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Prioritization of the Main Factors to Achieve Sustainable Project Management in the Construction Industry based on the Combination of Network Analysis and Dematel

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Abstract

This research was conducted with the aim of determining the main factors of achieving sustainable project management in the construction industry based on the combination of network analysis and Dematel. The research method in this study is descriptive and applied in terms of purpose, and in terms of the process and method of data collection and analysis, it is a survey research. In this research, 10 questionnaires required by the research were presented to the managers of the construction projects of schools in Tehran, and all of these respondents were male participants. After collecting the questionnaires, the questionnaires were extracted and analyzed. The prioritization of the main factors to achieve sustainable project management in the construction industry was done based on the combination of network analysis and Dimetal. After collecting the data, it was entered into the environmental software and then using the network analysis technique (ANP) and Fuzzy Dematel, the priorities and relationships between the features were determined. The studies in the available sources led to the identification and preliminary criteria for achieving sustainable project management in the construction industry. The result of which was 23 sub-indexes and 4 main factors of cost, quality, environmental factors and social factors to achieve sustainable project management in the construction industry.

Keywords: sustainable project, network analysis, construction industry, sustainable project management.

Introduction

In recent decades, attention has been paid to the significant negative damage caused by human activities in the environment, and sustainability is proposed as a solution that needs to be increased. In this regard, project management is different from the traditional project management in centuries, and with the passage of time and the increasing expansion of knowledge and attention to sustainable development, it is necessary to achieve a favorable performance in the field of project management in parallel with both. Yabim (Ziaei and Vakilnejad, 2021).

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Management of development projects is comprehensive and full of competencies. Management roles and titles are different in different industries. For this reason, the fourth edition of the project management project standard, in addition to describing the competencies in the form of special roles of the project manager, also describes the competencies in the domains of project management, project management, and project management. In level management projects in different projects, it causes differences in each level and the difference of each project. These are further increasing in the manufacturing industry (Soltisek and Differ, 2020, Chen et al., 2019). Due to their individuality, projects cannot use a single project management method and the same competencies for all projects. They differ from each other in the same country, and all these factors cause changes and differences in the importance of project managers' competence factors in different projects. On the other hand, sustainable project management is one of the global trends in project management. Projects have a fundamental role in the development and implementation of sustainable business practices and as a result the sustainable development of communities, and sustainable project management as the main model in this rapidly developing field should note that sustainable project management is sustainable project management. Rather, it is related to the sustainable management of projects. The project manager has a fundamental role in the project and it plays an important role in controlling the projects. Several projects without official responsibility in many aspects of the manager's projects become positions that they can use to implement sustainability projects and manage them (Saeidi and Yousefi, 1403).

The results of empirical research have shown that sustainable project management makes it possible to ensure the health, safety and satisfaction of employees in addition to reducing energy consumption and environmental damage (Alvanchi and Zandi, 2016). But one of the main issues and challenges in this field is the integration of sustainability in the management of construction projects. Today, sustainable development has become an important category in meeting urban needs, to achieve a healthier and safer society and environment, and at the global level, project managers, through the provision of a sustainable development management framework, address the issue of construction management and prioritization of sustainability criteria. have shown importance in it (Rezaei and Najafi, 2017). In this regard and with regard to the ever-increasing population growth and mass construction of residential complexes in the urban space, compliance with environmental sustainability standards and achieving the goal of sustainable development in our country has become a requirement. Knowing as much as possible the main factors of achieving sustainable project management in the construction industry and prioritizing the importance of these criteria according to the needs of construction in Iranian society can create practical and valuable solutions for project managers and contractors. In general, sustainability is a process that brings reorganization and a different orientation of the entire socio-economic system, which includes three economic, social and environmental areas (Farshad et al., 2015). Alvanchi and Zandi (2016) concluded in their study that the most important areas of project management knowledge to achieve sustainability are: scheduling and planning, stakeholder management, communication management, cost

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management and human resource management. Also, the most important skills needed to reduce the challenges in project management, decision-making based on the principles of sustainable development, teamwork, and the use of problem-solving skills have been identified.

Zarghami et al. (2018) have identified the effective factors in the planning management of sustainability-based residential complex construction projects in Iran, which include: environmental design, reduction of damage and waste, energy performance considerations, supply of local materials, air quality Inside buildings, quality of materials and materials, innovation in design, management of alternative resources, management of waste materials, thermal comfort, considerations for protecting the ozone layer, visual comfort, reduction in resource consumption, hearing comfort, ecosystem preservation, land sensitivity considerations. But in general, in current project management approaches, project management performance is influenced by three factors, "time", "cost" and "quality", and all three factors directly affect the efficiency and economic profit of the project. In some cases, social and environmental aspects of sustainability are considered as indicators of the "quality" factor in project management, but practical focus is not made on it much (Nik Andish, 2016).

If sustainability in project management is by integrating economic, social and environmental factors in project management and leadership systems (Stanitas et al., 2021), but sometimes managers in project-oriented organizations or in the management of construction projects, although they tend observe the sustainability considerations in the management of their projects, but they face problems in its implementation because in order to implement these considerations, they need factors that are examined under the main factors of achieving sustainable project management in this study. Therefore, according to what was stated in this study, to identify the main factors of achieving sustainable project management in the construction industry, the descriptive-analytical method and documentary, library studies and using the experiences of the country's construction project managers are used. The sample of the research is the construction projects of schools in Tehran, and the managers of construction projects of schools in Tehran are selected to participate in the research by random cluster sampling. The main factors of achieving sustainable project management in the construction industry using the literature review and research background as well as after consulting with research experts that include at least 5 and at most 10 project managers among the statistical population of the research that has more than twenty years They are selected if they have work experience. Then, based on the identified factors, a research questionnaire with a pairwise comparison scale is designed. The data obtained from the questionnaires are also analyzed in this research for the first time using the combination of network analysis (ANP) and DEMATEL methods, and based on the results, finally, the main factors of achieving sustainable project management in the industry The construction of the country is prioritized with a case study of construction projects of schools in Tehran.

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Theoretical foundations and research background

With the development and expansion of knowledge about ecological systems, the increasing attention to the care of natural and environmental resources in various human activities took on a more decisive role, so that the owners of various civil, economic and even cultural projects try to build and renovate facilities. and suitable infrastructures provide the context for effective use of resources (Chu et al., 2021). The process of project sustainability management or sustainable project management, by establishing cooperation between the project owner and consulting engineers in the field of choosing appropriate goals for the project and determining indicators related to sustainable development, helps the project owner to be convinced of the costs in the field of sustainability. Sustainable project management enables owners and project consultants to meet the demands and pay attention to the concerns of the stakeholders to invent indicators that fit the needs of the project so that the above indicators have a strong link and cause and effect with the fundamental goals of sustainable development (Hesu et al. , 2019).

