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RESEARCH ARTICLE

Sustainable construction through energy management practices: an integrated hierarchal framework of drivers in the construction sector

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Abstract
Reducing energy usage and promoting energy management practices remain hot issues in the construction sector. Construction firms are not interested to adopt energy conservation and management practices in their projects. Despite the successful integration of energy management practices in developed nations, their adaptability in developing countries, especially in Pakistan, is at a slow pace. Therefore, drivers to energy management practices need to be realized for its adoption. Based on this, the current study intends to evaluate the drivers of energy management practices adopted in the construction sector of Pakistan by using a four-stage methodology. Fuzzy Delphi method (FDM), interpretive structural modeling (ISM), and Matrice d'Impacts Croises Multiplication Appliques a un Classement (MICMAC) analysis were integrated with prioritizing essential drivers. Increased tax imposition on construction companies for energy usage and pollution contribution, promotion of investment subsidies for energy efficiency technologies, and increased enforcement of government rules and regulations regarding on-site energy management practices arose as significant drivers to adoption of energy management practices in the construction sector of Pakistan. These results will be helpful for policymakers to develop effective policies for integrating energy management practices in the construction sector. This study contributes significantly by developing a novel model of drivers affecting EMP adoption in the Pakistani construction sector. Further research might be expanded to other developing countries to validate current results.

Keywords Drivers · Energy management · Construction sector · Developing country · Sustainability · Interpretive structural modeling

Nomenclature

EMPs	Energy management practices
FDM	Fuzzy Delphi method
ISM	Interpretive structural modeling
MICMAC	Matrice d'Impacts Croises Multiplication Appliques a un Classement
GHG	Greenhouse gases
DFs	Driving forces
NEECA	National Energy Efficiency and Conservation Authority
PEECA	Punjab Energy Efficiency and Conservation Authority
PEC	Pakistan Engineering Council

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UNIDO	United Nations Industrial Development Organization
EEC	Energy efficiency and capacity
ESLS	Energy standards and labeling scheme
NPO	National Productivity Organization
EEMP	Energy Efficiency Management Project
JICA	Japan International Cooperation Agency
ECBC	Energy Conservation Building Codes
MCDM	Multi-criteria decision-making
IRM	Initial reachability matrix
FRM	Final reachability matrix

Introduction

Globally, the construction sector has an adverse impact on the natural environment, such as the operation of developing and transferring construction materials from one place to another place; constructing either commercial or domestic buildings consumes a large amount of energy and generates plenty of carbon dioxide (Wang et al. 2020). González-Torres et al. (2022) quoted that according to a report by United Nations, the construction sector consumes 40% of the energy and emits 9% of carbon dioxide globally. However, energy consumption and GHG emission level vary in various countries such as European countries that are responsible for 42% of energy wastage and produce 35% of carbon dioxide (Alqaralleh 2021; Radmehr et al. 2021). The USA is responsible for 50% of energy wastage and 36% of carbon emission (Salari et al. 2021). Furthermore, it has been estimated that GHG emission would rise to 21% by 2020 due to increase in building energy consumption (Iqbal et al. 2021b). Many researchers have discussed energy conservation practices and reduction strategies for carbon emission during the building lifecycle (Li et al. 2020). Worldwide, to eradicate environmental issues and energy conservation in building projects, the adoption of energy management activities has become a significant factor for construction industries (Himeur et al. 2021). The construction sector plays an imperative role in economic growth and helps reduce the unemployement gap (Qarnain et al. 2021; Xia et al. 2018). In 2016, the construction sector's output was 8800 billion US dollars compared to the 7900 billion US dollar in 2012 (Zhang et al. 2018). According to the Perspectives and Economics (2015) survey, it has been predicted that the international construction sector will grow up to 85% with an increasing contribution of 17500 billion US dollars till 2030, accounting for 14.7% of the gross global product. This significant growth in the construction sector will enhance economic growth and generate revenue for investors and many opportunities for jobs. Furthermore, this sector also promotes sustainability, living standard, safety, inhabitant's health, and contribution to national economic growth (Jacobs and Forst 2017).

For the last three decades, nations have been worried about the eco-environment energy supply due to an increase in the demand for energy consumption and fuel prices worldwide (Iqbal et al. 2021a; b). Reducing carbon emissions and minimizing energy use in all industries have become a major concern, and consuming a large amount of energy leads to the depletion of natural resources (Abbasi et al. 2021b; Ma et al. 2021). Energy has a vital role because developing countries face a shortage of energy resources, rapid urbanization, and an uncertain political environment (Ma and Xu 2022; Rafique and Rehman 2017). To reduce the adverse impact on the environment and energy consumption, it is essential to implement energy management practices (EMPs) in the country (Huo et al. 2020).

EMPs' adoption and development are not free of obstacles and challenges. Barriers such as initial high cost, deficiency of knowledge, and unawareness affect EMP adoption in the construction sector (Iqbal et al. 2021b; c). In light of these barriers, several forces drive and shape the adoption of EMPs among construction practitioners and stakeholders in different countries and regions. These driving forces (DFs) can be defined as: "Benefits that encourage and promote the implementation of cost-effective energy conservation investment in construction projects" (Thollander and Ottosson 2008). DFs towards the adoption of EMPs in construction projects are classified into different levels such as market-related DFs, potential energy policies, behavioral and organizational-related DFs, and policy instruments affecting the energy-intensive industry (Thollander and Ottosson 2008; Zhan 2021). Davies (2015) identified DFs of EMPs in the context of the UK's international construction projects from the developer's point of view. Darko et al. (2017a) proposed a framework of drivers promoting green and energy-saving technology adoption in Ghana. Song et al. (2016) found five developed countries attained expected benefits by adopting energy conservation models. Qi et al. (2010a) designed a five-force model of green construction in construction projects.

Despite several studies on DFs for EMP adoption, such studies from the perspective of developing countries are hardly discussed in the literature (Bond and Perrett 2012; Wu et al. 2021). Jiang et al. (2013) explored that very little research has been conducted to discover the DFs of EMP adoption in developing nations. Therefore, this study aims to identify major drivers of EMPs in developing countries, especially taking the case of the Pakistani construction industry. To identify significant drivers, the FDM approach was initially adopted because this methodology assists in mitigating the ambiguities and risks related to data collection and expert opinion. Furthermore, interpretive structural modeling (ISM) and Matrice d'Impacts Croises Multiplication Appliques a un Classement (MICMAC) were used for modeling and classifying major drivers. ISM provides a hierarchal structure of drivers. The MICMAC approach is adopted to classify the different drivers based on hidden and direct relationships.

Based on this, the current study has novelty in different aspects:

- Previously, many studies have been conducted literature-based and ignored the evaluation of EMPs using a sound methodology.
- Some researchers identified few drivers regarding the adoption of sustainable construction through EMPs, but this novel study identified different drivers in detail that could help to increase the adoption of EMPs in the construction industry.
- In developed countries, different significant DFs have been explored, but in the scenario of developing countries, especially Pakistan, this is the first study that examined major drivers of EMPs in the construction sector. Furthermore, this study could encourage other developing countries' construction sectors to implement EMPs while constructing commercial and non-commercial buildings.
- This study utilized the ISM-MICAMC approach to develop the interrelationship of different drivers and a hierarchical framework, advocating the construction sector to accomplish its goals without compromising the misuse of energy resources.

Implementation of EMPs will integrate sustainability in construction supply chains. However, it is not an easy task. Therefore, this study intends to deliver the following contributions:

- First of all, this study is a pioneer to discover the drivers of EMPs in the construction industry, which extends EMP literature and covers its knowledge from the perspective of developing nations.
- EMPs are at their infancy in the construction industry; therefore, this study contributes to enhancing the construction industry's ecological practices.
- Awareness and a better understanding of the impact of the EMPs in sustainable construction will also improve knowledge and experience of implementation issues of EMP construction.
- Propose policy and managerial implications to promote the EMP adoption in an appropriate way

The rest of the paper is organized as follows: the literature review is described in the second section, the research methodology is presented in the third section, the fourth section elaborates results and discussion, and the last section provides concluding remarks along with research implications, limitations, and future research directions.

Literature review

The purpose of green construction is to pay attention to energy conservation, protecting the natural environment and utilizing eco-friendly materials and innovative technologies to mitigate the adverse impact on the environment. Excessive use of energy resources leads to serious environmental problems such as GHG emissions, global warming, and climate change (Abbasi et al. 2021c). After the industrial revolution, the amount of carbon dioxide has increased in the air, which has raised the average temperature of the earth by 0.74% compared with the last century (Abbas et al. 2021d; Abbasi et al. 2022a; Abbasi et al. 2022b). The construction industry can reduce carbon dioxide compared to other industrial sectors (Abbasi, Hussain, et al., 2021; Kouyakhi and Shavvalpour 2021). Minimizing energy use by adopting EMPs is a strategic tool for construction companies to reduce carbon emissions. Advanced and innovative technologies are considered competitive tools to promote sustainable construction practices (Industrial Development Report 2011). Abbasi et al. (2021a) identified that sustainable energy could play a vital role to enhance long-term economic goals in the industrial sector. Implementation of EMPs in construction projects has many benefits, such as conservation of natural resources by minimizing environmental pollution, inhabitants' health, cost-saving, etc. (Akinbami and Lawal 2009). The comparison of the construction sector with other industrial sectors showed that the construction sector faced a lot of pressure and criticism to implement eco-friendly techniques and practices because of the hazardous environment (Gao et al. 2021; Iqbal et al. 2021a). Enshassi and Mayer (2005) suggested that customers establish strict environmental demands to exert pressure regarding EMP adoption in construction projects.

