaluation of sustainability status in terms of barriers in hospital service supply chain	Six obstacles were discovered that prevent the hospital from being very sustainable.	Multigrade fuzzy logic approach
4	Aliakbari Nouri et al. (2020)	Establishing a framework of sustainable practices to ensure sustainable service supply chain	Seven major practices were utilized to develop the framework	Fuzzy Delphi Method
5	Williams & Radnor (2022)	Creating sustainable service framework with key propositions to sustain innovation and improvement	A service framework was developed with seven propositions achieved from the stakeholders	High-level process mapping
6	Moldovan et al. (2022)	Developing a sanitary quality reference framework at micro system level in hospitals	A reference level of sustainability in terms of human rights was achieved integrating six core areas	Experimental Study
7	Dion & Evans (2023)	Outlining a framework to promote energy efficiency in hospitals	From case studies, three integrated conceptual strategy frameworks were created.	Critical appraisal and content analysis
8	Negarandeh & Tajdin (2022)	Designing a sustainable hospital waste management system	The developed model for wastes was solved with different tools to get the optimized result.	Fuzzy programming, goal programming, Lp-metric method
9	Bartram et al. (2020)	Investigating the role of medical professionals in promoting innovation and change in hospital service	The study revealed the importance of senior doctors in providing quality service design and implementation	Qualitative analysis
10	Farouk & Jawab (2020)	Appraising the level of sustainability in public hospitals in terms of medical supply chain	Two dysfunctions were found, and three recommendations were suggested to overcome the dysfunctions	Performance analysis
11	Swarnakar et al. (2023)	Prioritizing the critical success factors for sustainable lean six sigma implementation in healthcare organization	The findings will provide better understanding about lean six sigma to improve service quality in hospitals	Best-worst-method (BWM)
12	Abou-Nassar et al. (2020)	Establishing a blockchain decentralized interoperable trust framework for internet of things (IoT) zones in healthcare	The framework facilitates effective information exchange and trustworthy communication	IoT, Blockchain Technology

13	Chauhan et al. (2022)	Analyzing the critical success factors to drive the telemedicine services in hospitals	The results will help policymakers to devise plans for integrating telemedicine to improve service	BWM, DEMATEL
14	Pratici et al. (2022)	Identifying the variables that contribute to nation health system other than funding	The study figures out rooms for improvement in the organization culture and few demons to overcome	Qualitative analysis
15	Pandya & Kumar (2023)	Evaluating Industry 4.0 technologies that can make hospital service sustainable	Among twelve key Industry 4.0 technologies, artificial intelligence (AI), Big data analytics and IoT was found the most predominant ones	Fuzzy Delphi, Analytical Hierarchy Process (AHP)
16	Yousefinezhadi et al. (2020)	Assessing the view of hospital managers towards the standard and procedure of accreditation program	Some improvements in accreditation metrices were identified to ensure quality service	Descriptive and inferential statistics
17	Pederneiras et al. (2023)	Examining the Portuguese hospitals Sustainability performance under TBL approach	30% of the selected hospitals was found efficient while only 1% as sustainable under this approach	Data envelopment analysis
18	Valieva et al. (2021)	Formulating new approaches for sustainable financial management in hospitals	The study obtained parameters for adjusting cost and medical structure	Operational analysis
19	Sharma & Tripathi (2022)	Investigating how service providers can be involved in ensuring quality service	Hospital sustainability is reliant on service provider effort and quality-related initiatives.	Qualitative analysis
20	Pereno & Eriksson (2020)	Examining the strategies from the viewpoint of multi-stakeholder to establish sustainable healthcare	For the transition to sustainable healthcare, factors for reevaluating each stakeholder's role were identified and analyzed	Design-based analysis
21	Tonjang & Thawesaengskulthai (2022)	Developing an integrated framework on how total quality and innovation can be successfully managed for sustainable performance of healthcare	The study exposed seven dimensions within the scope to expedite positive change in healthcare performance	Mixed method methodologies
22	Bhattacharya & Bhattacharya (2023)	Evaluating strategies for sustainable human resource planning for sustainable hospital service	Novel perspectives strategies for hiring healthcare personnel were identified and suggested to implement	Grounded approach, Empirical analysis
23	van Vooren et al. (2020)	Ascertaining the initiatives to implement sustainable health and wellbeing systems	Eight guiding principle with strategies were proposed towards the goal	Strategy-context-mechanism-outcome analysis

Table A2: Brief description of the initially identified factors

Factors	***Sub Factors***	***Conceptualization of factors***
	Medical and solid waste management system	Proper treatment of medical and solid waste will prevent diseases spreading and polluting the environment leading to environmental sustainability
	Recycling of hospital wastewater	Recycling wastewater rather than discharging it into drains will promote environmental sustainability. As active compounds of disease contained in medical wastewater are not exposed to nature, there is no possibility of spreading disease and water pollution

Environmental Perspective	Constructing Green Hospital Building	It will lessen energy consumption, CO2 emission, environmental degradation, etc., and improve ventilation via the use of sunlight. Green and clean environment will also create a real healing environment for the patients and enthusiasm among the healthcare professionals.
	Adoption of Lean Management practice	Minimization of process wastes through process improvements by adopting different managerial lean tools appropriate to the hospital setup.
	Proactive maintenance of all medical facilities	Deploying distributed maintenance management system assists managers to avoid any disruption in the medical facility.
Community Perspective	Availability of advanced diagnosis technologies and up-to-date facilities	Advanced tools provide authentic clinical results and appropriate diagnostics. Scarcity of healthcare 4.0 technologies and ICU, CCU, emergency ambulance, oxygen support, etc., will not ensure sustainable service.
	Diminishing the gap between the demand and availability of good doctors and staff	Doctors and staff are the key players and play the central role while dealing with patients. It is stressed that medical resources like doctors and staff should not be overloaded with patients
	Empathy of doctors and staff	Patients are contented with the service provided by a doctor when they engage in a participative approach. Both parties share their competencies and commit to sustainable care provision.
	Affordability and reliability of service	Any cost irrelevant to the service provided will affect the loyalty of patients. To deal with it, there should be no hidden costs. Patients must have a perception about the hospital that there is no likelihood of loss of life.
	Advanced information and communication technology	Sharing information through a centralized server resulting in no communication gap between patients and health professionals. Collection and analysis of patients' big data through ICT will ensure improved diagnostic and clinical accuracy.
	E-health Service	Integration of technology in delivering health-care service to the patients at a distant place especially during outbreaks like the COVID-19 pandemic to avoid virus transmission.
	Proper maintenance and monitoring of hospital supporting services	Emergency ambulance, food, daycare, pure water, laundry, pharmacy, blood bank, etc., contribute to customers' satisfaction and so sustainable service design
Hospitals' Employees Perspective	Ensuring the quality of work life	Avoidance of activities such as long working hours, continuous shift work, safety considerations, etc., may lead to psychological stress and destroy work-life balance.
	Motivation, Training and Development	Managing human resources in such a way to keep staff happy and focused on their responsibilities. This may be achieved by providing proper compensation, creating a smooth career path, developing skills and competencies, etc.
	Employee Empowerment	Instituting participative management that ensures the involvement of employees in the decision-making process at any stage.
	Patients' positive and participative attitude	Managing the patients' behavior towards doctors and staff and their participative approach improve the quality of co-created service and culture
	Availability of protective resources for frontliners	Supply of masks, PPE, gloves, face shields, respirators, gowns, etc. should be adequate while sustainability is the concern.

	Adoption of new practices	A dynamic shift towards sustainable service will require a new organizational setup who are eager to adopt new practices and way of work.
Hospitals' Management Perspective	Effective supply chain management	Efficient management of the hospital supply chain from the perspective of the triple bottom line approach will benefit the hospital by not only lowering the operating costs but also drawing the environmental benefit.
	Assessment system of hospital performance	For being reliable to the patients, measuring the level of patients' satisfaction and their perceptions of performance are essential for any hospital. As a result, a data-driven assessment system will provide the insight and periodic evaluations will pave the continuous drive for improvement.
	Leadership and Organizational Commitment	Sustainability in service requires leadership which will foster the principled sustainable vision and develop new and adequate mechanisms to start a participative model engaging all the stakeholders in hospitals service management.
	Developing intellectual capital through knowledge management	Intellectual capital comprised of human capital and structural capital can be enriched with knowledge management within the organization. It deals with helping people while collaborating, innovating, and making correct decisions in an efficient way.
	Benchmarking international best service practice	Adoption of new trends practiced globally will give the customers a new experience for their diagnosis. Benchmarking the practice and following it will make the service sustainable.
	Perceived reputation of the hospital	Attracting patients and achieving their trust in the long run through the reputation and providing quality service as assumed.
	Reforming organizational structure	Sustainable hospital service management requires organizational reformation over traditional practice and competencies. Recruiting health service management graduates is an example of the refurbishments required.
	Collaboration with other hospitals	Synchronization of service with other hospitals to mitigate lack within the facility and also provide the substantial service that patients seek.
	Support of trained volunteers	Involvement of trained volunteers in any emergency crisis or in public health-conscious program.
Government Perspective	Implementation of Public Health Policies	Government can set policies to improve the awareness about sustainability to incorporate it into the hospitals.
	Accreditation	Achievement of certain service quality milestones helps get accredited, thus drawing the faith of patients. It naturalizes gradual and systemic quality improvement.
	Engaging experienced doctors in top management	Strategic planning and management of the health service will be reflected in the decisions of experienced doctors.
	Sustainable procurement	Procurement of medical associated machines and tools with consideration of life cycle cost and financial benefits will reduce the operating costs and so patients' service costs.
	Public-Private partnership	Elimination of budget constraints while ensuring value enhancing and resilient growth of hospital service.
	Local production of medical equipment	Importing medical equipment overseas has a direct impact on the service cost. Instead, local production will sustain the affordability of equipment and positively influence the service cost.

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CRediT author statement

Saifur Rahman Tushar: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation**; Md. Abdul Moktadir:** Conceptualization, Visualization, Methodology, Software, Data Analysis, Validation, Writing- Original draft preparation, Writing- Reviewing and Editing; **Simonov Kusi-Sarpong:** Conceptualization, Visualization, Investigation, Methodology, Writing- Original draft preparation, Writing- Reviewing and Editing**; Jingzheng REN:** Visualization, Software, Investigation, Writing- Reviewing and Editing.