The project manager's responsibility for the sustainability of a project is also included in the latest editions of professional project management standards. For example, the fourth edition of the Project Management Competency Basis standard explicitly mentions the impacts of project processes and its products on the environment and society and acknowledges the relationship between projects and sustainability. Also, it determines a role for the project manager in this regard. In this regard, the codes of ethics and professional conduct of the American Project Management Institute and the International Project Management Association describe the professional responsibility of the project manager for sustainability (Silvios, 2021). Despite these attentions, more detailed studies show that project management standards do not address the role of empowering projects in sustainability (Zhou, 2020). There is general agreement that sustainability competencies are necessary for society, however, the lack of a specific competency framework for sustainability has led to a plurality of definitions of sustainability knowledge, skills, attitudes, and values. To develop sustainable project management in the construction industry, recognizing and applying effective competencies in sustainable project management is a necessity. Therefore, the issue of sustainability in the field of project management has been looked at from the point of view of competence. The discussion about the competences in the field of sustainability seeks to solve the basic problem of having the right attitudes, knowledge and skills on the part of the human resources working in the project and especially the management levels; Because the three main sides of the improvement triangle, i.e., the existence of suitable human resources, the existence of efficient processes, and the existence of necessary technology regarding sustainable development, together can achieve sustainability goals (Saeidi and Yousefi, 1403).

Calderon et al. (2024) in a research titled project management and system dynamics modeling: time to connect with innovation and sustainability investigated the need to connect project management (PM) with innovation and sustainability to meet new social needs. Social demands have facilitated more complexity and uncertainty in the field of project management and led to

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theoretical and practical developments. The key developments identified show that project management is becoming more holistic and interdisciplinary in nature in order to successfully deal with this complexity and uncertainty. Moreover, holistic thinking is naturally related to systems thinking, which justifies the choice of system dynamics to support project management decision-making. An extensive critical review of system dynamics modeling has been conducted in light of the developments identified in the field of project management. The contribution of this paper connects innovation and sustainability to the discipline of project management with the initial development of the causal loop diagram.

In an article, Ziyai, Vakilinejad et al. (2021) discussed the multi-objective optimization of daylight performance and temperature comfort in classrooms with light shelves. The method used in the research is based on three steps: daylight optimization of light shelf parameters, thermal comfort analysis for the selected solutions, and selection of the best option. Four parameters of the light shelf including height, length of the outer part, length and angle of the inner part are considered as variables. Then, a multi-objective algorithm has been applied to find the optimal combination of parameters based on daylight performance indicators. The results of the research showed that the use of light shelves in Tehran with less cloudy sky than in Sari is more effective in providing daylight and thermal comfort, especially for cases with a higher window-to-wall ratio (WWR). Also, there was a significant relationship between rotation angle and daylight availability in terms of WWR in each city. Also, it was found that taking daylight and comfort issues into account, the value of window-to-wall ratio (WWR) for the best option is higher in Tehran than in Sari.

Won et al. (2019) have identified the factors affecting the energy consumption performance of large-scale office buildings based on the principles of sustainable development. In this article, by developing the factors presented in the research of Anshasi et al. (2018), the factors affecting the energy consumption performance of large-scale office buildings based on the principles of sustainable development have been identified as follows: In the dimension of economic factors of sustainable development: scale and Business scope, effects on local economy, capital budgeting, financial plan. In the dimension of social factors of sustainable development: recruitment and management of human resources, capacity of construction infrastructure, community amenities, safety and health assessment of workers. In the dimension of environmental factors of sustainable development: preservation of the environment and ecology, evaluation of the amount of air pollution, evaluation of the amount of water pollution, evaluation of the amount of noise, evaluation of the amount of sewage and construction waste, how to manage and consume energy regulations and guidelines. Also, the following factors have been identified in building design: intensity of energy consumption, window-to-wall ratio, physical form of the building, direction of building, climatic design of windows, shades. In an article, Jiaedong et al. (2018) identified factors affecting green development in the construction of residential buildings based on social network analysis. Based on this, the identified indicators for green (sustainable) development in buildings are: mandatory policy for green development, incentive policy for green development, strictness in monitoring and approval,

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level of local economic development, local cooperation, renewable energy consumption and green consumption development. , the level of technology for green construction, the level of design in green construction, the application of green technology in design and construction, the appreciation of consumers for complying with the principles of green construction, the level of consumer income, the incentive policy for green purchases, the development strategy and Innovation orientation, appreciation and positioning of the developer to develop the principles of green architecture, experience and ability to develop the principles of green architecture.

Saeedi and Yousefi (1403) in a research called sustainability competencies of project managers in the management of projects in the construction industry identified the sustainability competencies needed by project managers in the construction industry. The current study has a developmental orientation in terms of methodology and an exploratory objective. Data was collected through 11 semi-structured interviews with the qualitative method of multiple case study and thematic analysis. The participants are project managers of the construction industry, who were chosen non-randomly. The most important findings in the analysis section resulted in a list of 12 sustainability competencies of project managers, which are categorized into three categories: knowledge, skill and attitude. Having stable knowledge and being up-to-date in this field are two competencies with a major knowledge approach. In the skill category, creative use of available resources, interpersonal skills, and the ability to implement issues related to sustainability are three key competencies. But in the third category, which has the largest contribution, value-oriented thinking, ethical orientation, forward-looking, continuous learning, education-oriented thinking and sustainability-based behavior are the most important competencies for sustainable project management.

Taei et al. (2018) in an article have discussed the design of sustainable schools model in line with the development of sustainable cities based on the network analysis process. According to the results of the research, the factors influencing the design of the sustainable school model are: having an organizational structure suitable for sustainable development (board of trustees, board of directors, teachers, etc.), the use of materials in accordance with the principles of sustainability, suitable equipment for sustainable development, building construction According to the principles of sustainable development, energy saving.

Dob and Yadgari (2018) evaluated the application of green architecture in the design of a hospital hotel by improving the quality of the environment from the perspective of sustainable architecture. According to the results of the research, the factors influencing the design of the building by improving the quality of the environment from the perspective of sustainable architecture are: climate design of the open space (courtyard), light radiation and the location of the building, sustainable building materials suitable for the climate of the region, the intensity of energy consumption, the rate of windows to Wall, physical form of building, green design and purchase.