Matosović and Tomšić (2018) illustrated that financial support from the government and other stakeholders regarding the adoption of energy-efficient instruments in construction projects could help conserve energy in residential and commercial buildings. Trotta (2020) identified that proper awareness and information about energy efficiency help attract owners to adopt EMPs during the construction of buildings. The Indian government started financial incentives and rewards for the construction sector to promote energy conservation in residential buildings (Shukla and Zia 2016). Eshraghi and Maleki (2016) classified that adopting sustainable practices in the industry, especially in the construction sector, requires a supportive mechanism from concerned authorities. A sustainable environment could be enhanced through the EMP adoption in the buildings. Neofytou et al. (2020) defined that energy conservation planning for future construction projects leads to saving the project's cost. Energy conservation in industries help to mitigate the carbon footprints in the environment (Darko et al. 2018; Abbasi et al. 2021d).

Wong and Zhou (2015) investigated that many advantages could be attained by implementing EMPs in the industrial sector, such as fulfilling customer requirements, organization goodwill, and competitive benefit. Darko et al. (2017a) proposed a framework of green and energy-saving technology adoption in Ghana, composed of five main drivers, including environmental, company, and construction industry-related, cost- and energy-related, and financial and health safety–related drivers. Successful completion of green projects efficiently can minimize project cost, quality, and energy conservation (Iqbal et al. 2021b; Abbasi et al. 2020). A higher level of devotion leads to superior and beneficial improvements in the construction industry (Wilkinson et al. 2021). Gholipour et al. (2022) investigated that major motivating factors for energy conservation are minimizing the expense, keeping the environment clean, fulfilling the customer's requirement, and having committed workers. Wilkinson et al. (2021) also found certain advantages of green construction such as cost conservation through better energy management and operational strategies, enhancing the investment, creating new market opportunities by introducing environment-friendly goods and services, market leadership, and increasing shareholders interactions. From the construction context, various researches have shown that corporate social responsibility in the construction sector can enhance the competitive benefits and company productivity (Iqbal et al. 2021b, c; Zhang et al. 2018). Li et al. (2019) suggested a way for accomplishing green construction; they found that awareness of construction technologies among stakeholders can gain many benefits. Furthermore, he divided driving forces of EMPs into four categories, such as energy-based driving forces and social, legislative, and developmental forces. Trianni et al. (2017) divided driving forces into various groups, e.g., laws, financial, knowledge, and technical training.

The cost is considered an important driver (Teng et al. 2019). Energy management in construction projects could mitigate the cost of energy bills, which is regarded as a financial advantage for stakeholders. Abbasi et al. (2021e) and Wilkinson et al. (2021) identified that energy efficiency and reduction of carbon emission are essential to accomplish economic improvement in the industry. According to Enshassi et al., (2018), contractors should adopt energy conservation measures in the building projects to minimize the energy consumption in urban territories, which also could be beneficial for contractors in terms of cost-saving. Different financial schemes such as subsidies, economic, and tax policies are also considered significant DFs to promote EMPs (Iqbal et al. 2021d; Enshassi et al. 2018).

Some previous studies on driving forces (Hong et al. 2017; Neri et al. 2018) found that human behavior and the promotion of investment subsidies for energy efficiency technologies are significant drivers to enhance sustainable energy adoption in construction projects. Abbasi and Adedoyin (2021) and Abbasi et al. (2021f) identified that the adoption of energy technologies helps minimize the use of carbon material and contributes to the national economy. Edwards (2006) highlighted that competitive advantage and lower maintenance costs are imperative drivers that could help organizations adopt EMP practices.

Therefore, based on the above literature, it can be said that different countries, especially Pakistan, are suffering from unstable political environment, economic, societal, and energy crisis issues. The adoption of EMPs in Pakistan is in its infancy. Even EMPs are considered significant in Pakistan, but unfortunately, authorities are more concerned with energy production than energy conservation. In 1983, a bold step for the sake of energy conservation was taken by the government of Pakistan through a bailout package of USAID operated by Pakistan energy planning and development (EP&D). Moreover, in 1986, an institute known as the national energy conservation center (ENERCON) was introduced for energy-saving activities. The purpose of establishing this institute was energy conservation in commercial and non-commercial building projects. Later, this institute was merged into the national energy efficiency and conservation authority (NEECA) through the national energy efficiency and saving act 2016 (Malik et al. 2020). As a result, NEECA introduced a plan to utilize energy-efficient tools during building projects.

Furthermore, one province of Pakistan, known as Punjab, passed a resolution to raise the Punjab energy efficiency and conservation agency (PEECA). Therefore, the Pakistan engineering council (PEC) plays a vital role in coordinating with the ministry of housing and development and ENERCON to design specific codes and policies for EMPs in construction projects. Such types of codes can assist the construction industry in promoting sustainable, eco-friendly, energy-efficient, green, and zero-energy building projects in Pakistan (Iqbal et al. 2021b). A detailed description of various suitable policies is given in Table 1.

Research methodology

A four-stage methodology was introduced to identify the most important drivers to EMP adoption in the construction sector of Pakistan. Initially, this study collected literature on drivers of EMP adoption, which were used to obtain data from experts and filtered the most relevant drivers. The screened drivers were further used to develop an ISM-based model and MICMAC analysis. The overall study approach in a systematic way is shown in Fig. 1.

Table 1 National and international policies for EMPs

Policy instrument	Description
United Nations Industrial Development Organization (UNIDO)	The UNIDO plays a vital role in protecting the natural environment. The basic purpose of this organization is to improve the natural environment through the adoption of green energy and renewable energy sources, also promoting energy-efficient technologies in the industry like the construction sector to mitigate the carbon footprints
Energy Efficiency and Capacity (EEC)	USAID has funded this project for 3 years. The primary purpose of this project is to promote energy conservation and implementation of EMPs for the contribution to the national economy
GIZ Renewable Energy-Energy Efficiency (RE-EE) Project	This project has been designed to assist the government of Pakistan regarding the EMPs in the manufacturing and construction industries.
NEECA	The NEECA project was introduced in 1985 through the help of USAID. The primary purpose of this project is to design energy conservation policies for those industries which consume a large amount of energy and produce carbon. In Pakistan, the construction, manufacturing, and transport sectors are the main contributors to consume energy
Energy Standards & Labeling Scheme (ESLS)	GEF funds the (ESLS) project; this project aims to promote EMPs through energy-efficient equipment for the sake of energy saving and mitigation of carbon emission
National Productivity Organization (NPO)	ENERCON and NPO outsource an organization known as Building Energy Audit (BEA). The purpose of this project is to conduct an audit of government commercial and non-commercial buildings regarding the adoption of energy-saving activities.
Energy Efficiency Management Project (EEMP)	This project was introduced to design plans for implementing EMPs in different industries such as the construction sector and manufacturing sector, with coordination of the Japan International Cooperation Agency (JICA).
Japan International Cooperation Agency (JICA)	JICA's primary purpose is to enhance the energy-efficient technologies and EMPs in Pakistan with the help of ENERCON.
Energy Conservation Building Codes (ECBC)	NEECA and the government of Pakistan introduced an act in 2015 for energy conservation and established codes for energy-efficient buildings. This initiative was taken under the Energy Conservation Act 2015, section 13.

Exploring drivers from earlier literature

The purpose of the study was the adoption of EMP drivers in construction projects in Pakistan. For this purpose, 80 research articles were initially reviewed from 40 journals related to energy management, sustainability, green construction, renewable energy in construction projects, sustainable construction, sustainable environment, and energy conservation in building projects. These papers were retrieved from widely used databases including Scopus, Google Scholar, Springer, Science direct, research gate, Taylor and Francis. The keywords which were used to search in databases include "energy" or "energy management practices" or "driving forces and energy management practices" or "drivers and energy management practices" or "drivers and green construction" or "sustainable construction and drivers."

Based on the literature collection, papers were initially filtered on the title and abstract. Later, articles were thoroughly analyzed to be retained for the current study. Fifty-three papers and twenty-eight journals were filtered by removing irrelevant and repetitive studies. Moreover, these remaining papers and journals were considered valid for further study. These 53 papers can provide a better understanding to explain the drivers supporting EMPs in construction projects. Some of the popular journals that were considered for this study are Journal of Cleaner Production (9 papers), Journal of Renewable and Sustainable Energy Review (6 papers), Journal of Energy Policy (4 papers), Journal of Building and Environment (3 papers), Journal of Habitat International (3 papers), Energy (2 papers), Journal of Engineering, Construction, and Architectural Management (2 papers), Sustainability (1 paper), and International Journal of Construction Management (1 paper). Articles that were reviewed in the literature were from 2004 to 2022.