Supplementary Files

Driving sustainable healthcare service management in the hospital sector

Appendix B: Delphi method and grey DEMATEL method

Hi
Greetings!!!!
We are conducting research to understand sustainable service management in hospital management. We have identified a number of driving factors towards sustainability in the service sector. We need your kind feedback to understand the importance of the identified factors. Hence, we would kindly request that you give us some time.
Thanks in advance!!!
a. Please kindly tell us your name:
b. Your service company name:
c. Job experience:
d. Working area:
e: Please input the suitable value to rate the factors (where 5 means highest importance and 1 means very low importance).

Table B1: Feedback of 20 experts for factors' selection

Sub Factors	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20
1. Medical and solid waste management system	4	1	4	5	5	3	5	4	3	4	4	4	5	4	5	4	4	4	5	5
2. Recycling of hospital wastewater	5	5	4	4	5	4	4	5	3	3	4	4	5	4	4	3	2	4	3	5
3. Constructing green hospital building	4	5	1	4	5	1	5	4	4	4	4	4	4	5	4	5	5	5	4	4
4. Adoption of lean management practice	5	4	5	3	5	5	4	5	1	5	4	4	3	5	5	4	4	3	2	4
5. Proactive maintenance of all medical facilities	5	4	5	4	4	5	3	5	5	3	3	4	3	4	2	5	4	2	5	5
1. Availability of advanced diagnosis technologies and up-to-date facilities	4	3	5	3	4	4	5	5	2	3	5	3	5	5	4	5	5	5	4	3
2. Diminishing the gap between the demand and availability of good doctors and staff	3	4	1	3	4	5	2	4	3	4	1	4	5	5	5	4	2	3	4	4
3. Empathy of doctors and staff	5	3	5	5	4	5	5	2	4	5	3	4	4	3	3	3	3	4	4	4
4. Affordability and reliability of service	5	5	4	2	4	4	5	3	3	5	3	4	4	5	5	5	5	4	2	4
5. Advanced information and communication technology	4	2	5	3	4	4	5	4	5	4	3	3	5	3	4	3	4	5	4	5
6. E-health Service	4	4	3	5	3	4	4	5	5	4	4	3	3	5	4	2	4	4	5	5

7. Proper maintenance and monitoring of hospital support services	3	5	4	4	4	5	5	5	2	5	5	4	3	5	5	2	5	4	4	3
1. Ensuring the quality of work life	3	4	5	4	5	4	4	4	3	3	2	4	4	4	5	3	5	3	3	5
2. Motivation, training and development	5	5	3	5	5	4	2	5	3	3	4	5	4	3	2	4	5	3	5	5
3. Employee Empowerment	4	3	4	3	3	5	3	2	3	5	3	3	4	3	5	4	2	5	4	5
4. Patients' positive and participative attitude	5	4	3	5	3	4	4	4	5	4	5	4	4	5	5	4	3	4	3	2
5. Availability of protective resources for frontliners	5	4	4	5	4	4	5	5	4	5	2	4	2	5	3	5	4	4	4	4
6. Adoption of new practices	4	2	4	1	4	5	4	4	4	3	4	4	4	3	5	3	3	4	4	5
1. Effective supply chain management	5	3	3	3	5	3	5	4	4	5	5	4	5	3	5	3	4	4	3	3
2. Assessment system of hospital performance	5	1	1	5	4	5	1	5	3	3	4	5	4	4	4	3	3	3	5	4
3. Leadership and organizational commitment	4	3	4	2	3	5	2	4	4	5	3	4	5	5	5	5	3	4	2	3
4. Developing intellectual capital through knowledge management	4	4	5	4	5	4	4	3	2	3	5	4	5	3	5	5	4	4	5	4
5. Benchmarking international best service practice	5	4	5	5	4	4	3	5	4	4	4	5	5	3	4	3	3	4	5	4
6. Perceived reputation of the hospital	4	4	4	3	4	3	4	4	5	4	4	4	4	3	4	4	4	4	5	5
7. Reforming organizational structure	3	5	3	3	5	5	3	3	2	3	4	3	3	5	4	3	4	3	5	4
8. Collaboration with other hospitals	5	3	3	4	4	3	4	5	4	5	5	3	3	4	5	4	5	4	5	4
9. Support of trained volunteers	3	4	4	3	3	5	5	5	3	4	3	4	4	5	3	2	3	4	3	3
1. Implementation of public health policies	4	5	5	4	3	4	4	4	5	4	5	4	4	3	5	5	4	4	4	4
2. Accreditation	5	5	5	4	4	5	4	3	4	3	5	4	3	4	4	3	3	4	5	4
3. Engaging experienced doctors in top management	5	4	5	4	4	5	3	5	4	4	4	5	4	4	4	4	4	5	4	3
4. Sustainable procurement	5	3	4	2	5	2	3	3	3	4	5	4	3	3	5	5	5	3	5	3
5. Public-private partnership	4	3	4	4	5	3	4	5	3	5	5	3	3	3	5	3	3	4	3	5
6. Local production of medical equipment	1	3	3	3	3	3	3	4	3	3	3	3	4	3	3	5	4	4	3	3

Table B2: Profiles of experts who participated in grey DEMATEL data collection

Expert's Code	**Job experience**	**Working area**
E1	20	Manager operations
E5	21	Manager (service)
E12	20	Logistics manager
E13	19	Service manager
E19	19	Manager (IT)
E20	21	Service manager

Table B3: Grey relation matrix constructed with the assistance of Expert-1

E1	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20
D1	0.00	0.40	0.00	0.40	0.20	0.00	0.20	0.60	0.60	0.00	0.40	0.40	0.20	0.40	0.40	0.60	0.40	0.60	0.40	0.20
	0.00	0.80	0.40	0.80	0.60	0.40	0.60	1.00	1.00	0.40	0.80	0.80	0.60	0.80	0.80	1.00	0.80	1.00	0.80	0.60
D2	0.00	0.00	0.40	0.00	0.00	0.00	0.20	0.40	0.00	0.40	0.00	0.20	0.20	0.00	0.40	0.40	0.00	0.00	0.20	0.00
	0.40	0.00	0.80	0.40	0.40	0.40	0.60	0.80	0.40	0.80	0.40	0.60	0.60	0.40	0.80	0.80	0.40	0.40	0.60	0.40
D3	0.20	0.00	0.00	0.40	0.00	0.00	0.20	0.40	0.00	0.00	0.40	0.60	0.20	0.60	0.40	0.40	0.00	0.00	0.40	0.20
	0.60	0.40	0.00	0.80	0.40	0.40	0.60	0.80	0.40	0.40	0.80	1.00	0.60	1.00	0.80	0.80	0.40	0.40	0.80	0.60
D4	0.00	0.00	0.40	0.00	0.20	0.00	0.00	0.60	0.00	0.00	0.60	0.60	0.40	0.60	0.60	0.00	0.20	0.00	0.60	0.40
	0.40	0.40	0.80	0.00	0.60	0.40	0.40	1.00	0.40	0.40	1.00	1.00	0.80	1.00	1.00	0.40	0.60	0.40	1.00	0.80
D5	0.60	0.00	0.20	0.00	0.00	0.00	0.00	0.60	0.20	0.40	0.60	0.00	0.20	0.40	0.60	0.60	0.40	0.00	0.20	0.40
	1.00	0.40	0.60	0.40	0.00	0.40	0.40	1.00	0.60	0.80	1.00	0.40	0.60	0.80	1.00	1.00	0.80	0.40	0.60	0.80
D6	0.20	0.40	0.00	0.60	0.00	0.00	0.00	0.20	0.20	0.00	0.40	0.20	0.00	0.40	0.20	0.20	0.00	0.40	0.20	0.40
	0.60	0.80	0.40	1.00	0.40	0.00	0.40	0.60	0.60	0.40	0.80	0.60	0.40	0.80	0.60	0.60	0.40	0.80	0.60	0.80
D7	0.20	0.00	0.20	0.40	0.20	0.00	0.00	0.20	0.00	0.00	0.40	0.20	0.00	0.20	0.20	0.20	0.00	0.40	0.00	0.20
	0.60	0.40	0.60	0.80	0.60	0.40	0.00	0.60	0.40	0.40	0.80	0.60	0.40	0.60	0.60	0.60	0.40	0.80	0.40	0.60
D8	0.60	0.20	0.20	0.00	0.20	0.40	0.00	0.00	0.20	0.00	0.00	0.00	0.20	0.40	0.20	0.00	0.00	0.40	0.00	0.20
	1.00	0.60	0.60	0.40	0.60	0.80	0.40	0.00	0.60	0.40	0.40	0.40	0.60	0.80	0.60	0.40	0.40	0.80	0.40	0.60
D9	0.20	0.00	0.40	0.40	0.20	0.20	0.00	0.20	0.00	0.20	0.00	0.20	0.20	0.40	0.00	0.20	0.00	0.20	0.00	0.20
	0.60	0.40	0.80	0.80	0.60	0.60	0.40	0.60	0.00	0.60	0.40	0.60	0.60	0.80	0.40	0.60	0.40	0.60	0.40	0.60
D10	0.40	0.00	0.20	0.00	0.40	0.00	0.20	0.20	0.20	0.00	0.40	0.00	0.00	0.40	0.20	0.00	0.00	0.00	0.40	0.20
	0.80	0.40	0.60	0.40	0.80	0.40	0.60	0.60	0.60	0.00	0.80	0.40	0.40	0.80	0.60	0.40	0.40	0.40	0.80	0.60
D11	0.60	0.40	0.20	0.00	0.20	0.20	0.20	0.20	0.40	0.20	0.00	0.40	0.20	0.20	0.00	0.20	0.00	0.40	0.20	0.20
	1.00	0.80	0.60	0.40	0.60	0.60	0.60	0.60	0.80	0.60	0.00	0.80	0.60	0.60	0.40	0.60	0.40	0.80	0.60	0.60
D12	0.60	0.00	0.40	0.00	0.40	0.00	0.60	0.20	0.20	0.00	0.40	0.00	0.20	0.00	0.60	0.20	0.20	0.00	0.00	0.20
	1.00	0.40	0.80	0.40	0.80	0.40	1.00	0.60	0.60	0.40	0.80	0.00	0.60	0.40	1.00	0.60	0.60	0.40	0.40	0.60
D13	0.20	0.00	0.00	0.20	0.20	0.20	0.20	0.40	0.0	0.00	0.20	0.40	0.00	0.20	0.40	0.00	0.00	0.20	0.40	0.20
	0.60	0.40	0.40	0.60	0.60	0.60	0.60	0.80	0.40	0.40	0.60	0.80	0.00	0.60	0.80	0.40	0.40	0.60	0.80	0.60
D14	0.40	0.20	0.20	0.00	0.20	0.60	0.60	0.20	0.20	0.20	0.20	0.20	0.40	0.00	0.20	0.20	0.20	0.40	0.20	0.20
	0.80	0.60	0.60	0.40	0.60	1.00	1.00	0.60	0.60	0.60	0.60	0.60	0.80	0.00	0.60	0.60	0.60	0.80	0.60	0.60
D15	0.00	0.60	0.40	0.00	0.60	0.00	0.60	0.20	0.20	0.40	0.20	0.20	0.00	0.40	0.00	0.40	0.20	0.20	0.00	0.40
	0.40	1.00	0.80	0.40	1.00	0.40	1.00	0.60	0.60	0.80	0.60	0.60	0.40	0.80	0.00	0.80	0.60	0.60	0.40	0.80
D16	0.00	0.20	0.0	0.20	0.60	0.60	0.20	0.00	0.00	0.20	0.40	0.20	0.00	0.20	0.20	0.00	0.00	0.00	0.40	0.20
	0.40	0.60	0.4	0.60	1.00	1.00	0.60	0.40	0.40	0.60	0.80	0.60	0.40	0.60	0.60	0.00	0.40	0.40	0.80	0.60
D17	0.00	0.40	0.0	0.40	0.20	0.40	0.20	0.00	0.20	0.00	0.00	0.20	0.00	0.00	0.20	0.20	0.00	0.00	0.20	0.20
	0.40	0.80	0.4	0.80	0.60	0.80	0.60	0.40	0.60	0.40	0.40	0.60	0.40	0.40	0.60	0.60	0.00	0.40	0.60	0.60
D18	0.40	0.40	0.40	0.00	0.40	0.40	0.00	0.20	0.40	0.40	0.20	0.40	0.40	0.20	0.40	0.00	0.20	0.00	0.40	0.40
	0.80	0.80	0.80	0.40	0.80	0.80	0.40	0.60	0.80	0.80	0.60	0.80	0.80	0.60	0.80	0.40	0.60	0.00	0.80	0.80