Jalil Piran and colleagues (2018) investigated the role and performance of the green roof in the field of energy conservation with a sustainable architecture approach. In this article, it is stated

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that although in the discussion of sustainability, environmental and economic factors are more emphasized, but in recent years, social factors have been given a lot of attention as a prerequisite for sustainability. The results of the research showed that the principles of sustainable architecture, which is conservation of natural energy, reduction of the use of fossil fuels and coexistence with the environment and climate, should be considered by designers and activists in the field of architecture, because the preservation and protection of the world's natural resources, reduction of air pollution and other Environmental pollution, protection of the ozone layer, physical and mental health, the future of humanity, etc. are among the most important missions of humans.

Research questions

Based on the problem raised in this research, the following questions can be asked:

1- What are the main factors to achieve sustainable project management in the construction industry?

2- How is the prioritization of the main factors to achieve sustainable project management in the construction industry based on the ANP method?

3- How is the analysis of the relationship between the main factors of achieving sustainable project management in the construction industry based on the DEMATEL method?

Research methodology

Research in terms of methodology is the application of scientific methods in solving a problem or answering the questions raised for it. In general, the types of research in social and management sciences can be divided according to two criteria a) the purpose and nature of the research and b) the method of data collection and analysis. The research method in this research is of applied descriptive type and analytical type in terms of purpose, and in terms of process and method of data collection and analysis, it is a survey research. Applied researches are researches that are used to meet human needs by using the background and cognitive background and information provided by basic researches. In the field of applied research, there are many methods, the most important of which are historical, exploratory, descriptive survey, correlational, causal, and experimental. In terms of method, this research is descriptive and in terms of data collection and analysis, it is a survey research. In survey research, questionnaires are mainly used, but other techniques such as interviews, observations, etc. are also used. The survey research method is a method to collect data in which certain groups of people are asked to answer a certain number of questions. These answers form the set of research information. This method can be used in all kinds of exploratory, descriptive, explanatory and evaluation studies.

Society is a set of hypothetical or real members to which research results are generalized. The sample of the research is the construction projects of schools in Tehran, and the managers of

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construction projects of schools in Tehran are selected to participate in the research by random cluster sampling. The main factors of achieving sustainable project management in the construction industry using the literature review and research background as well as after consulting with research experts that include at least 5 and at most 10 project managers among the statistical population of the research that has more than twenty years They are selected if they have work experience. Then, based on the identified factors, a research questionnaire with a pairwise comparison scale is designed. In this research, the collected data are collected using the library method and the questionnaire field method. Therefore, firstly, in the second chapter, the literature and research background were reviewed using the library method to identify the necessary components for ranking. After presenting the identified factors to the research experts and also asking for opinions from the supervisors and advisors, the final factors were selected and the research questionnaire was based on The selected factors are designed based on the range of pairwise comparisons and are provided to the research participants. Therefore, data collection in this section is done by field survey method. ,

Research findings

The purpose of scientific research is to answer the initial question. The main goal of the current research is to prioritize the main factors of achieving sustainable project management in the construction industry based on the combination of network analysis method and Dimtel, in this chapter the collected data will be ranked first with the help of network analysis method. Then, using the fuzzy Dimitel technique, the relationship between the main factors of achieving sustainable project management in the construction industry is determined. Therefore, the calculation methods and analysis methods were explained in the following. In this section, the collected data was analyzed using the network analysis technique (ANP). The ANP method is one of the multi-criteria decision-making methods (MADM), which is similar to the AHP method, but in which the criteria or sub-criteria or the options have dependencies or relationships. In fact, the AHP method can be considered a special mode of the network technique. . ANP is implemented using Super Decisions software and is applied to a variety of decisions including marketing, medical, political, military, social, and forecasting, among many others. The ANP method and its application in various fields are well documented in the operational research literature. In this research, there are 17 criteria and 2 options that are ranked based on the fuzzy TOPSIS method. The table below shows the specifications of the criteria. Figure 1 shows the relationship between criteria and sub-criteria, which was designed in Super Decision software.

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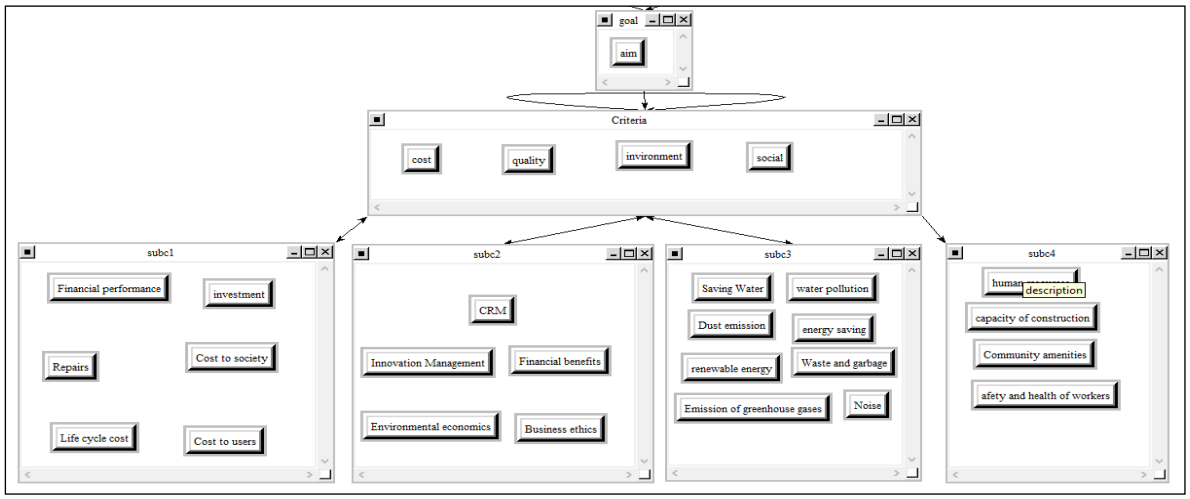

Figure (1): Relationship between criteria and sub-criteria

By using the weights obtained in the previous step, the initial supermatrix is formed.