The comprehensive literature review listed 21 drivers of EMPs adoption in different contexts, as shown in Table A1 (Supplementary data). After exploring primary drivers from the literature review, the next step is to identify the most relevant drivers. For this purpose, FDM was introduced, which has been discussed in the next section.

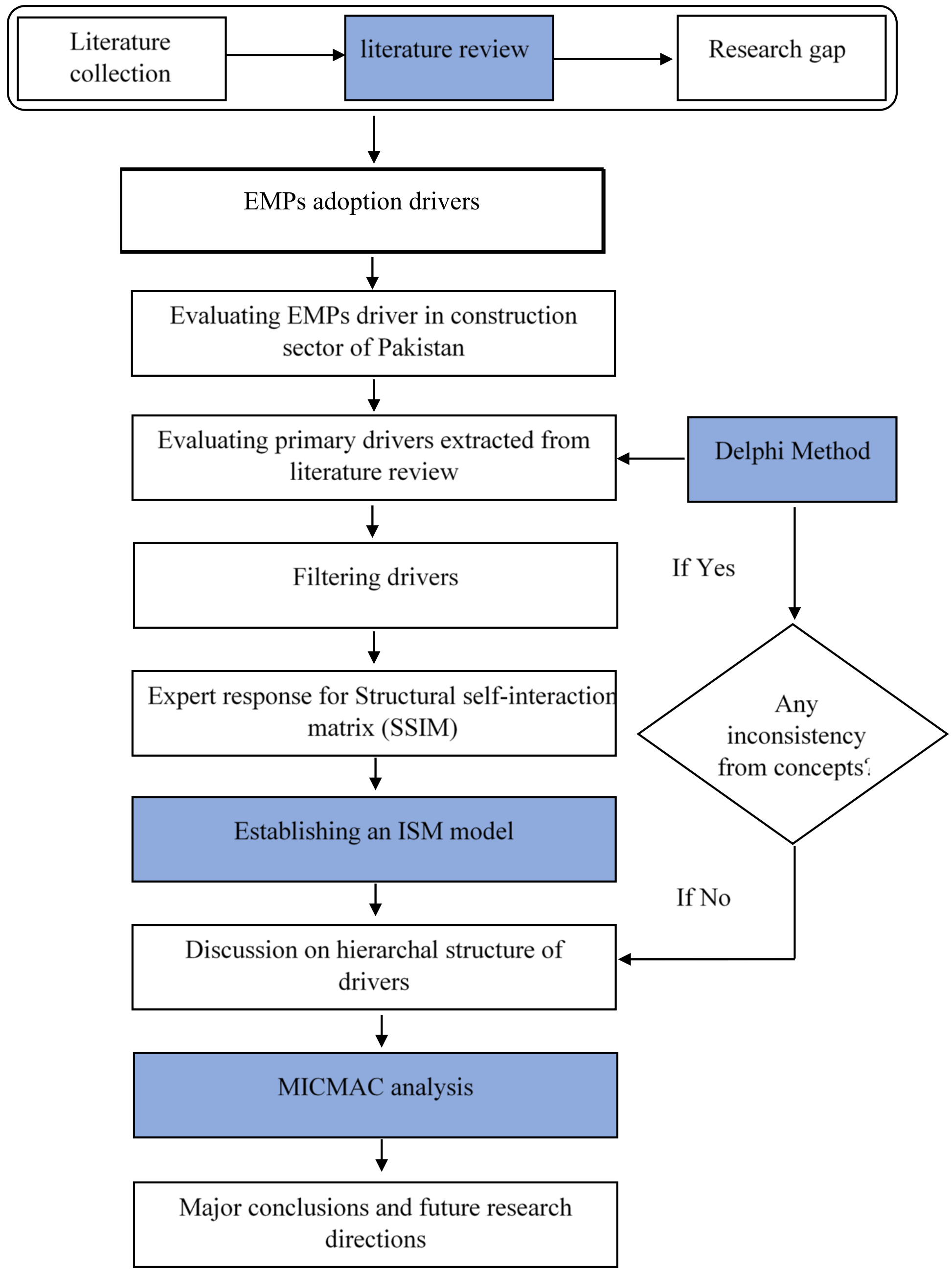


Fig. 1 A step-by-step approach to identify drivers for EMPs adoption

Filtering drivers through the fuzzy Delphi method

The Delphi method was introduced in 1950 during a project funded by the US Air Force. Initially, this method was designed for workers, engaged with RAND Corporation (Rowe and Wright 1999). The Delphi method has been adopted in various areas of research. Experts' opinion is significant in the Delphi method, but there are some limitations in the Delphi method, such as it takes a long time, which causes the decision-making process to slow (Bui et al. 2020). Chances of little convergence exist in the Delphi method, execution cost is high, and the Delphi method requires comments from experts that participate in the discussion, so there is also a possibility of different opinions in a live discussion (Bui et al. 2020).

The FDM was adopted in this study to screen out the significant and most suitable drivers regarding the adoption of EMPs in the construction industry of Pakistan because FDM is a reliable approach for the selection criteria; also, expert's judgment is considered in this technique (Iqbal et al. 2021e).

According to Hussain et al. (2021), Fuzzy theory is helpful to reduce the ambiguity of the Delphi method, and Delphi was combined with fuzzy, which is known as the fuzzy Delphi method (FDM). Iqbal et al. (2022a) defined that the merit of this approach is that in FDM, the data is collected from the experts in the relevant field and does not focus on statistical sampling to represent the population. Usmani et al. (2022) stated that FDM is the best-known technique to analyze, arrange, and structure inputs from the experts. This allows experts to adjust their responses and reduce the number of variables influencing and obtaining the most relevant variables (Iqbal et al. 2021a; c). Hussain et al., (2019) identified that this approach assists to get a consensus among respondents

The application of FDM for drivers supporting EMPs in the construction sector of Pakistan is given below:

Designing and piloting the questionnaire

The study's questionnaire was developed based on those drivers collected from the literature review. Later, a list of drivers was prepared and sent to two academicians for content validity. Later, these academicians were also part of the experts' panel for further study. They checked inconsistency and irregularity in the questionnaire. After their approval, the questionnaire was ready to distribute among experts.

Questionnaire distribution

The questionnaires were distributed between experts from the construction sector, the energy sector, and professors from universities in Pakistan. In this process, 3.5 mean scores were selected as a threshold; Choi and Sirakaya (2006) also adopted these criteria in their study. The driver that value was 32 and above was accepted otherwise rejected (as shown in Fig. 2). Two drivers got fewer scores than the threshold criteria through this process, so such drivers were eliminated for further study. In this process, the expert's recommendations regarding modification, elimination, and addition of drivers were also considered. The first-round outcome is presented in Table A2 (Supplementary data). Furthermore, during the collection of data, there were chances of biasness, so to eliminate this factor, this process was done to certify the validity of data through the adoption of a five-point Likert scale (Luthra and Mangla 2018).

Managing expert's opinions and developing the triangular fuzzy numbers (TFNs)

In this paper, calculation method of TFNs is followed by the research paper of Hsu and Yang (2000). TFNs were utilized to count experts' opinions' maximum and minimum values. To avoid ambiguity, geometric means were used to draw

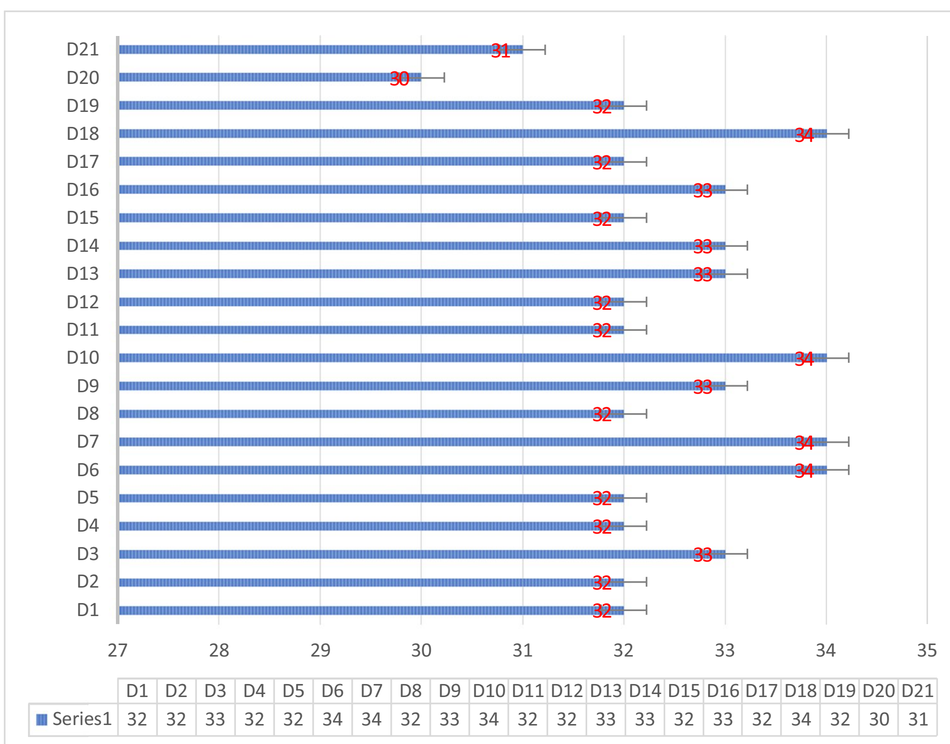


Fig. 2 Filtering suitable drivers through FDM's experts' ranking

the TFN outcomes in sequence (Kuo and Chen 2008). A geometric mean is where experts' values, both minimum and maximum values, are enlisted. In this study, the geometric mean represents the results of experts' opinions.