D19	0.00	0.20	0.20	0.00	0.40	0.20	0.20	0.20	0.40	0.00	0.20	0.20	0.60	0.20	0.20	0.40	0.00	0.40	0.00	0.00
	0.40	0.60	0.60	0.40	0.80	0.60	0.60	0.60	0.80	0.40	0.60	0.60	1.00	0.60	0.60	0.80	0.40	0.80	0.00	0.40
D20	0.40	0.20	0.40	0.20	0.20	0.40	0.20	0.40	0.00	0.20	0.20	0.40	0.20	0.20	0.40	0.20	0.20	0.00	0.20	0.00
	0.80	0.60	0.80	0.60	0.60	0.80	0.60	0.80	0.40	0.60	0.60	0.80	0.60	0.60	0.80	0.60	0.60	0.40	0.60	0.00

Table B4: Grey relation matrix constructed with the assistance of Expert-5

E5	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.00	0.20	0.60	0.20	0.40	0.20	0.60	0.20	0.60	0.20	0.20	0.40	0.20	0.40	0.60	0.40	0.20	0.60	0.20	0.60
	0.00	0.60	1.00	0.60	0.80	0.60	1.00	0.60	1.00	0.60	0.60	0.80	0.60	0.80	1.00	0.80	0.60	1.00	0.60	1.00
D2	0.40	0.00	0.20	0.40	0.40	0.00	0.20	0.40	0.20	0.20	0.00	0.20	0.20	0.20	0.20	0.00	0.40	0.00	0.20	0.40
	0.80	0.00	0.60	0.80	0.80	0.40	0.60	0.80	0.60	0.60	0.40	0.60	0.60	0.60	0.60	0.40	0.80	0.40	0.60	0.80
D3	0.20	0.40	0.00	0.20	0.40	0.60	0.20	0.60	0.40	0.00	0.00	0.20	0.20	0.40	0.40	0.60	0.60	0.20	0.00	0.60
	0.60	0.80	0.00	0.60	0.80	1.00	0.60	1.00	0.80	0.40	0.40	0.60	0.60	0.80	0.80	1.00	1.00	0.60	0.40	1.00
D4	0.20	0.60	0.20	0.00	0.40	0.20	0.40	0.40	0.60	0.20	0.20	0.20	0.20	0.20	0.60	0.20	0.20	0.20	0.40	0.40
	0.60	1.00	0.60	0.00	0.80	0.60	0.80	0.80	1.00	0.60	0.60	0.60	0.60	0.60	1.00	0.60	0.60	0.60	0.80	0.80
D5	0.40	0.20	0.40	0.20	0.00	0.60	0.20	0.40	0.20	0.20	0.00	0.20	0.40	0.20	0.60	0.60	0.20	0.40	0.60	0.20
	0.80	0.60	0.80	0.60	0.00	1.00	0.60	0.80	0.60	0.60	0.40	0.60	0.80	0.60	1.00	1.00	0.60	0.80	1.00	0.60
D6	0.20	0.40	0.40	0.40	0.60	0.00	0.60	0.40	0.00	0.20	0.40	0.40	0.20	0.60	0.60	0.60	0.20	0.60	0.40	0.40
	0.60	0.80	0.80	0.80	1.00	0.00	1.00	0.80	0.40	0.60	0.80	0.80	0.60	1.00	1.00	1.00	0.60	1.00	0.80	0.80
D7	0.60	0.20	0.40	0.60	0.20	0.20	0.00	0.20	0.60	0.00	0.20	0.20	0.40	0.20	0.20	0.00	0.40	0.00	0.20	0.00
	1.00	0.60	0.80	1.00	0.60	0.60	0.00	0.60	1.00	0.40	0.60	0.60	0.80	0.60	0.60	0.40	0.80	0.40	0.60	0.40
D8	0.40	0.00	0.20	0.00	0.20	0.20	0.20	0.00	0.40	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.00	0.40	0.20	0.40
	0.80	0.40	0.60	0.40	0.60	0.60	0.60	0.00	0.80	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.40	0.80	0.60	0.80
D9	0.0	0.20	0.60	0.60	0.20	0.0	0.40	0.40	0.00	0.40	0.0	0.20	0.0	0.20	0.20	0.20	0.00	0.20	0.20	0.20
	0.4	0.60	1.00	1.00	0.60	0.4	0.80	0.80	0.00	0.80	0.4	0.60	0.4	0.60	0.60	0.60	0.40	0.60	0.60	0.60
D10	0.40	0.00	0.40	0.20	0.00	0.20	0.20	0.20	0.00	0.00	0.20	0.20	0.40	0.00	0.00	0.20	0.00	0.40	0.20	0.20
	0.80	0.40	0.80	0.60	0.40	0.60	0.60	0.60	0.40	0.00	0.60	0.60	0.80	0.40	0.40	0.60	0.40	0.80	0.60	0.60
D11	0.20	0.40	0.20	0.40	0.20	0.20	0.40	0.20	0.20	0.20	0.00	0.20	0.00	0.40	0.20	0.20	0.60	0.40	0.60	0.00
	0.60	0.80	0.60	0.80	0.60	0.60	0.80	0.60	0.60	0.60	0.00	0.60	0.40	0.80	0.60	0.60	1.00	0.80	1.00	0.40
D12	0.20	0.60	0.20	0.20	0.60	0.40	0.20	0.60	0.40	0.20	0.20	0.00	0.20	0.20	0.20	0.60	0.60	0.20	0.60	0.20
	0.60	1.00	0.60	0.60	1.00	0.80	0.60	1.00	0.80	0.60	0.60	0.00	0.60	0.60	0.60	1.00	1.00	0.60	1.00	0.60

D13	0.20	0.20	0.20	0.40	0.60	0.20	0.20	0.00	0.20	0.00	0.20	0.40	0.00	0.60	0.20	0.40	0.60	0.20	0.60	0.40
	0.60	0.60	0.60	0.80	1.00	0.60	0.60	0.40	0.60	0.40	0.60	0.80	0.00	1.00	0.60	0.80	1.00	0.60	1.00	0.80
D14	0.20	0.40	0.20	0.60	0.20	0.40	0.20	0.20	0.60	0.20	0.20	0.20	0.20	0.00	0.20	0.60	0.20	0.20	0.60	0.20
	0.60	0.80	0.60	1.00	0.60	0.80	0.60	0.60	1.00	0.60	0.60	0.60	0.60	0.00	0.60	1.00	0.60	0.60	1.00	0.60
D15	0.20	0.20	0.00	0.20	0.20	0.40	0.40	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.00	0.20	0.20
	0.60	0.60	0.40	0.60	0.60	0.80	0.80	0.60	0.60	0.80	0.60	0.60	0.60	0.60	0.00	0.60	0.60	0.40	0.60	0.60
D16	0.60	0.20	0.20	0.20	0.40	0.60	0.20	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.40	0.00	0.40	0.40	0.20	0.60
	1.00	0.60	0.60	0.60	0.80	1.00	0.60	0.40	0.40	0.60	0.60	0.60	0.60	0.60	0.80	0.00	0.80	0.80	0.60	1.00
D17	0.20	0.60	0.20	0.60	0.20	0.20	0.40	0.20	0.60	0.20	0.60	0.20	0.40	0.20	0.20	0.20	0.00	0.20	0.00	0.20
	0.60	1.00	0.60	1.00	0.60	0.60	0.80	0.60	1.00	0.60	1.00	0.60	0.80	0.60	0.60	0.60	0.00	0.60	0.40	0.60
D18	0.60	0.20	0.40	0.20	0.40	0.60	0.60	0.20	0.40	0.40	0.40	0.20	0.20	0.40	0.20	0.20	0.20	0.00	0.40	0.40
	1.00	0.60	0.80	0.60	0.80	1.00	1.00	0.60	0.80	0.80	0.80	0.60	0.60	0.80	0.60	0.60	0.60	0.00	0.80	0.80
D19	0.40	0.40	0.20	0.20	0.20	0.20	0.20	0.00	0.60	0.20	0.20	0.00	0.20	0.40	0.20	0.40	0.20	0.20	0.00	0.20
	0.80	0.80	0.60	0.60	0.60	0.60	0.60	0.40	1.00	0.60	0.60	0.40	0.60	0.80	0.60	0.80	0.60	0.60	0.00	0.60
D20	0.60	0.60	0.40	0.20	0.60	0.20	0.40	0.20	0.00	0.00	0.40	0.40	0.20	0.60	0.40	0.20	0.20	0.60	0.40	0.00
	1.00	1.00	0.80	0.60	1.00	0.60	0.80	0.60	0.40	0.40	0.80	0.80	0.60	1.00	0.80	0.60	0.60	1.00	0.80	0.00