Table (1): Initial supermatrix

		cost	invironment	quality	social	aim
Criteria	cost	0.086	0.102	0.092	0.192	0.113
	invironment	0.546	0.578	0.498	0.594	0.582
	quality	0.265	0.243	0.195	0.143	0.240
	social	0.103	0.077	0.215	0.072	0.065
goal	aim	0	0	0	0	1
subc1	Cost to society	0.266	0	0	0	0
	Cost to users	0.046	0	0	0	0
	Financial performance	0.116	0	0	0	0
	investment	0.162	0	0	0	0
	Life cycle cost	0.262	0	0	0	0
	Repairs	0.147	0	0	0	0
subc2	Business ethics	0	0	0.128	0	0
	CRM	0	0	0.087	0	0
	Environmental economics	0	0	0.378	0	0
	Financial benefits	0	0	0.159	0	0
	Innovation Management	0	0	0.248	0	0
subc3	Dust emission	0	0.038	0	0	0
	Emission of greenhouse gases	0	0.124	0	0	0
	energy saving	0	0.210	0	0	0
	Noise	0	0.039	0	0	0
	renewable energy	0	0.106	0	0	0

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	Saving Water	0	0.193	0	0	0
	Waste and garbage	0	0.114	0	0	0
	water pollution	0	0.176	0	0	0
subc4	afety and health of workers	0	0	0	0.330	0
	capacity of construction	0	0	0	0.288	0
	Community amenities	0	0	0	0.087	0
	human resources	0	0	0	0.295	0

Formation of balanced supermatrix

After forming the primary supermatrix, the balanced supermatrix must be created. The balanced supermatrix is obtained from the normalization of the primary supermatrix.

Table (2): Balanced super matrix

		cost	invironment	quality	social	aim
Criteria	cost	0.020	0.012	0.026	0.073	0.056
	invironment	0.128	0.070	0.141	0.226	0.291
	quality	0.062	0.030	0.055	0.054	0.120
	social	0.024	0.009	0.061	0.027	0.033
goal	aim	0	0	0	0	0.5
subc1	Cost to society	0.204	0	0	0	0
	Cost to users	0.036	0	0	0	0
	Financial performance	0.089	0	0	0	0
	investment	0.124	0	0	0	0
	Life cycle cost	0.201	0	0	0	0
	Repairs	0.113	0	0	0	0
subc2	Business ethics	0	0	0.092	0	0
	CRM	0	0	0.062	0	0
	Environmental economics	0	0	0.271	0	0
	Financial benefits	0	0	0.114	0	0
	Innovation Management	0	0	0.178	0	0
subc3	Dust emission	0	0.034	0	0	0
	Emission of greenhouse gases	0	0.109	0	0	0
	energy saving	0	0.185	0	0	0

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	Noise	0	0.034	0	0	0
	renewable energy	0	0.093	0	0	0
	Saving Water	0	0.169	0	0	0
	Waste and garbage	0	0.100	0	0	0
	water pollution	0	0.154	0	0	0
subc4	afety and health of workers	0	0	0	0.205	0
	capacity of construction	0	0	0	0.178	0
	Community amenities	0	0	0	0.054	0
	human resources	0	0	0	0.183	0

Forming the bounded supermatrix

We raise the weighted supermatrix to the infinite power so that it converges. The converged matrix is the bounded supermatrix.

Table (3): Bounded supermatrix

		Criteria				
		cost	invironment	quality	social	aim
Criteria	cost	0.031	0.031	0.031	0.031	0.031
	invironment	0.241	0.241	0.241	0.241	0.240
	quality	0.041	0.041	0.041	0.041	0.045
	social	0.064	0.064	0.064	0.064	0.059
goal	aim	0.000	0.000	0.000	0.000	0.018
subc1	Cost to society	0.013	0.013	0.013	0.013	0.013
	Cost to users	0.002	0.002	0.002	0.002	0.002
	Financial performance	0.006	0.005	0.006	0.006	0.006
	investment	0.008	0.008	0.008	0.008	0.008
	Life cycle cost	0.013	0.013	0.013	0.013	0.013
	Repairs	0.007	0.007	0.007	0.007	0.007
subc2	Business ethics	0.008	0.008	0.008	0.008	0.008
	CRM	0.005	0.005	0.005	0.005	0.006

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	Environmental economics	0.023	0.023	0.023	0.023	0.024
	Financial benefits	0.010	0.010	0.010	0.010	0.010
	Innovation Management	0.015	0.015	0.015	0.015	0.016
subc3	Dust emission	0.017	0.016	0.017	0.017	0.016
	Emission of greenhouse gases	0.054	0.054	0.054	0.054	0.052
	energy saving	0.091	0.091	0.091	0.091	0.089
	Noise	0.017	0.017	0.017	0.017	0.016
	renewable energy	0.046	0.046	0.046	0.046	0.044
	Saving Water	0.084	0.083	0.084	0.084	0.081
	Waste and garbage	0.049	0.049	0.049	0.049	0.048
	water pollution	0.076	0.076	0.076	0.076	0.074
subc4	afety and health of workers	0.027	0.027	0.027	0.027	0.024
	capacity of construction	0.023	0.024	0.023	0.023	0.021
	Community amenities	0.007	0.007	0.007	0.007	0.006
	human resources	0.024	0.024	0.024	0.024	0.022

Prioritizing main factors and sub-criteria

Table 4-7 shows the prioritization of the main factors and sub-criteria of each cluster using the network analysis technique (ANP). As can be seen, among the main factors affecting sustainable project management in the construction industry, environmental factors with a weight of 0.639 are the most important factors, followed by social factors with a relative weight of 0.154 in the second place and quality factor with a relative weight of 0.120 in the third place. And then the cost factor is ranked fourth with a weight of 0.084. Among the cost factors, the weight of the following criteria is as follows.

The sub-criterion of the cost imposed on the society with a relative weight of 0.266 ranks first in importance. Also, the sub-criterion of the project life cycle cost with a relative weight of 0.262 is in the second place, and the sub-criterion of investment and improvement in services and facilities with a relative weight of 0.162 is in the third place, the sub-criterion of the cost of repairs and maintenance with a relative weight of 0.147 is in the fourth place and below the criterion Financial performance (return on investment, debt repayment, profitability and liquidity) is ranked fifth in importance with a relative weight of 0.116 and finally below the

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criterion of cost imposed on users with a relative weight of 0.046 in the sixth rank of importance. Among the quality factors, the following criteria are weighted as follows.