Suppose $W_j^n = \left(a_j^n\, b_j^n\, c_j^n\right)$ illustrate the preference of each expert EMPs driver j developed by "*nth*" judgment of experts in TFNs. To integrate the choice of all "n" judgment, Eq. (1) will be utilized as

$$W_j = \left(a_j b_j c_j\right) = \left(a = \min\left\{a_{ij}\right\}, b_j = \frac{1}{n}\sum_{i=1}^{n} b_{ij}, c_j = \max\left\{c_{ij}\right\}\right) \tag{1}$$

as w_j represents cumulative TFNs.

Selection of drivers

In the last section, TFN is given for every driver along with geometric means, minimum values of experts' opinions, and maximum values of experts' opinions. The 80/20 rule was implemented to select the important factors (Kuo and Chen 2008). This describes that 20% of drivers are responsible for 80% of drivers. In this process utilizing the FDM, the significant drivers are recognized by comparing the weight of each driver with the threshold $\sim_w$. $\sim_w$ presents the average weight of drivers regarding EMPs in construction project.

$$w_j = \frac{a_j + b_j + c_j}{a}, j = 1, 2, 3, \ldots m \tag{2}$$

As ″wɛ is denoted as a crisp score representing the aggregate preference of each expert EMP driver j.

Suppose $a_j \geq w$, then driver j is accepted.

Suppose $a_j < w$, then driver j is excluded.

After collecting data from experts, the main drivers were filtered. Experts recommended deleting two drivers named "Fear of increasing energy prices, 'employees' knowledge acquisition about EMPs." Therefore, after the application of FDM, 19 drivers were filtered out of a list of 21 drivers.

[d]drivers deleted after FDM

Developing a hierarchal structure through interpretive structural modeling

Interpretive structural modeling is a technique in which the contextual relationship between variables is checked to explain some specific problem or an issue. ISM is an effective tool to decompose a complex system into various subsystems, and a hierarchical model could be developed to interpret the relationship between different factors (Guan et al. 2020). ISM is a multi-criterion decision-making (MCDM) approach. Different MCDM approaches have been utilized to sort out the complex problems, such as the analytical hierarchy process (AHP), TOPSIS, COPRAS (complex proportional assessment), best worst method (BWM), and DEMATEL. A comparison of ISM-MICMAC techniques and these methodologies (Iqbal et al. 2021e; Singh et al. 2020; Stanujkic et al. 2018) is shown in Table A3 (Supplementary data). This novel qualitative approach aims to resolve the complex relationships of different variables by representing a hierarchical structural model (Shanker and Barve 2021).

ISM has been adopted in different social sciences, engineering, medical, and supply chain studies. Ullah et al. (2022) adopted the ISM approach to identify the factors of green innovation to enhance the sustainability. Hassan et al. (2021) utilized the ISM-MICMAC approach to discover the safety factors that affect the dairy supply chain in context of Pakistan. Ullah et al. (2021) used this novel approach to analyze the significant obstacles that hinder the adoption of green innovation in manufacturing industry. Iqbal et al. (2022b) adopted ISM to find out the essential lockdown strategies during the COVID-19 era. Ahmad et al. (2021b) adopted the hybrid approach of ISM-MICMAC to identify the important strategies for sustainable brownfield redevelopment in perspective of developing countries. Ahmad et al. (2021a) used the ISM approach in their study to explore the strategies of supply chain sustainability in the critical situation of pandemic.

The pros of this technique are that it represents the sequence and importance of the complex contextual relationship between variables (Govindan et al. 2012). The roots of ISM are derived from graph theory, and many experts have implemented the ISM technique in different areas of research (Iqbal et al. 2022a; Mandal and Deshmukh 1994).

ISM technique is interpretive because a group of experts on their experience draws their opinions about the relationship between groups. Furthermore, based on these variables' relationship, a hierarchical framework is designed to define them. There are different stages in ISM, which are briefly described below:

Stage 1: In the first stage, different drivers that are interrelated with each other were selected.

Stage 2: In the second stage, the drivers' relationship is checked; either one driver leads another driver or not.

Stage 3: The third stage is developing the structural self-interaction matrix to check the belongingness of drivers.

Stage 4: The structural self-interaction matrix (SSIM) was converted into an initial reachability matrix to convert the SSIM into binary values (0, 1). Furthermore, to check the transitivity of drivers, an initial reachability matrix is evaluated based on the general assumption. Suppose X relates to Y, Y relates with Z, and then X must be related to Z.

Stage 5: At stage 5, various levels are developed by partitioning the reachability matrix.
Stage 6: A digraph is drawn, which depends on the relationship specified in the reachability matrix; transitivity is also mitigated.
Stage 7: The digraph of ISM drivers is replaced into statements.
Stage 8: The ISM model is again reviewed to check the transparency; if there is some inconsistency, then corrected with modifications.

Application of ISM

The implementation of ISM consists of different steps, which are given below.

Structural self-interaction matrix For developing the SSIM, a group of different experts gathered in one place. Experts provided their opinions about drivers' relationships and a contextual relationship among drivers through brainstorming and discussion. The data of this study were collected in November 2021. SSIM and other procedures are adopted through the study of Iqbal et al. (2021c). Experts from well-reputed firms were invited to gather the relevant data. We made many phone calls and wrote e-mails to experts regarding collecting relevant data. Finally, seven out of twenty-one experts agreed to help us to collect data through a brainstorming session. These experts consist of two developers, one civil engineer, one architect, one consultant, one professor, and one associate professor. Experts' detail has been given in Table A4 (Supplementary data).

Nikjow et al. (2021) identified that sample size in integrated ISM-MICMAC approach can vary from study to study. However, Ravi and Shankar (2005) examine that the minimum number of respondents in the ISM-MICMAC approach should be two. Iqbal et al. (2021d) used nine experts to identify the obstacles regarding the adoption of energy efficiency in the construction sector. Most of the previous studies (Bux et al. 2020; Hussain et al. 2019) employed less than fifteen experts as a sample enough for the ISM-MICMAC approach. Tan et al. (2019) utilized five experts to explore the BIM barriers in the Chinese construction industry. Malek and Desai (2019) used seven experts in their study to identify the strategies for sustainable manufacturing. Gan et al. (2018) identified significant obstacles to the transitions regarding off-site construction in Chinese construction industry in which the sample size of the study was taken eight.

Four alphabets were used to describe the contextual relationship of drivers (i and j):

V = It describes that driver i affects driver j;
A = it describes that driver j affects driver i;
X = It describes that both driver i and driver j affect each other;
O = It describes that drivers i and j do not affect each other.

The formulation of SSIM was done through the contextual association among drivers. The basic concept to establish SSIM after that conversion of SSIM into initial reachability matrix (IRM) and IRM has been presented in Fig. 3.

The SSIM is defined in Eqs. (3) and (4):

$$A = \left(a_{ij}\right)_{n\times n} \quad (3)$$

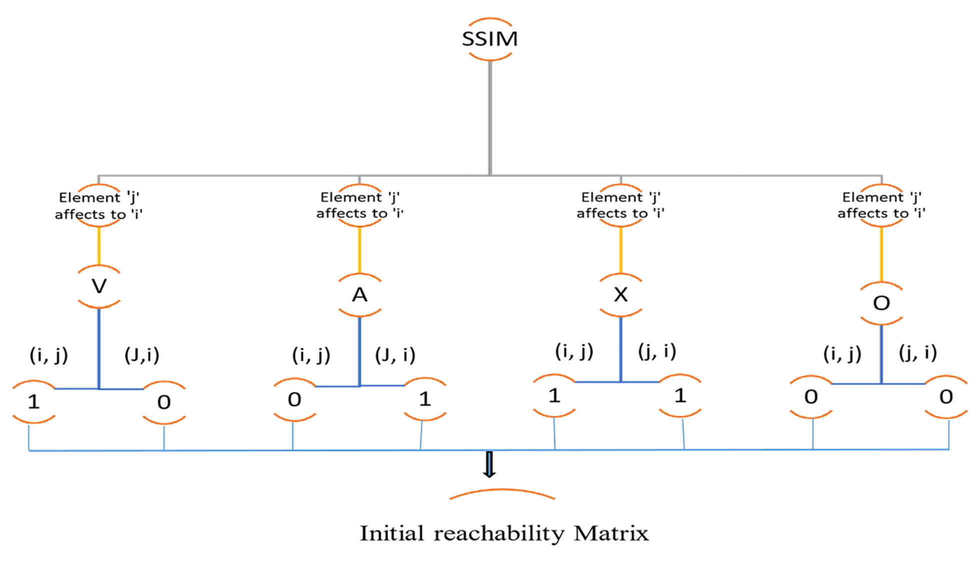


Fig. 3 The process of establishing and converting SSIM into IRM and FRM

$$a_{ij} = \begin{cases} 1, V_i M V_j \\ 0, V_i \overline{M} V_j \end{cases} \quad (4)$$

where M denotes that V_i has a direct influence on V_j, and $\overline{M}$ denotes that V_i has no direct impact on V_j.