Table B5: Grey relation matrix constructed with the assistance of Expert-12

E12	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.00	0.60	0.60	0.20	0.20	0.60	0.20	0.60	0.60	0.00	0.60	0.20	0.20	0.20	0.60	0.60	0.20	0.20	0.40	0.60
	0.00	1.00	1.00	0.60	0.60	1.00	0.60	1.00	1.00	0.40	1.00	0.60	0.60	0.60	1.00	1.00	0.60	0.60	0.80	1.00
D2	0.40	0.00	0.20	0.40	0.40	0.00	0.40	0.20	0.20	0.20	0.00	0.20	0.40	0.20	0.20	0.20	0.40	0.60	0.60	0.20
	0.80	0.00	0.60	0.80	0.80	0.40	0.80	0.60	0.60	0.60	0.40	0.60	0.80	0.60	0.60	0.60	0.80	1.00	1.00	0.60
D3	0.20	0.40	0.00	0.00	0.20	0.20	0.20	0.00	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.60	0.60	0.00	0.20	0.20
	0.60	0.80	0.00	0.40	0.60	0.60	0.60	0.40	0.60	0.60	0.60	0.60	0.40	0.60	0.60	1.00	1.00	0.40	0.60	0.60
D4	0.40	0.20	0.20	0.00	0.20	0.40	0.20	0.40	0.20	0.00	0.40	0.40	0.60	0.60	0.20	0.60	0.20	0.20	0.60	0.20
	0.80	0.60	0.60	0.00	0.60	0.80	0.60	0.80	0.60	0.40	0.80	0.80	1.00	1.00	0.60	1.00	0.60	0.60	1.00	0.60
D5	0.40	0.20	0.40	0.20	0.00	0.40	0.20	0.20	0.20	0.40	0.20	0.60	0.40	0.20	0.40	0.60	0.20	0.40	0.60	0.20
	0.80	0.60	0.80	0.60	0.00	0.80	0.60	0.60	0.60	0.80	0.60	1.00	0.80	0.60	0.80	1.00	0.60	0.80	1.00	0.60
D6	0.40	0.60	0.20	0.00	0.00	0.00	0.60	0.40	0.20	0.00	0.00	0.60	0.20	0.60	0.40	0.00	0.40	0.20	0.00	0.00
	0.80	1.00	0.60	0.40	0.40	0.00	1.00	0.80	0.60	0.40	0.40	1.00	0.60	1.00	0.80	0.40	0.80	0.60	0.40	0.40
D7	0.40	0.40	0.20	0.20	0.40	0.20	0.00	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.40	0.20	0.60	0.60	0.20	0.60
	0.80	0.80	0.60	0.60	0.80	0.60	0.00	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.80	0.60	1.00	1.00	0.60	1.00

D8	0.40	0.20	0.40	0.20	0.40	0.40	0.20	0.00	0.40	0.40	0.20	0.40	0.20	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	0.80	0.60	0.80	0.60	0.80	0.80	0.60	0.00	0.80	0.80	0.60	0.80	0.60	0.80	0.80	0.80	0.80	0.80	0.80	0.80
D9	0.0	0.40	0.60	0.60	0.20	0.00	0.00	0.40	0.00	0.00	0.00	0.20	0.40	0.20	0.00	0.20	0.00	0.60	0.60	0.20
	0.4	0.80	1.00	1.00	0.60	0.40	0.40	0.80	0.00	0.40	0.40	0.60	0.80	0.60	0.40	0.60	0.40	1.00	1.00	0.60
D10	0.40	0.00	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.00	0.20	0.40	0.00	0.20	0.20	0.20	0.00	0.20	0.40	0.40
	0.80	0.40	0.80	0.60	0.60	0.60	0.60	0.40	0.60	0.00	0.60	0.80	0.40	0.60	0.60	0.60	0.40	0.60	0.80	0.80
D11	0.60	0.60	0.20	0.60	0.60	0.20	0.40	0.20	0.60	0.20	0.00	0.20	0.40	0.40	0.60	0.20	0.60	0.60	0.60	0.40
	1.00	1.00	0.60	1.00	1.00	0.60	0.80	0.60	1.00	0.60	0.00	0.60	0.80	0.80	1.00	0.60	1.00	1.00	1.00	0.80
D12	0.40	0.60	0.40	0.00	0.40	0.20	0.40	0.00	0.60	0.00	0.20	0.00	0.20	0.60	0.20	0.60	0.60	0.20	0.20	0.60
	0.80	1.00	0.80	0.40	0.80	0.60	0.80	0.40	1.00	0.40	0.60	0.00	0.60	1.00	0.60	1.00	1.00	0.60	0.60	1.00
D13	0.20	0.20	0.20	0.40	0.60	0.20	0.20	0.00	0.60	0.60	0.20	0.40	0.00	0.60	0.60	0.20	0.40	0.20	0.60	0.60
	0.60	0.60	0.60	0.80	1.00	0.60	0.60	0.40	1.00	1.00	0.60	0.80	0.00	1.00	1.00	0.60	0.80	0.60	1.00	1.00
D14	0.00	0.20	0.60	0.20	0.40	0.00	0.20	0.00	0.20	0.60	0.20	0.40	0.20	0.00	0.20	0.20	0.20	0.20	0.20	0.20
	0.40	0.60	1.00	0.60	0.80	0.40	0.60	0.40	0.60	1.00	0.60	0.80	0.60	0.00	0.60	0.60	0.60	0.60	0.60	0.60
D15	0.20	0.20	0.40	0.40	0.20	0.00	0.20	0.20	0.40	0.40	0.20	0.20	0.40	0.20	0.00	0.40	0.20	0.00	0.20	0.00
	0.60	0.60	0.80	0.80	0.60	0.40	0.60	0.60	0.80	0.80	0.60	0.60	0.80	0.60	0.00	0.80	0.60	0.40	0.60	0.40
D16	0.60	0.20	0.20	0.20	0.40	0.60	0.20	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.40	0.00	0.40	0.40	0.20	0.60
	1.00	0.60	0.60	0.60	0.80	1.00	0.60	0.40	0.40	0.60	0.60	0.60	0.60	0.60	0.80	0.00	0.80	0.80	0.60	1.00
D17	0.40	0.60	0.20	0.20	0.60	0.20	0.20	0.40	0.20	0.00	0.20	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.00
	0.80	1.00	0.60	0.60	1.00	0.60	0.60	0.80	0.60	0.40	0.60	0.80	0.60	0.60	0.60	0.60	0.00	0.60	0.60	0.40
D18	0.60	0.20	0.40	0.40	0.40	0.60	0.20	0.00	0.60	0.60	0.40	0.20	0.40	0.60	0.60	0.20	0.40	0.00	0.20	0.40
	1.00	0.60	0.80	0.80	0.80	1.00	0.60	0.40	1.00	1.00	0.80	0.60	0.80	1.00	1.00	0.60	0.80	0.00	0.60	0.80
D19	0.60	0.20	0.20	0.20	0.00	0.60	0.20	0.20	0.00	0.00	0.60	0.20	0.00	0.20	0.40	0.60	0.40	0.40	0.00	0.60
	1.00	0.60	0.60	0.60	0.40	1.00	0.60	0.60	0.40	0.40	1.00	0.60	0.40	0.60	0.80	1.00	0.80	0.80	0.00	1.00
D20	0.40	0.60	0.60	0.40	0.20	0.40	0.20	0.00	0.40	0.40	0.20	0.60	0.20	0.00	0.40	0.40	0.60	0.40	0.20	0.00
	0.80	1.00	1.00	0.80	0.60	0.80	0.60	0.40	0.80	0.80	0.60	1.00	0.60	0.40	0.80	0.80	1.00	0.80	0.60	0.00

Table B6: Grey relation matrix constructed with the assistance of Expert 13

E13	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.00	0.60	0.20	0.60	0.20	0.20	0.40	0.60	0.20	0.60	0.20	0.20	0.40	0.20	0.20	0.40	0.20	0.40	0.20	0.40
	0.00	1.00	0.60	1.00	0.60	0.60	0.80	1.00	0.60	1.00	0.60	0.60	0.80	0.60	0.60	0.80	0.60	0.80	0.60	0.80
D2	0.20	0.00	0.20	0.40	0.40	0.20	0.40	0.20	0.40	0.40	0.00	0.20	0.40	0.40	0.20	0.00	0.20	0.20	0.20	0.20
	0.60	0.00	0.60	0.80	0.80	0.60	0.80	0.60	0.80	0.80	0.40	0.60	0.80	0.80	0.60	0.40	0.60	0.60	0.60	0.60
D3	0.40	0.40	0.00	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.40	0.40	0.40	0.60	0.60
	0.80	0.80	0.00	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.80	0.80	0.80	1.00	1.00
D4	0.60	0.60	0.20	0.00	0.40	0.20	0.20	0.20	0.60	0.40	0.60	0.60	0.40	0.20	0.20	0.20	0.20	0.60	0.20	0.40
	1.00	1.00	0.60	0.00	0.80	0.60	0.60	0.60	1.00	0.80	1.00	1.00	0.80	0.60	0.60	0.60	0.60	1.00	0.60	0.80