The sub-criterion of environmental economics and accounting with a relative weight of 0.378 is in the first place and the sub-criterion of innovation management (research and development, consumption patterns, production, productivity and flexibility) is in the second place with a relative weight of 0.248 and the sub-criterion of financial benefits of good actions (social, environmental, health and safety, job creation, education) with a relative weight of 0.159 in the third place and under the standard of business ethics (fair trade, bribery and corruption, technical and legal requirements) with a relative weight of 0.128 in the fourth place and Finally, under the criterion of managing the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), it ranks fifth with a relative weight of 0.087. Among the environmental factors, the weight of the sub-criteria is as follows.

As can be seen, the energy saving sub-criterion with a relative weight of 0.210 ranks first in importance. Also, the sub-criterion of saving water consumption with a relative weight of 0.193 is in the second place, and the sub-criterion of water pollution with a relative weight of 0.176 is in the third place, as well as the sub-criterion of greenhouse gas emissions with a relative weight of 0.124 in the fourth place of importance and the sub-criterion of waste and waste management produced with a relative weight of 0.114 in the fifth rank of importance and under the criterion of the use of renewable energy with a relative weight of 0.106 in the sixth rank and under the criterion of noise pollution with a relative weight of 0.039 in the seventh rank and finally under the criterion of the emission of particles and dust with a weight Relative 0.038 ranks eighth. Among the factors of social factors, the weight of the sub-criteria is as follows.

The sub-criterion of worker safety and health assessment with a relative weight of 0.330 is in the first place of importance, and the sub-criterion of human resources recruitment and management with a relative weight of 0.295 is in the second place, and the sub-criterion of the capacity of construction infrastructures is in the third place with a relative weight of 0.288, and finally, the sub-criterion of facilities. The welfare of society is ranked fourth with a relative weight of 0.087.

Table (4): Prioritization of main factors and sub-criteria

Criterion weight in the cluster (limited)	*Benchmark weight in the cluster (normalized)*	Below the criteria	*The weight of the main factor*	The main invoice
0.006	0.116	Financial performance	**0.084**	cost
0.008	0.162	Investment and improvement in services and facilities		
0.007	0.147	The cost of repairs and maintenance		

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0.013	0.266	Cost imposed on society		
0.013	0.262	Project life cycle cost		
0.002	0.046	Cost imposed on users		
0.006	0.087	Managing the company's relationship with customers		quality
0.010	0.159	Financial benefits of good actions		
0.016	0.248	Innovation management	**0.120**	
0.024	0.378	Environmental economics and accounting		
0.008	0.128	Business ethics		
0.081	0.193	Save water		Environmental factors
0.074	0.176	water pollution		
0.052	0.124	Emission of greenhouse gases		
0.016	0.038	Emission of particles and dust		
0.044	0.106	Use of renewable energy	**0.639**	
0.089	0.210	Energy saving		
0.048	0.114	Waste and waste management		
0.016	0.039	The amount of noise pollution		
0.022	0.295	Recruitment and management of human resources		Social factors
0.021	0.288	The capacity of construction infrastructure	**0.157**	
0.006	0.087	Community amenities		
0.024	0.330	Assessing the safety and health of workers		

Steps of Dimtel's method

Step 1: Formation of fuzzy direct correlation matrix

To identify the pattern of relationships between n criteria, an n×n matrix is first formed. The effect of the element included in each row on the elements included in the column in this matrix is inserted as a fuzzy number. If the perspective of more than one person is used, each of the experts should complete the existing matrix. Then, the simple average of comments is used and the direct correlation matrix z is formed.

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$$z = \begin{bmatrix} 0 & \cdots & \tilde{z}_{n1} \\ \vdots & \ddots & \vdots \\ \tilde{z}_{1n} & \cdots & 0 \end{bmatrix}$$

The table below shows the direct correlation matrix, which is the pairwise comparisons of experts. If several experts were used in the evaluation, the following matrix is the arithmetic mean of all experts.

Direct correlation matrix

Due to the large size of the matrix, a part of the direct correlation matrix is shown:

Energy saving	Save water	water pollution	Emission of greenhouse gases		Waste and waste management	Financial performance	Managing the company's relationship with customers	Community amenities	Cost imposed on users
Energy saving	(0.000,0.000,0.000)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	…	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)
Save water	(0.000,0.000,0.250)	(0.000,0.000,0.000)	(0.750,1.000,1.000)	…	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)
water pollution	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.000,0.000,0.000)	…	(0.500,0.750,1.000)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.500,0.750,1.000)	(0.500,0.750,1.000)
greenhouse emissions	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.500,0.750,1.000)	…	(0.000,0.000,0.000)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)
Waste and waste management	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.500,0.750,1.000)	…	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.500,0.750,1.000)
Use of renewable energy	(0.750,1.000,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	…	(0.750,1.000,1.000)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.000,0.250,0.500)
Environmental economics and accounting	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	…	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.000,0.250,0.500)
Evaluation of safety and health of workers	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	…	(0.000,0.250,0.500)	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.500,0.750,1.000)
Recruitment and management of human resources	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	…	(0.000,0.000,0.250)	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.000,0.250,0.500)

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The capacity of construction infrastructures	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	…	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.500,0.750,1.000)
Innovation management	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.000,0.250,0.500)	…	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.250,0.500,0.750)
Emission of particles and dust	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.000,0.250)	…	(0.000,0.000,0.250)	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.500,0.750,1.000)
Noise level	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.000,0.250)	…	(0.000,0.000,0.250)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.500,0.750,1.000)	(0.250,0.500,0.750)
A cost imposed on society	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.250,0.500)	…	(0.000,0.250,0.500)	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.000,0.000,0.250)	(0.000,0.250,0.500)
Project life cycle cost	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.000,0.250)	…	(0.000,0.000,0.250)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)
Financial benefits of good actions	(0.000,0.250,0.500)	(0.000,0.000,0.250)	(0.000,0.250,0.500)	…	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.000,0.250,0.500)
Investment and improvement in services and facilities	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	…	(0.500,0.750,1.000)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.500,0.750,1.000)
business ethics	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.250,0.500)	…	(0.250,0.500,0.750)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	(0.000,0.250,0.500)
The cost of repairs and maintenance	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.000,0.250)	…	(0.000,0.000,0.250)	(0.000,0.000,0.000)	(0.500,0.750,1.000)	(0.000,0.000,0.250)	(0.000,0.000,0.250)
Financial performance	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	…	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.000,0.000,0.000)	(0.000,0.250,0.500)	(0.250,0.500,0.750)
Managing the company's relationship with customers	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	…	(0.500,0.750,1.000)	(0.000,0.250,0.500)	(0.250,0.500,0.750)	(0.000,0.000,0.000)	(0.250,0.500,0.750)
Community amenities	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.500,0.750,1.000)	…	(0.500,0.750,1.000)	(0.000,0.000,0.250)	(0.000,0.250,0.500)	(0.000,0.250,0.500)	(0.000,0.000,0.000)
Cost imposed on users	(0.000,0.000,0.250)	(0.000,0.000,0.250)	(0.000,0.000,0.250)	…	(0.000,0.000,0.250)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.250,0.500,0.750)	(0.000,0.250,0.500)

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Also, the phase spectrum used in the model is given in the table below.