The response of experts in the form of SSIM using four notations mentioned above is represented in Table 2.

Initial reachability matrix After the SSIM, the initial reachability matrix is designed. The initial reachability matrix is intended to show the contextual relationship among drivers in a binary structure. Reachability matrix (R) can tell both direct and indirect relationships in a matrix. A reachability matrix (R) can be obtained by Eq. (5):

$$\boldsymbol{A^1 \neq A^2 \neq A^3 \neq \cdots \neq A^{\lambda} = A^{\lambda+1} = R} \quad (5)$$

where λ is the number of calculations.

1. Suppose in SSIM (i, j) denoted as V, then in the reachability matrix, (i, j) will be entered as 1 and (j, i) will be as 0.
2. Suppose in SSIM, (i, j) denoted as A, then in the reachability matrix, (i, j) will be entered as 0 and (j, i) will be as 1.
3. Suppose in SSIM, (i, j) denoted as X, then in the reachability matrix, (i, j) will be entered as 1, and (j, i) will be as 1 in the reachability matrix.
4. Suppose in SSIM, (i, j) denoted as O, then in the reachability matrix, (i, j) will be entered as 0 and (j, i) will be as 0 in the reachability matrix.

The results for the conversion of SSIM into IRM are shown in Table A5 (Supplementary data).

Final reachability matrix After getting the IRM, the next procedure is developing final reachability matrix (FRM). It is designed after proving the transitivity between variables. This can be described as suppose X relates with Y, Y relates with Z, and then X must be associated with Z. The results for the conversion of IRM into FRM are shown in Table A6 (Supplementary data).

Level partitions Once FRM is completed, every driver's reachability set and antecedent set were formed. From the antecedent and reachability set, common values were listed in the intersection set, then from these three sets, level partitions were designed. Through this method, drivers got their level were removed for the next process. This procedure was being continued until the last driver got its level.

This can be obtained by locating the reachability set $\boldsymbol{RS}(\boldsymbol{V_i})$, antecedent set $\boldsymbol{AS}(\boldsymbol{V_i})$, and intersection set $\boldsymbol{IS}(\boldsymbol{V_i})$, which are defined as Eqs. (6) to (8):

$$\boldsymbol{RS}\left(\boldsymbol{V_i}\right) = \left\{ \boldsymbol{V_j} \middle| \boldsymbol{V_j} \in \boldsymbol{V}, \boldsymbol{r_{ij}} = \boldsymbol{1} \right\} \quad (6)$$

$$\boldsymbol{AS}\left(\boldsymbol{V_i}\right) = \left\{ \boldsymbol{V_j} \middle| \boldsymbol{V_j} \in \boldsymbol{V}, \boldsymbol{r_{ij}} = \boldsymbol{1} \right\} \quad (7)$$

$$\boldsymbol{IS}\left(\boldsymbol{V_i}\right) = \boldsymbol{RS}\left(\boldsymbol{V_i}\right) \cap \boldsymbol{AS}\left(\boldsymbol{V_i}\right) \quad (8)$$

The level partitioning process was expressed as Eq. (9):

$$\boldsymbol{L_m} = \{\boldsymbol{V_j} | \boldsymbol{V_j} \varepsilon \boldsymbol{V} - \boldsymbol{L_0} - \boldsymbol{L_1} - \cdots - \boldsymbol{L_{m-1}}, \boldsymbol{IS}(\boldsymbol{V_i}) = \boldsymbol{RS}(\boldsymbol{F_i})\} \quad (9)$$

where $\boldsymbol{L_m}$ denotes level $\boldsymbol{m}$; $\boldsymbol{m} = \boldsymbol{1}, \boldsymbol{2}, \cdots, l; l \leq \boldsymbol{n}; \boldsymbol{L_0} = \emptyset$.

Drivers were partitioned into five iterations. After extracting all levels, the final ISM model is drawn through a digraph. Total six levels were derived from level partitions as represented in Table A7 (Supplementary data). Finally, the six levels along representative variables are shown in Table A8 (Supplementary data).

Interpretive structural model A hierarchal structural framework is formulated from the levels of the final partition. Initially, a diagraph was established in which different EMP drivers are linked (Fig. 4). To develop the final ISM model, transitivity is mitigated from the original diagraph, and that diagraph is converted into the interpretive structural model, shown in Fig. 5.

MICMAC analysis

The purpose of developing the MICMAC graph is to find and observe drivers' driving and dependence power. In MICMAC analysis, drivers are divided into four clusters and their driving power and dependence power. These four clusters are autonomous, dependent, linkage, and independent clusters. Autonomous drivers have low driving power and low dependence power. These drivers do not directly relate with other drivers, but because of some relations with other drivers, their relation might be strong. The dependent drivers do not have strong driving power, but their dependence power is strong. Total three drivers (6, 12, and 18) came out in this category. The linkage drivers take both powers like their dependence, and driving power is strong. These drivers are not stable regarding their nature. During the process, if any action is taken on one driver, it might also influence other drivers. All drivers 6, 12, 18, 4, and 5 appeared in the linkage category. The independent drivers have weak dependence power, but their driving power is high. Driver 4 and driver 5 emerged in this category.

The driving force $DF(V_i)$and dependence power $DP(V_i)$ of each variable was calculated by Eqs.. (10) and (11).

Table 2 SSIM

Sr.	Drivers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Increased efficiency in construction processes and management practices		V	V	V	A	V	V	V	V	A	O	V	A	A	A	V	A	V	A
2	Contribute towards national economic growth and more job opportunities			V	V	V	V	V	V	O	V	V	V	A	O	O	V	V	O	O
3	Availability of new energy-saving solutions, innovative technology, and tools in the local market				A	A	V	V	V	V	V	V	V	V	A	O	A	A	V	X
4	Increased tax imposition on construction companies for energy usage and pollution contribution					V	O	V	O	V	V	V	V	V	V	O	V	V	O	O
5	Promotion of investment subsidies for energy efficiency technologies						V	V	V	V	V	V	V	V	V	O	V	V	V	V
6	Decreased price levels of energy-saving technology for the construction industry							V	V	V	A	A	V	O	A	O	A	O	O	O
7	Aligned with the smart business and international energy-saving trend								V	X	X	A	V	V	V	O	V	A	O	A
8	Gained competitive advantage									V	V	V	V	V	V	V	V	O	O	O
9	Recognition of energy-saving buildings as Productivity assets										V	O	V	V	V	O	V	A	V	O
10	Reduced use of construction materials in the economy											A	V	V	A	O	A	A	V	A
11	Lower maintenance cost												V	O	O	O	A	O	O	O
12	Facilitating a culture of best practice sharing													O	V	V	A	O	O	O
13	Reduced carbon emissions and environmental pollution														V	O	A	A	V	O
14	Increased education level and awareness of contractors' employees regarding EMP issues															O	V	V	O	X
15	Development of database related to the successful adoption of EMPs in construction projects																V	V	O	O
16	Promotion of sustainable long-term energy management strategic plans																	A	V	V
17	Increased enforcement of government rules and regulations regarding on-site EMPs																		V	V
18	Enhanced occupants' health, safety, and comfort																			O
19	Availability of skilled and technical EMPs experts																			