D5	0.20	0.20	0.40	0.20	0.00	0.60	0.20	0.20	0.00	0.20	0.40	0.60	0.20	0.00	0.20	0.20	0.20	0.40	0.60	0.20
	0.60	0.60	0.80	0.60	0.00	1.00	0.60	0.60	0.40	0.60	0.80	1.00	0.60	0.40	0.60	0.60	0.60	0.80	1.00	0.60
D6	0.60	0.20	0.60	0.00	0.60	0.00	0.60	0.40	0.00	0.60	0.40	0.00	0.60	0.00	0.60	0.20	0.60	0.40	0.40	0.40
	1.00	0.60	1.00	0.40	1.00	0.00	1.00	0.80	0.40	1.00	0.80	0.40	1.00	0.40	1.00	0.60	1.00	0.80	0.80	0.80
D7	0.20	0.40	0.60	0.20	0.20	0.20	0.00	0.20	0.60	0.20	0.20	0.20	0.20	0.20	0.40	0.60	0.20	0.00	0.40	0.00
	0.60	0.80	1.00	0.60	0.60	0.60	0.00	0.60	1.00	0.60	0.60	0.60	0.60	0.60	0.80	1.00	0.60	0.40	0.80	0.40
D8	0.20	0.00	0.20	0.20	0.20	0.20	0.20	0.00	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.20
	0.60	0.40	0.60	0.60	0.60	0.60	0.60	0.00	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.60
D9	0.60	0.00	0.20	0.60	0.40	0.20	0.00	0.40	0.00	0.40	0.00	0.00	0.20	0.20	0.20	0.20	0.00	0.20	0.00	0.60
	1.00	0.40	0.60	1.00	0.80	0.60	0.40	0.80	0.00	0.80	0.40	0.40	0.60	0.60	0.60	0.60	0.40	0.60	0.40	1.00
D10	0.60	0.60	0.20	0.40	0.20	0.20	0.20	0.20	0.20	0.00	0.40	0.20	0.40	0.20	0.20	0.40	0.20	0.00	0.20	0.40
	0.80	0.80	0.60	0.80	0.60	0.60	0.60	0.60	0.60	0.00	0.80	0.60	0.80	0.60	0.60	0.80	0.60	0.40	0.60	0.80
D11	0.40	0.20	0.20	0.60	0.40	0.20	0.60	0.40	0.60	0.00	0.00	0.20	0.40	0.20	0.20	0.60	0.40	0.60	0.60	0.40
	0.80	0.60	0.60	1.00	0.80	0.60	1.00	0.80	1.00	0.40	0.00	0.60	0.80	0.60	0.60	1.00	0.80	1.00	1.00	0.80
D12	0.40	0.40	0.20	0.60	0.40	0.20	0.20	0.20	0.60	0.40	0.20	0.00	0.20	0.20	0.20	0.60	0.20	0.20	0.60	0.60
	0.80	0.80	0.60	1.00	0.80	0.60	0.60	0.60	1.00	0.80	0.60	0.00	0.60	0.60	0.60	1.00	0.60	0.60	1.00	1.00
D13	0.40	0.60	0.20	0.60	0.20	0.20	0.20	0.00	0.20	0.00	0.20	0.40	0.00	0.60	0.20	0.20	0.40	0.60	0.20	0.40
	0.80	1.00	0.60	1.00	0.60	0.60	0.60	0.40	0.60	0.40	0.60	0.80	0.00	1.00	0.60	0.60	0.80	1.00	0.60	0.80
D14	0.40	0.20	0.20	0.20	0.00	0.20	0.20	0.00	0.20	0.00	0.20	0.40	0.20	0.00	0.20	0.20	0.20	0.20	0.20	0.40
	0.80	0.60	0.60	0.60	0.40	0.60	0.60	0.40	0.60	0.40	0.60	0.80	0.60	0.00	0.60	0.60	0.60	0.60	0.60	0.80
D15	0.20	0.20	0.20	0.40	0.40	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.40	0.00	0.40
	0.60	0.60	0.60	0.80	0.80	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.60	0.60	0.00	0.60	0.60	0.80	0.40	0.80
D16	0.20	0.40	0.60	0.20	0.00	0.00	0.40	0.60	0.20	0.00	0.00	0.00	0.20	0.20	0.20	0.00	0.40	0.40	0.40	0.20
	0.60	0.80	1.00	0.60	0.40	0.40	0.80	1.00	0.60	0.40	0.40	0.40	0.60	0.60	0.60	0.00	0.80	0.80	0.80	0.60
D17	0.40	0.60	0.20	0.60	0.20	0.60	0.20	0.60	0.20	0.20	0.40	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.00
	0.80	1.00	0.60	1.00	0.60	1.00	0.60	1.00	0.60	0.60	0.80	0.80	0.60	0.60	0.60	0.60	0.00	0.60	0.60	0.40
D18	0.60	0.20	0.60	0.60	0.40	0.40	0.40	0.60	0.60	0.20	0.40	0.40	0.40	0.20	0.40	0.20	0.20	0.00	0.40	0.20
	1.00	0.60	1.00	1.00	0.80	0.80	0.80	1.00	1.00	0.60	0.80	0.80	0.80	0.60	0.80	0.60	0.60	0.00	0.80	0.60
D19	0.20	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.20	0.00	0.60	0.40	0.20	0.20	0.00	0.20	0.40	0.20	0.00	0.20
	0.60	0.60	0.80	0.60	0.80	0.60	0.60	0.60	0.60	0.40	1.00	0.80	0.60	0.60	0.40	0.60	0.80	0.60	0.00	0.60
D20	0.40	0.40	0.60	0.20	0.20	0.60	0.40	0.40	0.20	0.00	0.20	0.40	0.40	0.20	0.60	0.20	0.20	0.60	0.40	0.00
	0.80	0.80	1.00	0.60	0.60	1.00	0.80	0.80	0.60	0.40	0.60	0.80	0.80	0.60	1.00	0.60	0.60	1.00	0.80	0.00

Table B7: Grey relation matrix constructed with the assistance of Expert 19

E19	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.00	0.60	0.40	0.00	0.20	0.40	0.40	0.40	0.20	0.00	0.20	0.40	0.40	0.40	0.20	0.60	0.60	0.40	0.20	0.40
	0.00	1.00	0.80	0.40	0.60	0.80	0.80	0.80	0.60	0.40	0.60	0.80	0.80	0.80	0.60	1.00	1.00	0.80	0.60	0.80

D2	0.20	0.00	0.60	0.20	0.40	0.20	0.40	0.20	0.40	0.00	0.20	0.20	0.00	0.20	0.00	0.20	0.20	0.00	0.40	0.40
	0.60	0.00	1.00	0.60	0.80	0.60	0.80	0.60	0.80	0.40	0.60	0.60	0.40	0.60	0.40	0.60	0.60	0.40	0.80	0.80
D3	0.20	0.40	0.00	0.60	0.20	0.40	0.20	0.20	0.40	0.20	0.40	0.20	0.40	0.40	0.20	0.00	0.20	0.20	0.00	0.20
	0.60	0.80	0.00	1.00	0.60	0.80	0.60	0.60	0.80	0.60	0.80	0.60	0.80	0.80	0.60	0.40	0.60	0.60	0.40	0.60
D4	0.60	0.20	0.20	0.00	0.40	0.40	0.20	0.40	0.40	0.60	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.40	0.60	0.20
	1.00	0.60	0.60	0.00	0.80	0.80	0.60	0.80	0.80	1.00	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.80	1.00	0.60
D5	0.40	0.40	0.40	0.20	0.00	0.60	0.00	0.20	0.40	0.20	0.00	0.20	0.40	0.20	0.60	0.00	0.20	0.40	0.20	0.60
	0.80	0.80	0.80	0.60	0.00	1.00	0.40	0.60	0.80	0.60	0.40	0.60	0.80	0.60	1.00	0.40	0.60	0.80	0.60	1.00
D6	0.40	0.40	0.60	0.40	0.60	0.00	0.60	0.40	0.00	0.60	0.40	0.00	0.20	0.40	0.40	0.20	0.60	0.20	0.60	0.60
	0.80	0.80	1.00	0.80	1.00	0.00	1.00	0.80	0.40	1.00	0.80	0.40	0.60	0.80	0.80	0.60	1.00	0.60	1.00	1.00
D7	0.40	0.60	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.60	0.40	0.20	0.20	0.60	0.40	0.20	0.20	0.40	0.20	0.20
	0.80	1.00	0.60	0.60	0.60	0.60	0.00	0.60	0.60	1.00	0.80	0.60	0.60	1.00	0.80	0.60	0.60	0.80	0.60	0.60
D8	0.20	0.00	0.20	0.20	0.20	0.20	0.20	0.00	0.40	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.00	0.40
	0.60	0.40	0.60	0.60	0.60	0.60	0.60	0.00	0.80	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.40	0.80
D9	0.00	0.20	0.20	0.40	0.00	0.20	0.00	0.40	0.00	0.40	0.60	0.00	0.60	0.20	0.20	0.00	0.00	0.20	0.00	0.60
	0.40	0.60	0.60	0.80	0.40	0.60	0.40	0.80	0.00	0.80	1.00	0.40	1.00	0.60	0.60	0.40	0.40	0.60	0.40	1.00
D10	0.60	0.60	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.00	0.20	0.20	0.40	0.20	0.40	0.20	0.20	0.00	0.20	0.20
	1.00	1.00	0.60	0.80	0.60	0.80	0.60	0.60	0.60	0.00	0.60	0.60	0.80	0.60	0.80	0.60	0.60	0.40	0.60	0.60
D11	0.20	0.20	0.40	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.00	0.40	0.20	0.20	0.60	0.20	0.20	0.60	0.40	0.60
	0.60	0.60	0.80	0.60	0.80	0.60	0.80	0.60	0.60	0.60	0.00	0.80	0.60	0.60	1.00	0.60	0.60	1.00	0.80	1.00
D12	0.20	0.20	0.60	0.40	0.20	0.40	0.20	0.00	0.40	0.20	0.40	0.00	0.20	0.20	0.20	0.60	0.20	0.60	0.20	0.20
	0.60	0.60	1.00	0.80	0.60	0.80	0.60	0.40	0.80	0.60	0.80	0.00	0.60	0.60	0.60	1.00	0.60	1.00	0.60	0.60
D13	0.20	0.40	0.60	0.20	0.20	0.40	0.60	0.20	0.20	0.00	0.20	0.40	0.00	0.60	0.60	0.60	0.60	0.00	0.60	0.00
	0.60	0.80	1.00	0.60	0.60	0.80	1.00	0.60	0.60	0.40	0.60	0.80	0.00	1.00	1.00	1.00	1.00	0.40	1.00	0.40
D14	0.40	0.20	0.40	0.60	0.20	0.60	0.20	0.20	0.60	0.20	0.60	0.20	0.20	0.00	0.20	0.20	0.20	0.20	0.20	0.40
	0.80	0.60	0.80	1.00	0.60	1.00	0.60	0.60	1.00	0.60	1.00	0.60	0.60	0.00	0.60	0.60	0.60	0.60	0.60	0.80
D15	0.20	0.20	0.20	0.40	0.40	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.20	0.40	0.00	0.40	0.00	0.20	0.20	0.40
	0.60	0.60	0.60	0.80	0.80	0.60	0.60	0.60	0.80	0.60	0.60	0.60	0.60	0.80	0.00	0.80	0.40	0.60	0.60	0.80
D16	0.60	0.20	0.20	0.20	0.20	0.40	0.60	0.60	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.00	0.60	0.20	0.20	0.60
	1.00	0.60	0.60	0.60	0.60	0.80	1.00	1.00	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.00	1.00	0.60	0.60	1.00
D17	0.60	0.40	0.20	0.00	0.60	0.60	0.40	0.00	0.40	0.20	0.40	0.40	0.20	0.40	0.20	0.20	0.00	0.60	0.20	0.20
	1.00	0.80	0.60	0.40	1.00	1.00	0.80	0.40	0.80	0.60	0.80	0.80	0.60	0.80	0.60	0.60	0.00	1.00	0.60	0.60
D18	0.60	0.20	0.40	0.40	0.20	0.40	0.20	0.00	0.60	0.60	0.20	0.40	0.40	0.40	0.40	0.40	0.20	0.00	0.20	0.40
	1.00	0.60	0.80	0.80	0.60	0.80	0.60	0.40	1.00	1.00	0.60	0.80	0.80	0.80	0.80	0.80	0.60	0.00	0.60	0.80
D19	0.60	0.40	0.20	0.20	0.20	0.40	0.20	0.20	0.20	0.60	0.00	0.60	0.20	0.20	0.40	0.40	0.20	0.20	0.00	0.40
	1.00	0.80	0.60	0.60	0.60	0.80	0.60	0.60	0.60	1.00	0.40	1.00	0.60	0.60	0.80	0.80	0.60	0.60	0.00	0.80
D20	0.60	0.20	0.40	0.20	0.60	0.20	0.40	0.40	0.60	0.60	0.40	0.20	0.40	0.40	0.20	0.60	0.60	0.60	0.40	0.00
	1.00	0.60	0.80	0.60	1.00	0.60	0.80	0.80	1.00	1.00	0.80	0.60	0.80	0.80	0.60	1.00	1.00	1.00	0.80	0.00