Table (6): Phase spectrum

U	M	L	verbal expression	cod
0.25	0	0	no effect	1
0.5	0.25	0	Very low impact	2
0.75	0.5	0.25	Low impact	3
1	0.75	0.5	High impact	4
1	1	0.75	Very high impact	5

Step 2: Normalize the fuzzy direct correlation matrix

The following relation is used to normalize the fuzzy direct correlation matrix.

$$\tilde{x}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right)$$

$$r = \max_{i,j}\left\{\max_{i} \sum_{j=1}^{n} u_{ij}, \max_{j} \sum_{i=1}^{n} u_{ij}\right\} \qquad i, j \in \{1,2,3,\dots,n\}$$

Table (7): Fuzzy direct correlation matrix

Cost imposed on users	Community amenities	Managing the company's relationship with customers	Financial performance	Waste and waste management		Emission of greenhouse gases	water pollution	Save water	Energy saving
(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	…	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.000,0.000,0.000)	Energy saving
(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	…	(0.041,0.054,0.054)	(0.000,0.000,0.000)	(0.000,0.000,0.014)	Save water
(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.027,0.041,0.054)	…	(0.000,0.000,0.000)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	water pollution
(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.000,0.000,0.000)	…	(0.027,0.041,0.054)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	Emission of greenhouse gases
(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	…	(0.027,0.041,0.054)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	Waste and waste management
(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.041,0.054,0.054)	…	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.041,0.054,0.054)	Use of renewable energy
(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	…	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	Environmental economics and accounting
(0.027,0.041,0.054)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.027,0.041,0.054)	(0.000,0.014,0.027)	…	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	Assessing the safety and health of workers
(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.000,0.000,0.014)	…	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	Recruitment and management of human resources

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(0.027,0.041,0.054)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	...	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	The capacity of construction infrastructure
(0.014,0.027,0.041)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	...	(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.027,0.041,0.054)	Innovation management
(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.027,0.041,0.054)	(0.000,0.000,0.014)	...	(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	Emission of particles and dust
(0.014,0.027,0.041)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.027,0.041,0.054)	(0.000,0.000,0.014)	...	(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	The amount of noise pollution
(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.000,0.014,0.027)	...	(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	Cost imposed on society
(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.000,0.000,0.014)	...	(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	Project life cycle cost
(0.000,0.014,0.027)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	...	(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.000,0.014,0.027)	Financial benefits of good actions
(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.027,0.041,0.054)	...	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	Investment and improvement in services and facilities
(0.000,0.014,0.027)	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.014,0.027,0.041)	...	(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	Business ethics
(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.027,0.041,0.054)	(0.000,0.000,0.000)	(0.000,0.000,0.014)	...	(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	The cost of repairs and maintenance
(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.000,0.000,0.000)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	...	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	Financial performance
(0.014,0.027,0.041)	(0.000,0.000,0.000)	(0.014,0.027,0.041)	(0.000,0.014,0.027)	(0.027,0.041,0.054)	...	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	Managing the company's relationship with customers
(0.000,0.000,0.000)	(0.000,0.014,0.027)	(0.000,0.014,0.027)	(0.000,0.000,0.014)	(0.027,0.041,0.054)	...	(0.027,0.041,0.054)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	Community amenities
(0.000,0.014,0.027)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.014,0.027,0.041)	(0.000,0.000,0.014)	...	(0.000,0.000,0.014)	(0.000,0.000,0.014)	(0.000,0.000,0.014)	Cost imposed on users

Step 3: Calculation of the fuzzy matrix of the complete connection

In this step, according to the following relationship, the fuzzy matrix of total relationships is formed.

$$\tilde{T} = \lim_{k\to+\infty} (\tilde{x}^1 \oplus \tilde{x}^2 \oplus \ldots \oplus \tilde{x}^k)$$

row of the fuzzy number of the total relations matrix If each$\tilde{t}_{ij} = (l''_{ij}, m''_{ij}, u''_{ij})$,is of the form :it is calculated as follows

$$[l''_{ij}] = x_l \times (I - x_l)^{-1}$$

$$[m''_{ij}] = x_m \times (I - x_m)^{-1}$$

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$[u^{"}_{ij}] = x_u \times (I - x_u)^{-1}$

In other words, first calculate the inverse of the normal matrix and then subtract it from theI matrix and finally multiply the normal matrix by the resulting matrix to do The following table .shows a part of the complete fuzzy relation matrix