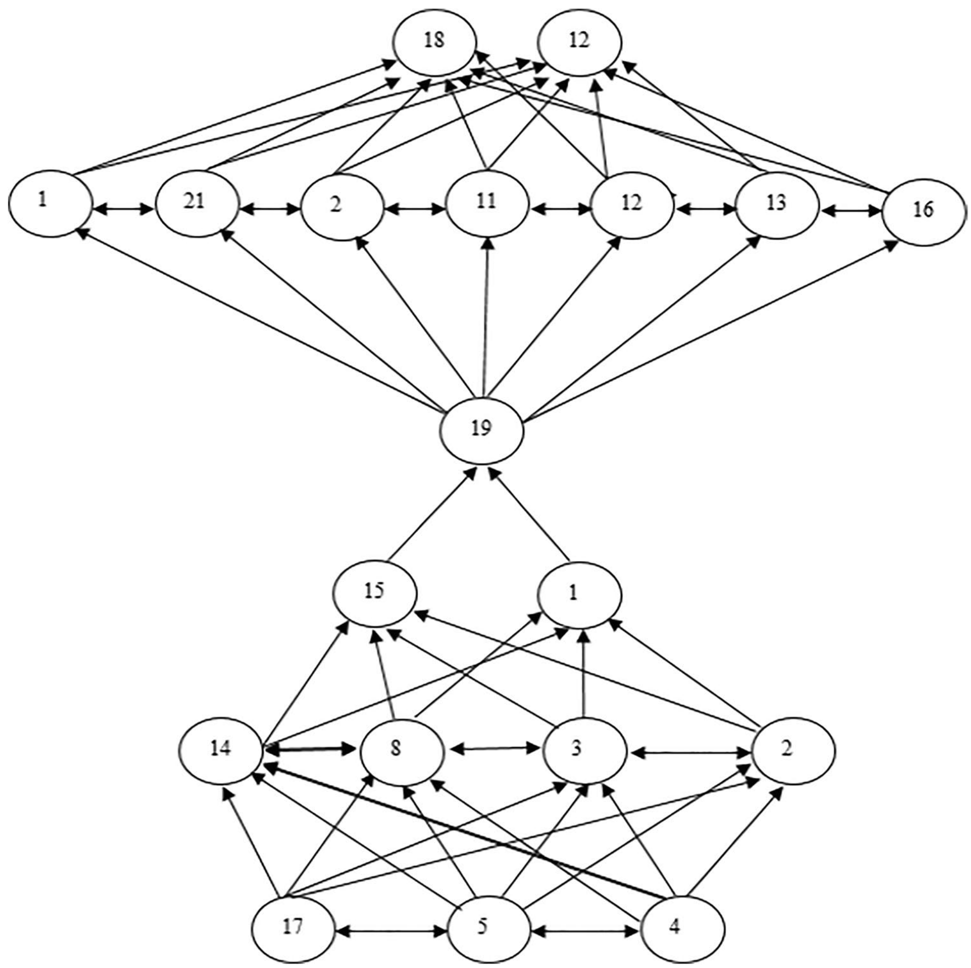


Fig. 4 Diagraph of EMP drivers

$$DF\left(V_i\right) = \sum\nolimits_{j=1}^{n} f_{ij} (i = 1, 2, \ldots, n) \tag{10}$$

$$DF\left(V_i\right) = \sum\nolimits_{j=1}^{n} f_{ji} (i = 1, 2, \ldots, n) \tag{11}$$

The MICMAC analysis for drivers to EMPs adoption is shown in Fig. 6, and the relationship between clusters has been presented in Fig. 7.

Results and discussion

In the first part, results have been discussed with the ISM model, and in the second part, findings have been presented in the light of relevant literature, and context-based comparisons were made.

The hierarchal structure of EMP drivers

During the last three decades, the implementation of EMPs in the construction sector has attracted the intention of researchers and stakeholders. Adoption of efficient energy practices in the construction sector can enhance the efficiency of buildings, reduce environmental pollution, and generate profit for stakeholders. Developed countries such as the USA, Canada, the UK, and Australia gained many benefits by adopting sustainable practices in the construction industry.

Unfortunately, in developing countries, particularly Pakistan, energy management practices in the construction sector are rare. The construction industry of Pakistan can also gain many benefits by adopting energy-efficient technologies in the construction sector.

Due to the energy crisis, GHG emission, and waste of natural resources, the government and construction industry of Pakistan is taking an interest in adopting energy management practices. Various benefits can be achieved by adopting EMPs in construction projects, such as profit generation, reduced GHG emissions, overcoming energy shortfall, and corporate image building. This study aims to identify the drivers of implementing energy management practices in the construction sector of Pakistan. The ISM method and MICMAC analysis are used to formulate the structural