Table B8: Grey relation matrix constructed with the assistance of Expert 20

E20	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20
D1	0.00	0.60	0.60	0.20	0.60	0.20	0.20	0.40	0.20	0.40	0.60	0.20	0.20	0.20	0.40	0.20	0.40	0.60	0.20	0.40
	0.00	1.00	1.00	0.60	1.00	0.60	0.60	0.80	0.60	0.80	1.00	0.60	0.60	0.60	0.80	0.60	0.80	1.00	0.60	0.80
D2	0.40	0.00	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.40	0.00	0.20	0.20	0.20	0.20	0.00	0.40	0.00	0.40
	0.80	0.00	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.40	0.80	0.40	0.60	0.60	0.60	0.60	0.40	0.80	0.40	0.80
D3	0.40	0.60	0.00	0.20	0.40	0.60	0.20	0.40	0.60	0.20	0.60	0.40	0.40	0.00	0.20	0.20	0.40	0.40	0.60	0.60
	0.80	1.00	0.00	0.60	0.80	1.00	0.60	0.80	1.00	0.60	1.00	0.80	0.80	0.40	0.60	0.60	0.80	0.80	1.00	1.00
D4	0.20	0.60	0.20	0.00	0.40	0.40	0.40	0.40	0.20	0.40	0.40	0.20	0.20	0.60	0.20	0.20	0.20	0.20	0.40	0.60
	0.60	1.00	0.60	0.00	0.80	0.80	0.80	0.80	0.60	0.80	0.80	0.60	0.60	1.00	0.60	0.60	0.60	0.60	0.80	1.00
D5	0.20	0.40	0.20	0.40	0.00	0.20	0.20	0.20	0.40	0.20	0.00	0.20	0.40	0.40	0.20	0.60	0.60	0.20	0.40	0.60
	0.60	0.80	0.60	0.80	0.00	0.60	0.60	0.60	0.80	0.60	0.40	0.60	0.80	0.80	0.60	1.00	1.00	0.60	0.80	1.00
D6	0.40	0.40	0.40	0.60	0.60	0.00	0.60	0.40	0.00	0.20	0.40	0.40	0.00	0.20	0.40	0.40	0.20	0.60	0.60	0.60
	0.80	0.80	0.80	1.00	1.00	0.00	1.00	0.80	0.40	0.60	0.80	0.80	0.40	0.60	0.80	0.80	0.60	1.00	1.00	1.00
D7	0.20	0.40	0.60	0.20	0.20	0.20	0.00	0.20	0.60	0.20	0.20	0.40	0.20	0.20	0.00	0.40	0.20	0.00	0.40	0.20
	0.60	0.80	1.00	0.60	0.60	0.60	0.00	0.60	1.00	0.60	0.60	0.80	0.60	0.60	0.40	0.80	0.60	0.40	0.80	0.60
D8	0.00	0.00	0.20	0.20	0.00	0.20	0.20	0.00	0.40	0.20	0.40	0.20	0.20	0.20	0.20	0.40	0.20	0.20	0.00	0.40
	0.40	0.40	0.60	0.60	0.40	0.60	0.60	0.00	0.80	0.60	0.80	0.60	0.60	0.60	0.60	0.80	0.60	0.60	0.40	0.80
D9	0.20	0.00	0.60	0.20	0.00	0.40	0.40	0.40	0.00	0.40	0.40	0.00	0.20	0.60	0.20	0.20	0.20	0.00	0.20	0.20
	0.60	0.40	1.00	0.60	0.40	0.80	0.80	0.80	0.00	0.80	0.80	0.40	0.60	1.00	0.60	0.60	0.60	0.40	0.60	0.60
D10	0.20	0.40	0.20	0.40	0.20	0.20	0.20	0.20	0.40	0.00	0.20	0.20	0.40	0.20	0.20	0.40	0.20	0.00	0.20	0.40
	0.60	0.80	0.60	0.80	0.60	0.60	0.60	0.60	0.80	0.00	0.60	0.60	0.80	0.60	0.60	0.80	0.60	0.40	0.60	0.80
D11	0.20	0.40	0.20	0.40	0.20	0.40	0.20	0.20	0.40	0.20	0.00	0.20	0.20	0.40	0.40	0.20	0.20	0.60	0.60	0.40
	0.60	0.80	0.60	0.80	0.60	0.80	0.60	0.60	0.80	0.60	0.00	0.60	0.60	0.80	0.80	0.60	0.60	1.00	1.00	0.80
D12	0.20	0.60	0.40	0.20	0.00	0.40	0.20	0.00	0.40	0.20	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.20	0.60	0.20
	0.60	1.00	0.80	0.60	0.40	0.80	0.60	0.40	0.80	0.60	0.40	0.00	0.60	0.60	0.60	0.60	0.60	0.60	1.00	0.60
D13	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.40	0.60	0.20	0.20	0.40	0.00	0.60	0.00	0.20	0.40	0.60	0.60	0.00
	0.60	0.60	0.60	0.60	0.60	0.60	0.80	0.80	1.00	0.60	0.60	0.80	0.00	1.00	0.40	0.60	0.80	1.00	1.00	0.40
D14	0.20	0.60	0.20	0.60	0.40	0.60	0.60	0.20	0.40	0.60	0.40	0.60	0.20	0.00	0.20	0.40	0.20	0.20	0.20	0.40
	0.60	1.00	0.60	1.00	0.80	1.00	1.00	0.60	0.80	1.00	0.80	1.00	0.60	0.00	0.60	0.80	0.60	0.60	0.60	0.80
D15	0.40	0.20	0.20	0.20	0.20	0.00	0.20	0.20	0.40	0.40	0.20	0.20	0.20	0.20	0.00	0.40	0.20	0.40	0.20	0.40
	0.80	0.60	0.60	0.60	0.60	0.40	0.60	0.60	0.80	0.80	0.60	0.60	0.60	0.60	0.00	0.80	0.60	0.80	0.60	0.80
D16	0.60	0.20	0.40	0.60	0.20	0.00	0.60	0.20	0.00	0.20	0.40	0.20	0.40	0.20	0.40	0.00	0.40	0.20	0.60	0.60
	1.00	0.60	0.80	1.00	0.60	0.40	1.00	0.60	0.40	0.60	0.80	0.60	0.80	0.60	0.80	0.00	0.80	0.60	1.00	1.00
D17	0.40	0.60	0.40	0.60	0.20	0.60	0.20	0.20	0.40	0.60	0.20	0.40	0.20	0.20	0.20	0.20	0.00	0.00	0.40	0.40
	0.80	1.00	0.80	1.00	0.60	1.00	0.60	0.60	0.80	1.00	0.60	0.80	0.60	0.60	0.60	0.60	0.00	0.40	0.80	0.80
D18	0.60	0.20	0.40	0.20	0.00	0.60	0.60	0.20	0.40	0.20	0.40	0.60	0.60	0.20	0.40	0.00	0.20	0.00	0.20	0.40
	1.00	0.60	0.80	0.60	0.40	1.00	1.00	0.60	0.80	0.60	0.80	1.00	1.00	0.60	0.80	0.40	0.60	0.00	0.60	0.80

D19	0.60	0.20	0.40	0.40	0.20	0.40	0.20	0.40	0.40	0.20	0.60	0.40	0.20	0.20	0.20	0.40	0.40	0.60	0.00	0.40
	1.00	0.60	0.80	0.80	0.60	0.80	0.60	0.80	0.80	0.60	1.00	0.80	0.60	0.60	0.60	0.80	0.80	1.00	0.00	0.80
D20	0.20	0.40	0.20	0.40	0.60	0.40	0.40	0.20	0.60	0.40	0.60	0.20	0.60	0.20	0.60	0.40	0.20	0.20	0.60	0.00
	0.60	0.80	0.60	0.80	1.00	0.80	0.80	0.60	1.00	0.80	1.00	0.60	1.00	0.60	1.00	0.80	0.60	0.60	1.00	0.00

Table B9: Average relationship matrix for driving factors of hospital service management