Table (8): Full fuzzy relation matrix

Cost imposed on users	Community amenities	Managing the 'company s relationship with customers	Financial performance	The cost of repairs and maintenance	. . .	Waste and waste management	Emission of greenhouse gases	water pollution	Save water	Energy saving
(0.032,0.069,0.205)	(0.032,0.070,0.205)	(0.032,0.071,0.208)	(0.031,0.067,0.196)	(0.031,0.066,0.192)	. . .	(0.032,0.064,0.180)	(0.019,0.052,0.169)	(0.016,0.043,0.145)	(0.003,0.017,0.105)	Energy saving
(0.031,0.066,0.188)	(0.031,0.066,0.189)	(0.030,0.066,0.190)	(0.016,0.049,0.167)	(0.016,0.048,0.163)	. . .	(0.005,0.035,0.141)	(0.044,0.073,0.167)	(0.002,0.015,0.095)	(0.003,0.015,0.108)	Save water
(0.032,0.069,0.199)	(0.032,0.068,0.198)	(0.005,0.042,0.175)	(0.004,0.039,0.164)	(0.017,0.051,0.172)	. . .	(0.031,0.061,0.173)	(0.004,0.023,0.123)	(0.002,0.028,0.127)	(0.003,0.016,0.114)	water pollution
(0.020,0.059,0.198)	(0.020,0.059,0.198)	(0.020,0.060,0.201)	(0.019,0.056,0.188)	(0.018,0.054,0.184)	. . .	(0.005,0.024,0.131)	(0.031,0.064,0.184)	(0.003,0.030,0.136)	(0.004,0.019,0.123)	Emission of greenhouse gases
(0.032,0.069,0.202)	(0.020,0.057,0.191)	(0.019,0.057,0.192)	(0.031,0.067,0.194)	(0.031,0.066,0.190)	. . .	(0.018,0.049,0.163)	(0.030,0.062,0.177)	(0.002,0.029,0.130)	(0.016,0.042,0.141)	Waste and waste management
(0.008,0.049,0.187)	(0.021,0.062,0.199)	(0.021,0.062,0.201)	(0.021,0.059,0.190)	(0.006,0.044,0.173)	. . .	(0.045,0.078,0.182)	(0.032,0.066,0.185)	(0.029,0.057,0.161)	(0.043,0.070,0.159)	Use of renewable energy
(0.004,0.038,0.156)	(0.004,0.037,0.156)	(0.004,0.038,0.158)	(0.017,0.049,0.161)	(0.003,0.035,0.145)	. . .	(0.016,0.044,0.145)	(0.016,0.045,0.147)	(0.015,0.039,0.128)	(0.015,0.039,0.127)	Environmental economics and accounting
(0.030,0.064,0.186)	(0.004,0.039,0.161)	(0.018,0.052,0.176)	(0.030,0.062,0.178)	(0.030,0.061,0.175)	. . .	(0.003,0.031,0.136)	(0.002,0.032,0.138)	(0.001,0.026,0.118)	(0.002,0.014,0.105)	Assessing the safety and health of workers
(0.001,0.028,0.127)	(0.014,0.042,0.141)	(0.001,0.030,0.130)	(0.014,0.040,0.134)	(0.000,0.026,0.119)	. . .	(0.000,0.012,0.097)	(0.000,0.025,0.111)	(0.000,0.021,0.096)	(0.001,0.022,0.096)	Recruitment and management of human resources
(0.030,0.062,0.174)	(0.003,0.034,0.147)	(0.016,0.048,0.162)	(0.003,0.033,0.140)	(0.002,0.019,0.125)	. . .	(0.016,0.042,0.139)	(0.002,0.030,0.128)	(0.001,0.024,0.110)	(0.015,0.037,0.121)	The capacity of construction infrastructure

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(0.019,0.057,0.192)	(0.033,0.070,0.205)	(0.033,0.071,0.208)	(0.019,0.055,0.183)	(0.017,0.053,0.179)	...	(0.004,0.036,0.152)	(0.004,0.036,0.154)	(0.016,0.042,0.144)	(0.029,0.056,0.156)	Innovation management
(0.029,0.054,0.154)	(0.029,0.053,0.153)	(0.016,0.042,0.144)	(0.029,0.052,0.148)	(0.002,0.027,0.121)	...	(0.002,0.011,0.098)	(0.001,0.011,0.099)	(0.001,0.007,0.084)	(0.001,0.007,0.083)	Release of particles and dust
(0.015,0.040,0.139)	(0.029,0.054,0.153)	(0.030,0.056,0.156)	(0.028,0.052,0.146)	(0.015,0.039,0.131)	...	(0.002,0.011,0.097)	(0.001,0.010,0.097)	(0.001,0.007,0.083)	(0.001,0.008,0.083)	The amount of noise pollution
(0.000,0.027,0.123)	(0.001,0.015,0.111)	(0.001,0.027,0.124)	(0.001,0.013,0.104)	(0.014,0.038,0.127)	...	(0.000,0.023,0.105)	(0.000,0.023,0.106)	(0.000,0.007,0.079)	(0.000,0.007,0.079)	Cost imposed on society
(0.015,0.042,0.143)	(0.015,0.042,0.143)	(0.015,0.043,0.146)	(0.015,0.041,0.137)	(0.001,0.027,0.121)	...	(0.002,0.012,0.099)	(0.001,0.012,0.101)	(0.001,0.009,0.086)	(0.001,0.010,0.086)	Project life cycle cost
(0.001,0.028,0.126)	(0.028,0.054,0.152)	(0.015,0.041,0.140)	(0.001,0.026,0.120)	(0.014,0.038,0.129)	...	(0.001,0.012,0.096)	(0.001,0.024,0.109)	(0.000,0.008,0.082)	(0.000,0.021,0.094)	Financial benefits of good actions
(0.033,0.073,0.214)	(0.021,0.061,0.202)	(0.020,0.061,0.204)	(0.020,0.058,0.192)	(0.032,0.069,0.201)	...	(0.032,0.065,0.186)	(0.032,0.066,0.189)	(0.016,0.044,0.151)	(0.017,0.044,0.149)	Investment and improvement in services and facilities
(0.005, 0.038, 0.156)	(0.030,0.063,0.181)	(0.017,0.051,0.170)	(0.003,0.036,0.148)	(0.002,0.020,0.118)	...	(0.016,0.044,0.145)	(0.002,0.031,0.134)	(0.001,0.013,0.103)	(0.002,0.014,0.103)	Business ethics
(0.003,0.018,0.124)	(0.003,0.018,0.124)	(0.030,0.058,0.164)	(0.002,0.017,0.104)	(0.015,0.041,0.139)	...	(0.001,0.012,0.102)	(0.001,0.012,0.104)	(0.001,0.008,0.088)	(0.001,0.010,0.089)	The cost of repairs and maintenance
(0.015,0.044,0.146)	(0.001,0.030,0.133)	(0.001,0.017,0.108)	(0.002,0.029,0.127)	(0.001,0.028,0.124)	...	(0.002,0.028,0.116)	(0.002,0.028,0.117)	(0.001,0.024,0.101)	(0.002,0.024,0.100)	Financial performance
(0.017,0.050,0.166)	(0.003,0.023,0.127)	(0.016,0.049,0.167)	(0.003,0.034,0.145)	(0.002,0.033,0.141)	...	(0.029,0.057,0.156)	(0.017,0.045,0.146)	(0.015,0.038,0.126)	(0.015,0.038,0.125)	Managing the company's relationship with customers
(0.004,0.021,0.118)	(0.003,0.034,0.144)	(0.003,0.033,0.144)	(0.003,0.019,0.124)	(0.003,0.032,0.134)	...	(0.030,0.056,0.149)	(0.030,0.057,0.152)	(0.015,0.038,0.120)	(0.015,0.037,0.118)	Community amenities
(0.000,0.020,0.100)	(0.014,0.033,0.113)	(0.014,0.034,0.115)	(0.014,0.033,0.108)	(0.000,0.019,0.094)	...	(0.000,0.005,0.074)	(0.000,0.005,0.075)	(0.000,0.004,0.064)	(0.000,0.004,0.064)	Cost imposed on users