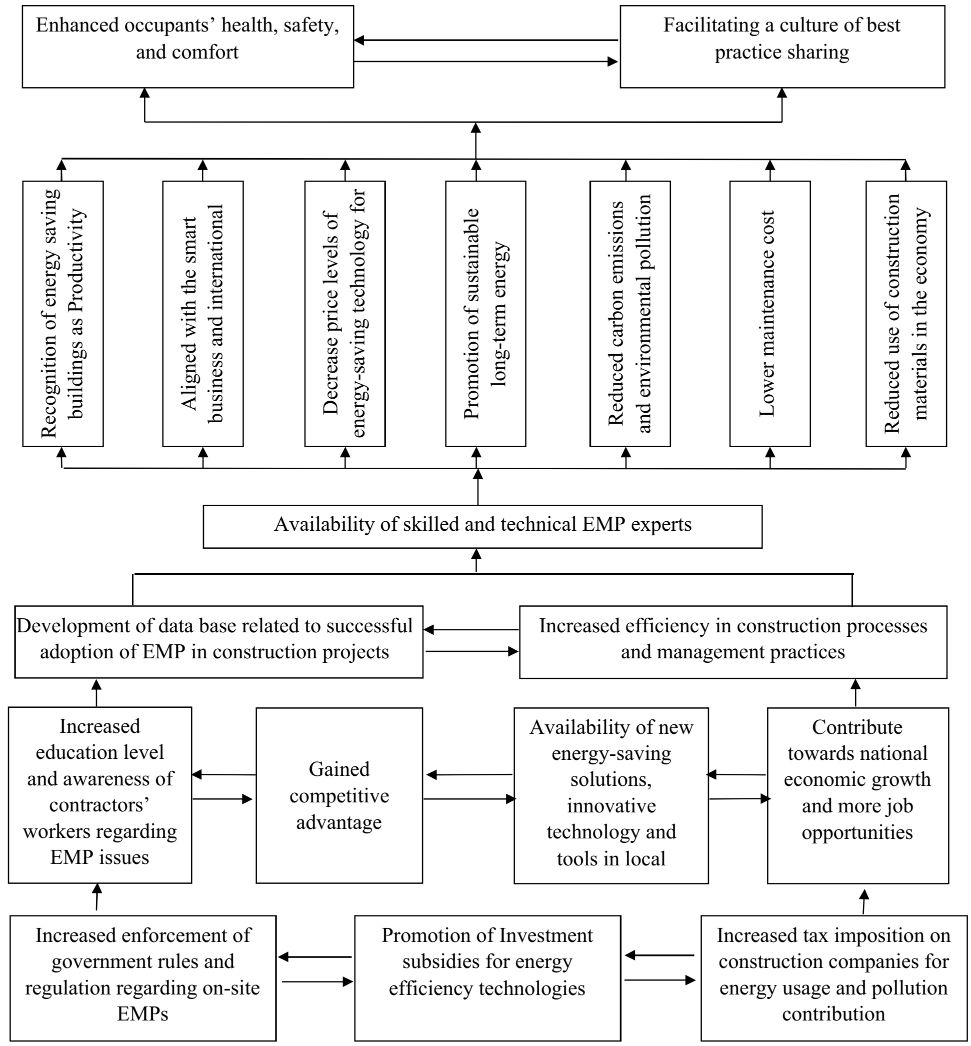


Fig. 5 ISM-based model of drivers to EMP adoption

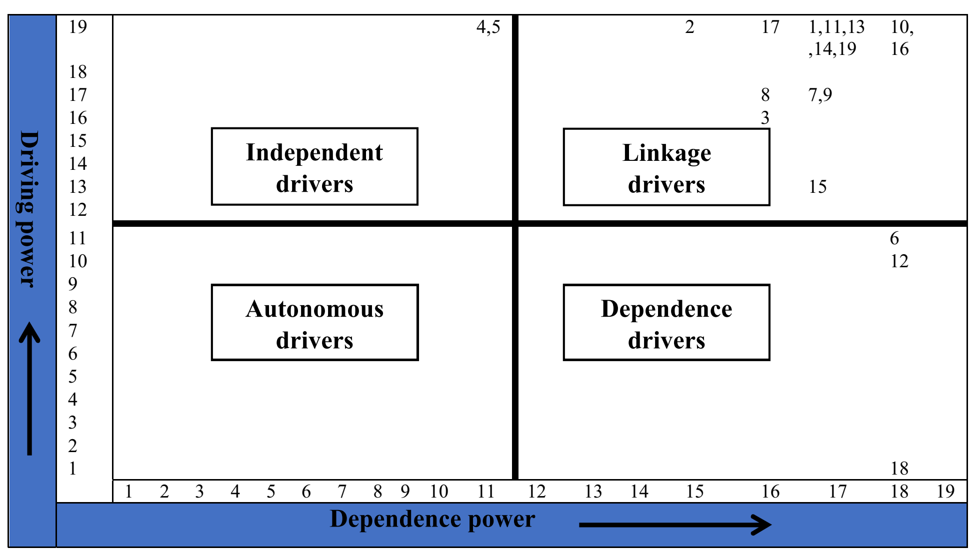


Fig. 6 MICMAC analysis of drivers to EMP adoption

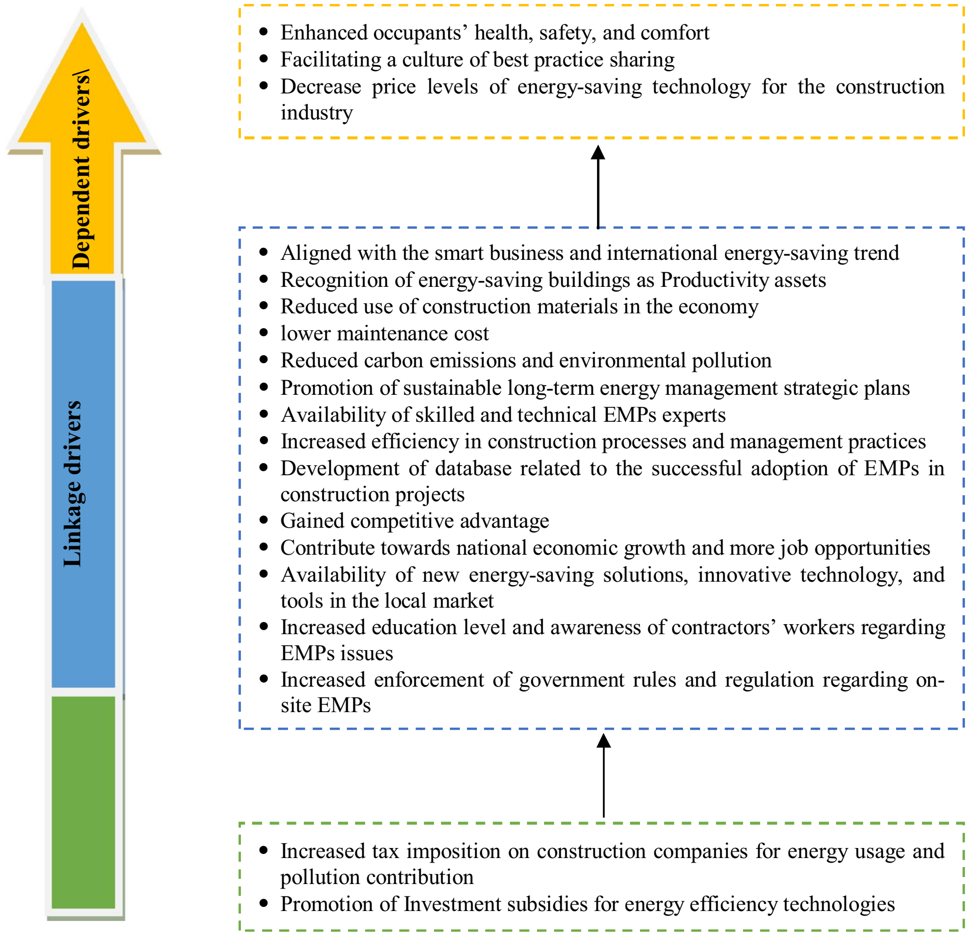


Fig. 7 Relationship between clusters of drivers

framework of drivers for implementing energy-efficient practices in construction projects.

A structural framework including nineteen drivers is formulated after an extensive discussion, and opinions of experts from the construction sector, educational sector, and business sector regarding the construction industry were sought. In the ISM-based structural framework, the drivers included in the first level are the least important, and the drivers included in the last level, which is level 7, were imperative, and these drivers also influence other drives.

The ISM model hierarchically represents the drivers of EMPs. According to the present study (D17), increased enforcement of government rules and regulation regarding on-site EMP, (D5) promotion of investment subsidies for energy efficiency technologies, and (D4) increased tax imposition on construction companies for energy usage, and pollution contribution are significant drivers that can insist on developers and clients through the adoption of EMPs in the construction industry of Pakistan. If the government imposes some bindings on contractors and clients to adopt energy-efficient technologies and emphasizes following pertinent rules during building construction, then efficiency can be improved. Developed countries that adopted energy-efficient technologies in their construction projects gained opportunities for increasing energy conservation (Qi et al. 2010b). Darko et al. (2017a) also identified government regulations and policies regarding sustainability as the top and the most significant driver. The promotion of energy-efficient technologies and the provision of funds from financial institutes and government to invest in sustainable construction encourage and motivate stakeholders to invest in sustainable building. This led to building trust in sustainable construction (Zhang et al. 2018). This driver is directly related to economic benefits such as cost-saving. Some organizations follow the traditional construction method, but the government intervention will compel them to abandon the conventional method and adopt EMPs in their construction projects. As a result, clients and developers become aware of the advantages of green construction, energy conservation, and pollution reduction; this bold step would turn into financial and environmental benefits (Johansson and Thollander 2018).

In the ISM hierarchy level, the fifth level consists of four drivers. These drivers are essential and related implementation of EMPs in the construction sector of Pakistan. These drivers included (D14) increased education level and awareness of contractors' employees regarding EMP issues; (D8) gains competitive advantage; (D3) availability of new energy-saving solutions, innovative technology, and tools in the local market; and (D2) contribute towards national economic growth and job opportunities. Enshassi et al. (2018) identified that a gap between the contractor, management, and client exists that is lack of information awareness and knowledge regarding the implementation of EMPs in construction projects. X. Li et al. (2019) found that improvement in the education of employees and practices of awareness and information sharing through meetings, conferences, and workshops can enhance the productivity of energy-efficient practices in the construction industry. Some organizations adopt strict environmental regulations to enforce the implementation of sustainability and organization principles, leading them to a competitive advantage in the market. They attain many benefits by adopting this strategy (Neri et al. 2018). The adoption of EMPs promotes the availability of energy-efficient equipment in the local market. Wilkinson et al. (2021) discover in their findings that the availability and manufacturing of innovative technology in the local market lead to promote the EMPs. Developers and clients can easily purchase and benefit from these technologies (Enshassi et al. 2018). The availability of energy-efficient technologies in the local market creates awareness among stakeholders, and stakeholders can save their costs instead of purchasing equipment from the international market (Chua and Oh 2011). Manufacturing and selling innovative technologies in the local market also contribute to the national economy, so the government of Pakistan should promote the production and availability of energy-efficient equipment in the local market. Adoption of EMPs in construction building projects reduces unemployment, increases economic growth, and provides financial benefits to clients and developers (Kibwami and Tutesigensi 2016). Contributions of the construction sector in national economy improve the image of the industry and attract the traditional organizations towards the adoption of energy management practices.

Level 4 includes two drivers: (D15) development of a database related to the successful adoption of EMPs in construction projects and (D1) increased efficiency in construction processes and management practices. Increasing data sharing and information sharing among clients, architects, developers, and professionals to improve energy-efficient technologies create a trustworthy relationship among stakeholders (Lutz et al. 2017). Construction organizations in Pakistan should design a framework of data sharing among architects, clients, and professional consultants to improve efficient energy activities. By adopting energy management practices in construction building projects, the efficiency of buildings can be improved, and the benefits of cost-saving can be gained through proper management of energy conservation (Darko et al. 2018). National Energy Conservation Centre of Pakistan (ENERCON) report showed that using energy-efficient equipment provides cost-saving benefits such as adopting EMPs during the construction of the building, saving 50% of energy, and reducing electricity bills (Malik and Awan 2018).

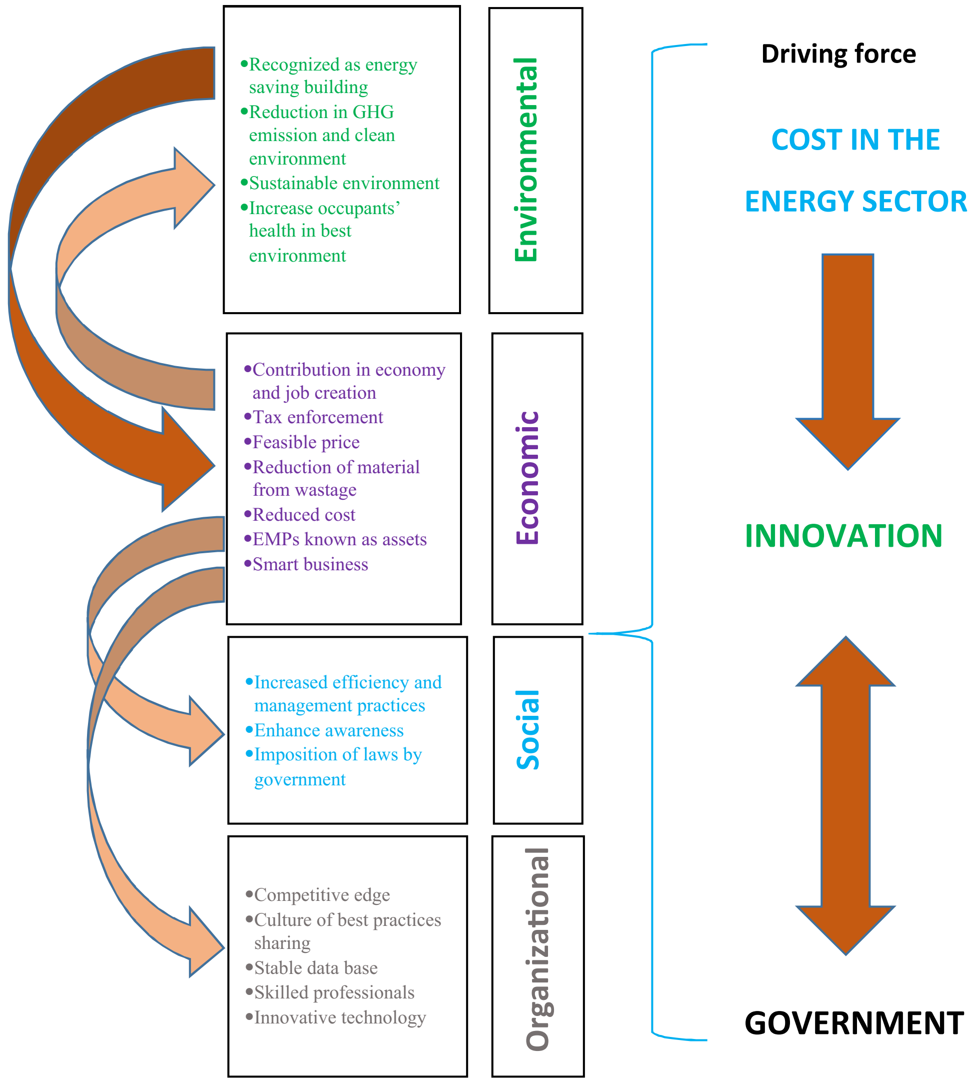
Level 3 consists of one driver, which is more important than level 2 drivers. This driver is (D19) availability of skilled and technical EMPs experts. If an organization has skilled workers and technical experts that can handle the complex nature of devices related to EMPs, that organization can improve its work productivity, save cost, and gain a competitive advantage in the market (Yevu et al. 2021). Organizations of construction projects in Pakistan can attain the opportunity of energy conservation in their building projects by hiring skilled and technical experts.