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.000	0.500	0.400	0.267	0.300	0.267	0.333	0.467	0.400	0.200	0.367	0.300	0.267	0.300	0.400	0.467	0.333	0.467	0.267	0.433
	0.000	0.900	0.800	0.667	0.700	0.667	0.733	0.867	0.800	0.600	0.767	0.700	0.667	0.700	0.800	0.867	0.733	0.867	0.667	0.833
D2	0.267	0.000	0.300	0.267	0.300	0.100	0.300	0.267	0.233	0.200	0.100	0.167	0.233	0.200	0.200	0.167	0.200	0.200	0.267	0.267
	0.667	0.000	0.700	0.667	0.700	0.500	0.700	0.667	0.633	0.600	0.500	0.567	0.633	0.600	0.600	0.567	0.600	0.600	0.667	0.667
D3	0.267	0.367	0.000	0.267	0.233	0.333	0.200	0.333	0.300	0.133	0.300	0.300	0.267	0.300	0.267	0.367	0.367	0.200	0.300	0.400
	0.667	0.767	0.000	0.667	0.633	0.733	0.600	0.733	0.700	0.533	0.700	0.700	0.667	0.700	0.667	0.767	0.767	0.600	0.700	0.800
D4	0.333	0.367	0.233	0.000	0.333	0.267	0.233	0.400	0.333	0.267	0.400	0.367	0.333	0.400	0.333	0.233	0.233	0.267	0.467	0.367
	0.733	0.767	0.633	0.000	0.733	0.667	0.633	0.800	0.733	0.667	0.800	0.767	0.733	0.800	0.733	0.633	0.633	0.667	0.867	0.767
D5	0.367	0.233	0.333	0.200	0.000	0.400	0.133	0.300	0.233	0.267	0.200	0.300	0.333	0.233	0.433	0.433	0.300	0.300	0.433	0.367
	0.767	0.633	0.733	0.600	0.000	0.800	0.533	0.700	0.633	0.667	0.600	0.700	0.733	0.633	0.833	0.833	0.700	0.700	0.833	0.767
D6	0.367	0.400	0.367	0.333	0.400	0.000	0.500	0.367	0.067	0.267	0.333	0.267	0.200	0.367	0.433	0.267	0.333	0.400	0.367	0.400
	0.767	0.800	0.767	0.733	0.800	0.000	0.900	0.767	0.467	0.667	0.733	0.667	0.600	0.767	0.833	0.667	0.733	0.800	0.767	0.800
D7	0.333	0.333	0.367	0.300	0.233	0.167	0.000	0.200	0.367	0.200	0.267	0.267	0.200	0.267	0.267	0.267	0.267	0.233	0.233	0.200
	0.733	0.733	0.767	0.700	0.633	0.567	0.000	0.600	0.767	0.600	0.667	0.667	0.600	0.667	0.667	0.667	0.667	0.633	0.633	0.600
D8	0.300	0.067	0.233	0.133	0.200	0.267	0.167	0.000	0.333	0.233	0.200	0.200	0.200	0.300	0.233	0.267	0.200	0.300	0.133	0.333
	0.700	0.467	0.633	0.533	0.600	0.667	0.567	0.000	0.733	0.633	0.600	0.600	0.600	0.700	0.633	0.667	0.600	0.700	0.533	0.733
D9	0.167	0.133	0.433	0.467	0.167	0.167	0.133	0.367	0.000	0.300	0.167	0.100	0.267	0.300	0.133	0.167	0.033	0.233	0.167	0.333
	0.567	0.533	0.833	0.867	0.567	0.567	0.533	0.767	0.000	0.700	0.567	0.500	0.667	0.700	0.533	0.567	0.433	0.633	0.567	0.733
D10	0.433	0.267	0.267	0.267	0.200	0.200	0.200	0.167	0.200	0.000	0.267	0.200	0.267	0.200	0.200	0.233	0.100	0.100	0.267	0.300
	0.800	0.633	0.667	0.667	0.600	0.600	0.600	0.567	0.600	0.000	0.667	0.600	0.667	0.600	0.600	0.633	0.500	0.500	0.667	0.700
D11	0.367	0.367	0.233	0.367	0.333	0.233	0.367	0.233	0.400	0.167	0.000	0.267	0.233	0.300	0.333	0.267	0.333	0.533	0.500	0.333
	0.767	0.767	0.633	0.767	0.733	0.633	0.767	0.633	0.800	0.567	0.000	0.667	0.633	0.700	0.733	0.667	0.733	0.933	0.900	0.733
D12	0.333	0.400	0.367	0.233	0.333	0.267	0.300	0.167	0.433	0.167	0.233	0.000	0.200	0.233	0.267	0.467	0.333	0.233	0.367	0.333
	0.733	0.800	0.767	0.633	0.733	0.667	0.700	0.567	0.833	0.567	0.633	0.000	0.600	0.633	0.667	0.867	0.733	0.633	0.767	0.733
D13	0.233	0.267	0.233	0.333	0.333	0.233	0.300	0.167	0.300	0.133	0.200	0.400	0.000	0.533	0.333	0.267	0.400	0.300	0.500	0.267
	0.633	0.667	0.633	0.733	0.733	0.633	0.700	0.567	0.700	0.533	0.600	0.800	0.000	0.933	0.733	0.667	0.800	0.700	0.900	0.667
D14	0.267	0.300	0.300	0.367	0.233	0.400	0.333	0.133	0.367	0.300	0.300	0.333	0.233	0.000	0.200	0.300	0.200	0.233	0.267	0.300
	0.667	0.700	0.700	0.767	0.633	0.800	0.733	0.533	0.767	0.700	0.700	0.733	0.633	0.000	0.600	0.700	0.600	0.633	0.667	0.700
D15	0.200	0.267	0.233	0.267	0.333	0.133	0.300	0.200	0.300	0.367	0.200	0.200	0.200	0.267	0.000	0.333	0.167	0.200	0.133	0.300
	0.600	0.667	0.633	0.667	0.733	0.533	0.700	0.600	0.700	0.767	0.600	0.600	0.600	0.667	0.000	0.733	0.567	0.600	0.533	0.700

D16	0.433	0.233	0.267	0.267	0.300	0.367	0.367	0.233	0.067	0.167	0.233	0.167	0.200	0.200	0.333	0.000	0.367	0.267	0.333	0.467
	0.833	0.633	0.667	0.667	0.700	0.767	0.767	0.633	0.467	0.567	0.633	0.567	0.600	0.600	0.733	0.000	0.767	0.667	0.733	0.867
D17	0.333	0.533	0.200	0.400	0.333	0.433	0.267	0.233	0.333	0.200	0.300	0.333	0.200	0.200	0.200	0.200	0.000	0.200	0.200	0.167
	0.733	0.933	0.600	0.800	0.733	0.833	0.667	0.633	0.733	0.600	0.700	0.733	0.600	0.600	0.600	0.600	0.000	0.600	0.600	0.567
D18	0.567	0.233	0.433	0.300	0.300	0.500	0.333	0.200	0.500	0.400	0.333	0.367	0.400	0.333	0.400	0.167	0.233	0.000	0.300	0.367
	0.967	0.633	0.833	0.700	0.700	0.900	0.733	0.600	0.900	0.800	0.733	0.767	0.800	0.733	0.800	0.567	0.633	0.000	0.700	0.767
D19	0.400	0.267	0.267	0.200	0.233	0.333	0.200	0.200	0.300	0.167	0.367	0.300	0.233	0.233	0.233	0.400	0.267	0.333	0.000	0.300
	0.800	0.667	0.667	0.600	0.633	0.733	0.600	0.600	0.700	0.567	0.767	0.700	0.633	0.633	0.633	0.800	0.667	0.733	0.000	0.700
D20	0.433	0.400	0.433	0.267	0.400	0.367	0.333	0.267	0.300	0.267	0.333	0.367	0.333	0.267	0.433	0.333	0.333	0.400	0.367	0.000
	0.833	0.800	0.833	0.667	0.800	0.767	0.733	0.667	0.700	0.667	0.733	0.767	0.733	0.667	0.833	0.733	0.733	0.800	0.767	0.000

Table B10: Crisp relationship matrix for driving factors of hospital service management

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.000	0.770	0.659	0.477	0.533	0.472	0.559	0.740	0.646	0.400	0.622	0.533	0.489	0.510	0.659	0.740	0.578	0.727	0.472	0.696
D2	0.518	0.000	0.589	0.535	0.596	0.281	0.577	0.535	0.481	0.450	0.296	0.400	0.500	0.427	0.444	0.388	0.450	0.427	0.530	0.535
D3	0.462	0.597	0.000	0.477	0.444	0.559	0.385	0.565	0.515	0.311	0.533	0.533	0.489	0.510	0.483	0.609	0.622	0.380	0.515	0.653
D4	0.548	0.597	0.439	0.000	0.578	0.472	0.428	0.653	0.559	0.489	0.667	0.622	0.578	0.640	0.571	0.433	0.444	0.467	0.733	0.609
D5	0.591	0.423	0.571	0.389	0.000	0.646	0.297	0.521	0.428	0.489	0.400	0.533	0.578	0.423	0.704	0.696	0.533	0.510	0.690	0.609
D6	0.591	0.640	0.615	0.565	0.667	0.000	0.777	0.609	0.210	0.489	0.578	0.489	0.400	0.597	0.704	0.477	0.578	0.640	0.603	0.653
D7	0.548	0.553	0.615	0.521	0.444	0.341	0.000	0.389	0.603	0.400	0.489	0.489	0.400	0.467	0.483	0.477	0.489	0.423	0.428	0.389
D8	0.505	0.207	0.439	0.302	0.400	0.472	0.341	0.000	0.559	0.444	0.400	0.400	0.400	0.510	0.439	0.477	0.400	0.510	0.297	0.565
D9	0.333	0.293	0.704	0.740	0.356	0.341	0.297	0.609	0.000	0.533	0.356	0.267	0.489	0.510	0.306	0.346	0.178	0.423	0.341	0.565
D10	0.653	0.445	0.483	0.477	0.400	0.385	0.385	0.346	0.385	0.000	0.489	0.400	0.489	0.380	0.395	0.433	0.267	0.250	0.472	0.521
D11	0.591	0.597	0.439	0.609	0.578	0.428	0.603	0.433	0.646	0.356	0.000	0.489	0.444	0.510	0.571	0.477	0.578	0.813	0.777	0.565
D12	0.548	0.640	0.615	0.433	0.578	0.472	0.515	0.346	0.690	0.356	0.444	0.000	0.400	0.423	0.483	0.740	0.578	0.423	0.603	0.565
D13	0.419	0.467	0.439	0.565	0.578	0.428	0.515	0.346	0.515	0.311	0.400	0.667	0.000	0.813	0.571	0.477	0.667	0.510	0.777	0.477
D14	0.462	0.510	0.527	0.609	0.444	0.646	0.559	0.302	0.603	0.533	0.533	0.578	0.444	0.000	0.395	0.521	0.400	0.423	0.472	0.521
D15	0.376	0.467	0.439	0.477	0.578	0.297	0.515	0.389	0.515	0.622	0.400	0.400	0.400	0.467	0.000	0.565	0.356	0.380	0.297	0.521
D16	0.677	0.423	0.483	0.477	0.533	0.603	0.603	0.433	0.210	0.356	0.444	0.356	0.400	0.380	0.571	0.000	0.622	0.467	0.559	0.740
D17	0.548	0.813	0.395	0.653	0.578	0.690	0.472	0.433	0.559	0.400	0.533	0.578	0.400	0.380	0.395	0.389	0.000	0.380	0.385	0.346
D18	0.850	0.423	0.704	0.521	0.533	0.777	0.559	0.389	0.777	0.667	0.578	0.622	0.667	0.553	0.659	0.346	0.444	0.000	0.515	0.609
D19	0.634	0.467	0.483	0.389	0.444	0.559	0.385	0.389	0.515	0.356	0.622	0.533	0.444	0.423	0.439	0.653	0.489	0.553	0.000	0.521
D20	0.677	0.640	0.704	0.477	0.667	0.603	0.559	0.477	0.515	0.489	0.578	0.622	0.578	0.467	0.704	0.565	0.578	0.640	0.603	0.000

Table B11: Normalized crisp relation matrix for driving factors of hospital service management

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.000	0.068	0.058	0.042	0.047	0.042	0.050	0.066	0.057	0.035	0.055	0.047	0.043	0.045	0.058	0.066	0.051	0.064	0.042	0.062

D2	0.046	0.000	0.052	0.047	0.053	0.025	0.051	0.047	0.043	0.040	0.026	0.035	0.044	0.038	0.039	0.034	0.040	0.038	0.047	0.047
D3	0.041	0.053	0.000	0.042	0.039	0.050	0.034	0.050	0.046	0.028	0.047	0.047	0.043	0.045	0.043	0.054	0.055	0.034	0.046	0.058
D4	0.049	0.053	0.039	0.000	0.051	0.042	0.038	0.058	0.050	0.043	0.059	0.055	0.051	0.057	0.051	0.038	0.039	0.041	0.065	0.054
D5	0.052	0.037	0.051	0.034	0.000	0.057	0.026	0.046	0.038	0.043	0.035	0.047	0.051	0.037	0.062	0.062	0.047	0.045	0.061	0.054
D6	0.052	0.057	0.055	0.050	0.059	0.000	0.069	0.054	0.019	0.043	0.051	0.043	0.035	0.053	0.062	0.042	0.051	0.057	0.053	0.058
D7	0.049	0.049	0.055	0.046	0.039	0.030	0.000	0.034	0.053	0.035	0.043	0.043	0.035	0.041	0.043	0.042	0.043	0.037	0.038	0.034
D8	0.045	0.018	0.039	0.027	0.035	0.042	0.030	0.000	0.050	0.039	0.035	0.035	0.035	0.045	0.039	0.042	0.035	0.045	0.026	0.050
D9	0.030	0.026	0.062	0.066	0.032	0.030	0.026	0.054	0.000	0.047	0.032	0.024	0.043	0.045	0.027	0.031	0.016	0.037	0.030	0.050
D10	0.058	0.039	0.043	0.042	0.035	0.034	0.034	0.031	0.034	0.000	0.043	0.035	0.043	0.034	0.035	0.038	0.024	0.022	0.042	0.046
D11	0.052	0.053	0.039	0.054	0.051	0.038	0.053	0.038	0.057	0.032	0.000	0.043	0.039	0.045	0.051	0.042	0.051	0.072	0.069	0.050
D12	0.049	0.057	0.055	0.038	0.051	0.042	0.046	0.031	0.061	0.032	0.039	0.000	0.035	0.037	0.043	0.066	0.051	0.037	0.053	0.050
D13	0.037	0.041	0.039	0.050	0.051	0.038	0.046	0.031	0.046	0.028	0.035	0.059	0.000	0.072	0.051	0.042	0.059	0.045	0.069	0.042
D14	0.041	0.045	0.047	0.054	0.039	0.057	0.050	0.027	0.053	0.047	0.047	0.051	0.039	0.000	0.035	0.046	0.035	0.037	0.042	0.046
D15	0.033	0.041	0.039	0.042	0.051	0.026	0.046	0.034	0.046	0.055	0.035	0.035	0.035	0.041	0.000	0.050	0.032	0.034	0.026	0.046
D16	0.060	0.037	0.043	0.042	0.047	0.053	0.053	0.038	0.019	0.032	0.039	0.032	0.035	0.034	0.051	0.000	0.055	0.041	0.050	0.066
D17	0.049	0.072	0.035	0.058	0.051	0.061	0.042	0.038	0.050	0.035	0.047	0.051	0.035	0.034	0.035	0.034	0.000	0.034	0.034	0.031
D18	0.075	0.037	0.062	0.046	0.047	0.069	0.050	0.034	0.069	0.059	0.051	0.055	0.059	0.049	0.058	0.031	0.039	0.000	0.046	0.054
D19	0.056	0.041	0.043	0.034	0.039	0.050	0.034	0.034	0.046	0.032	0.055	0.047	0.039	0.037	0.039	0.058	0.043	0.049	0.000	0.046
D20	0.060	0.057	0.062	0.042	0.059	0.053	0.050	0.042	0.046	0.043	0.051	0.055	0.051	0.041	0.062	0.050	0.051	0.057	0.053	0.000

Table B12: Total relationship matrix for driving factors of hospital service management

	D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**	**D16**	**D17**	**D18**	**D19**	**D20**
D1	0.324	**0.372**	**0.375**	**0.339**	**0.352**	0.333	**0.336**	**0.339**	**0.361**	0.297	**0.342**	**0.339**	0.320	0.333	**0.364**	**0.365**	**0.336**	**0.351**	**0.350**	**0.387**
D2	0.303	0.247	0.306	0.284	0.295	0.259	0.279	0.268	0.286	0.248	0.258	0.270	0.266	0.269	0.285	0.277	0.268	0.268	0.293	0.308
D3	0.318	0.317	0.276	0.299	0.303	0.300	0.282	0.287	0.307	0.253	0.295	0.299	0.282	0.293	0.307	0.314	0.300	0.283	0.311	**0.338**
D4	**0.349**	**0.339**	**0.337**	0.280	**0.336**	0.314	0.307	0.314	0.334	0.287	0.327	0.328	0.310	0.325	**0.337**	0.322	0.307	0.312	**0.352**	**0.359**
D5	**0.340**	0.313	**0.335**	0.301	0.276	0.318	0.285	0.293	0.310	0.277	0.294	0.309	0.299	0.296	**0.336**	0.332	0.303	0.304	**0.336**	**0.347**
D6	**0.365**	**0.354**	**0.362**	**0.337**	**0.354**	0.285	**0.345**	0.320	0.317	0.296	0.331	0.327	0.305	0.331	**0.359**	**0.336**	0.328	**0.336**	**0.352**	**0.374**
D7	0.305	0.294	0.307	0.284	0.283	0.264	0.231	0.256	0.296	0.244	0.273	0.276	0.257	0.271	0.287	0.284	0.271	0.268	0.285	0.296
D8	0.279	0.243	0.271	0.244	0.258	0.254	0.240	0.202	0.270	0.229	0.246	0.248	0.237	0.254	0.263	0.262	0.243	0.255	0.252	0.287
D9	0.262	0.247	0.289	0.277	0.251	0.240	0.233	0.252	0.220	0.234	0.240	0.235	0.243	0.253	0.249	0.248	0.222	0.245	0.253	0.285
D10	0.291	0.263	0.274	0.258	0.258	0.246	0.244	0.233	0.256	0.191	0.253	0.249	0.245	0.244	0.259	0.259	0.233	0.234	0.267	0.284
D11	**0.354**	**0.340**	**0.338**	0.332	**0.337**	0.312	0.322	0.298	**0.343**	0.278	0.272	0.318	0.300	0.315	**0.338**	0.326	0.318	**0.340**	**0.356**	**0.356**
D12	0.331	0.325	0.333	0.300	0.318	0.298	0.297	0.274	0.326	0.261	0.292	0.258	0.279	0.290	0.312	0.329	0.301	0.291	0.323	**0.337**

D13	0.323	0.314	0.321	0.313	0.321	0.297	0.300	0.275	0.316	0.260	0.292	0.317	0.247	0.325	0.322	0.311	0.311	0.300	**0.340**	0.332
D14	0.315	0.306	0.317	0.306	0.299	0.303	0.293	0.263	0.311	0.268	0.292	0.299	0.275	0.246	0.296	0.303	0.278	0.283	0.305	0.324
D15	0.277	0.272	0.279	0.266	0.280	0.247	0.261	0.243	0.275	0.251	0.253	0.256	0.245	0.258	0.233	0.277	0.247	0.251	0.260	0.293
D16	0.331	0.298	0.311	0.293	0.305	0.299	0.295	0.272	0.277	0.252	0.284	0.280	0.270	0.277	0.310	0.258	0.296	0.286	0.309	**0.339**
D17	0.317	0.326	0.301	0.305	0.306	0.302	0.282	0.270	0.303	0.254	0.287	0.294	0.267	0.275	0.292	0.287	0.240	0.276	0.293	0.305
D18	**0.393**	**0.345**	**0.378**	**0.343**	**0.351**	**0.357**	**0.335**	0.311	**0.371**	0.318	**0.338**	**0.346**	**0.334**	**0.337**	**0.364**	0.334	0.324	0.290	**0.353**	**0.380**
D19	0.325	0.299	0.309	0.284	0.296	0.293	0.276	0.266	0.300	0.251	0.296	0.292	0.272	0.279	0.297	0.310	0.283	0.291	0.261	0.320
D20	**0.378**	**0.360**	**0.376**	**0.337**	**0.361**	**0.342**	0.334	0.316	**0.348**	0.302	**0.336**	**0.344**	0.326	0.327	**0.366**	**0.350**	0.334	**0.342**	**0.359**	0.326