Furthermore, level 2 included seven drivers: (D16), (D13), (D11), (D10), (D9), (D7), (D6), and level 1 included two drivers: (D18) and (D12). These drivers are also important and can provide financial, economic, and environmental benefits regarding the adoption of EMPs.

Many articles and literature reviews related to drivers supporting the implementation of EMPs in the construction sector were studied. However, in the scenario of Pakistan, this is a pioneer study of drivers supporting the implementation of EMPs in construction projects in Pakistan. This study aimed to investigate the drivers that support the implementation of EMPs in construction projects in Pakistan. ISM model and MICMAC analysis were used to identify the various drivers supporting the implementation of EMPs in construction projects in Pakistan. The stakeholders can attain greater financial, economic, environmental, and corporate benefits by adopting energy management practices in construction projects.

Lastly, this research tried to integrate the literature review and results from the ISM methodology. Figure 8 elaborates the drivers that could insist the adoption of EMPs in construction projects, such as cost (high cost of fossil fuel energy could push stakeholders to divert their attention towards the adoption of sustainable EMPs in construction projects), innovation (advanced technology can lead to a decrease the production cost), and government (provision of funds and incentives from the government can encourage the stakeholders of the construction sector to promote EMPs; also, this practice could help mitigate the environmental degradation). Environmental driving forces help mitigate the adverse impacts of environmental pollution. Therefore, it is clear that economic and ecological driving forces are interdependent. The significant economic driving forces impact social and organizational driving forces through which EMPs can be achieved.

Fig. 8 Representation of EMP driver for promoting sustainability



Comparison with other countries

This novel study's top 5 drivers of EMPs were compared with other economies. Increased enforcement of government rules and regulations regarding on-site to implement EMPs was considered a significant driver in the perspective of the construction sector in Pakistan because enforcement of state laws through concerned authorities during the construction of a building can increase customers' trust. The construction industry can improve such drivers with the government's support and commitment. Promotion of investment subsidies for energy efficiency technologies was ranked second imperative driver in the context of given, but this driver was not among the results of the top 5 drivers of other developing countries. Increased tax imposition on construction companies for energy usage and pollution contribution was ranked number 3 in the context of Pakistan because heavy taxes on those firms or contractors which use an excessive amount of energy and cause to spread of pollution in the natural environment can discourage them. Support and motivation of top leadership play an important role in enhancing the work productivity of employees.

Increased education level and awareness of contractors' workers regarding EMP driving forces was placed on the fourth position ranked fourth in the perspective of Pakistan, but these findings were ranked third in the context of Palestine. Proper knowledge and education about energy efficiency helps attract potential customers regarding the adoption of EMPs in construction projects. Gained competitive advantage was at number 5 according to the results of EMP driving forces in Pakistan because adoption of innovative and green technologies in construction projects assists in attaining the competitive edge in local and international markets. Increased enforcement of government rules and regulations regarding on-site EMPs was considered an imperative driver in the perspective of Pakistan and India because the construction industry can gain many potential benefits through the proper enforcement of rules and regulations by concerned authorities. Promotion of investment subsidies for energy efficiency technologies was ranked at number 2 in the context of Pakistan, but in the perspective of other countries, this driving force was not found in the list of top 5 drivers. The construction sector can boost its profitability by promoting investment in energy-efficient technologies. Increased tax imposition on construction companies for energy usage and pollution contribution was placed at number 3 according to outcomes of the construction sector in Pakistan, but this driver did not exist in top 5 drivers of other emerging nations.

Furthermore, increased education level and awareness of contractors' workers regarding EMP issues was ranked fourth in the context of Pakistan because the proper implementation of EMPs in construction projects provides awareness and knowledge for workers and developers; however, this driver was also placed at fourth in the perspective of India. The motivation of employees through proper awareness and guidance about EMPs plays an essential role in enhancing energy-efficient practices. According to the outcome of this study, gained competitive advantage was placed at number 5 in the construction sector of Pakistan because adopting green practices in building projects leads firms to enhance their performance and attain a competitive advantage in the market. A comprehensive overview of emerged drivers in this study has been given in Table A9 (Supplementary data).

Conclusion

After extracting nineteen drivers at six levels in the ISM model, these are the significant drivers that can be beneficial for stakeholders of the construction sector of Pakistan: "increased tax imposition on construction companies for energy usage and pollution contribution," "promotion of investment subsidies for energy efficiency technologies," "increased enforcement of government rules and regulation regarding on-site EMPs." These drivers are significant and independent which leads to those drivers which are linked with driving and dependent drivers. Government needs less attention to concentrate such drivers because they are already significant in the system. Suppose the stakeholders of the construction sector of Pakistan implement energy management practices in their construction projects. In that case, they can gain many benefits from the perspective of energy conservation, economic growth, environmental and resource conservation, corporate image, market leadership, research and development, and financial benefits.

Enforcement of government rules and regulations plays a vital role in pressurizing developers and clients to adopt management practices in construction projects. This driver can increase the success of adopting EMPs in construction projects in Pakistan. Developments of sustainable and supportive policies for energy management in construction projects are considered significant features in the organizations. The promotion of EMPs and awareness is also considered an essential factor in adopting energy management practices in the construction sector of Pakistan. Awareness can be enhanced by providing education, training, and knowledge to clients and employees about energy management and conservation. If construction practitioners or construction firms of Pakistan conduct training sessions to educate their employees and clients regarding EMP adoption, then they can gain different benefits in terms of financial profit, cost saving, energy saving, and corporate image. Lastly, there are some driving forces including enhanced occupants' health, safety, and comfort and facilitating a culture of best practices sharing which are least important but required proper attention of government and construction stakeholders of Pakistan. So, these two DFs could play an important role to benefit EMP adoption in construction projects of Pakistan through proper attention of stakeholders.

Based on the study results, providing education and training to clients and employees about energy management is necessary for the construction sector of Pakistan. So, the government of Pakistan should provide education and awareness to contractors to boost up the construction industry. The government should start an energy management program through vocational institutes, and the government should promote research and development programs in universities about energy efficiency and energy conservation. Top-level management collaboration with the government and other concerned authorities such as environmental protection agencies could significantly enhance the EMP adoption. Employing the policies of developed nations will imperatively enhance the competitiveness of organizations. Therefore, managers should follow the policy guidelines of developed countries to promote the EMP adoption in construction projects. The government needs to provide funds and support for the research institutions so that they can perform research and development activities. Moreover, managers need to analyze the international market research and ensure the EMP adoption to enhance the green practices in construction projects. Government plays an important role in designing laws that could help minimize environmental degradation and increase sustainable practices in society. To ensure the enforcement of policies regarding EMP adoption, organizations must follow the rules and regulations that the government designs. The construction industry needs to develop policies for the welfare of stakeholders, energy conservation, and environmental protection. This is possible when all stakeholders design sustainable policies for their industry.

This study does have some certain limitations, such as this study being conducted from the perspective of Pakistan. Further studies can be conducted globally or in other developing countries. ISM and MICMAC approaches are used in this study, and these two approaches depend on the judgment of experts. So, there is a probability of bias from experts selected in this study. The analysis of this study is knowledge-based according to the current situation, and with the passage of time, experts can change their opinion. Also, the drivers that are taken for study are according to Pakistan's perspective and current situation. Later, other researchers can increase or decrease the drivers according to that situation. ISM and MICMAC approaches show the contextual relationship and severity of drivers. It does not statistically verify the drivers, so the SEM approach can be used to verify the drivers statistically.

The results of this research are important because they deliver knowledge and information about the DFs to achieve the purpose of EMP adoption in the construction industry of Pakistan. The DFs analyzed in our study could assist policymakers, stakeholders, and practitioners to promote EMPs in the local construction sector.

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Data availability Data is provided in supplementary form.

Declarations

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Consent to participate Not applicable.

Consent for publication Not applicable.

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