Step 4: De-fuzzifying the values of the complete correlation matrix

For de-fuzzification, theCFCS epiechoic and bell method has been used. The steps of the de-:fuzzification method are as follows

$$l_{ij}^{n} = \frac{\left(l_{ij}^{t} - min\, l_{ij}^{t}\right)}{\Delta_{min}^{max}}$$

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$$m_{ij}^{n} = \frac{(m_{ij}^{t} - min\ l_{ij}^{t})}{\Delta_{min}^{max}}$$

$$u_{ij}^{n} = \frac{(u_{ij}^{t} - min\ l_{ij}^{t})}{\Delta_{min}^{max}}$$

:so that

$$\Delta_{min}^{max} = max\ u_{ij}^{t} - min\ l_{ij}^{t}$$

:Calculation of upper and lower limits of normal values

$$l_{ij}^{s} = {m_{ij}^{n}}/{(1 + m_{ij}^{n} - l_{ij}^{n})}$$

$$u_{ij}^{s} = {u_{ij}^{n}}/{(1 + u_{ij}^{n} - l_{ij}^{n})}$$

cfcs .algorithm is a matrix with definite values

:Calculation of total normalized definitive values

$$x_{ij} = \frac{[l_{ij}^{s}(1 - l_{ij}^{s}) + u_{ij}^{s} \times u_{ij}^{s}]}{[1 - l_{ij}^{s} + u_{ij}^{s}]}$$

.The following table shows the dephased values of the complete correlation matrix

Table (9): complete deterministic correlation matrix

Cost imposed on users	Community amenities	Managing the company's relationship with customers	Financial performance	The cost of repairs and maintenance	Business ethics	Investment and improvement in services and facilities	Financial benefits of good actions	Project life cycle cost	Use of renewable energy	Waste and waste management	Emission of greenhouse gases	water pollution	Save water	Energy saving	
0.083	0.089	0.089	0.09	0.085	0.084	0.073	0.075	0.067	0.08	0.086	0.08	0.069	0.059	0.032	Energy saving
0.066	0.084	0.084	0.084	0.067	0.066	0.067	0.07	0.062	0.075	0.057	0.052	0.086	0.029	0.031	Save water
0.058	0.087	0.087	0.063	0.058	0.069	0.07	0.086	0.089	0.065	0.083	0.077	0.04	0.044	0.033	water pollution
0.074	0.08	0.079	0.08	0.075	0.074	0.086	0.09	0.094	0.08	0.087	0.043	0.081	0.047	0.037	Emission of greenhouse gases
0.071	0.088	0.077	0.077	0.084	0.084	0.083	0.087	0.078	0.055	0.047	0.066	0.078	0.045	0.057	Waste and waste management
0.076	0.07	0.081	0.082	0.077	0.064	0.076	0.08	0.094	0.045	0.088	0.091	0.083	0.072	0.081	Use of renewable energy

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0.065	0.057	0.056	0.057	0.066	0.053	0.065	0.055	0.07	0.061	0.065	0.06	0.061	0.053	0.053	Environmental economics and accounting
0.066	0.082	0.058	0.071	0.079	0.078	0.078	0.081	0.084	0.05	0.067	0.048	0.049	0.041	0.03	Assessing the safety and health of workers
0.042	0.045	0.058	0.046	0.055	0.042	0.042	0.044	0.058	0.039	0.042	0.026	0.039	0.034	0.034	Recruitment and management of human resources
0.062	0.079	0.052	0.066	0.05	0.038	0.062	0.052	0.066	0.034	0.063	0.057	0.046	0.038	0.051	The capacity of construction infrastructure
0.084	0.077	0.089	0.09	0.074	0.072	0.072	0.086	0.078	0.067	0.072	0.054	0.055	0.058	0.07	Innovation management
0.067	0.07	0.07	0.059	0.068	0.042	0.042	0.069	0.059	0.026	0.03	0.026	0.026	0.02	0.02	Release of particles and dust
0.066	0.057	0.07	0.072	0.067	0.054	0.054	0.068	0.058	0.026	0.03	0.026	0.025	0.02	0.021	The amount of noise pollution
0.04	0.043	0.031	0.043	0.029	0.053	0.04	0.055	0.057	0.037	0.04	0.037	0.037	0.019	0.019	Cost imposed on society
0.043	0.058	0.059	0.06	0.057	0.042	0.043	0.045	0.032	0.052	0.043	0.027	0.027	0.022	0.023	Project life cycle cost
0.053	0.044	0.07	0.058	0.042	0.053	0.041	0.026	0.058	0.038	0.042	0.026	0.038	0.02	0.033	Financial benefits of good actions
0.075	0.093	0.081	0.081	0.077	0.087	0.051	0.079	0.095	0.082	0.089	0.082	0.083	0.06	0.06	Investment and improvement in services and facilities
0.053	0.057	0.081	0.069	0.054	0.037	0.065	0.067	0.071	0.047	0.066	0.06	0.048	0.029	0.03	Business ethics
0.046	0.036	0.037	0.075	0.032	0.057	0.058	0.06	0.062	0.041	0.044	0.027	0.028	0.022	0.023	The cost of repairs and maintenance
0.032	0.06	0.047	0.033	0.046	0.044	0.045	0.034	0.049	0.054	0.059	0.042	0.042	0.036	0.037	Financial performance
0.051	0.068	0.041	0.068	0.052	0.051	0.051	0.054	0.068	0.048	0.064	0.072	0.061	0.052	0.052	Managing the company's relationship with customers
0.048	0.038	0.052	0.051	0.038	0.048	0.049	0.051	0.053	0.058	0.075	0.07	0.072	0.051	0.05	Community amenities
0.015	0.033	0.046	0.048	0.045	0.031	0.031	0.019	0.034	0.017	0.019	0.016	0.016	0.013	0.013	Cost imposed on users

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Step 5: Threshold calculation

All the determined complete correlation matrix values that are lower than the mean of the complete correlation matrix are identified and set to zero using the following relationship, in .other words, the causal relationship is not considered

$$TS = \frac{\sum_{i=1}^{n}\sum_{j=1}^{m} V_{ij}}{m \times n}$$

$$U_{ij} = \begin{cases} V_{ij} & V_{ij} \geq TS \\ 0 & Others \end{cases}$$

.The table below shows the full correlation matrix with values below the threshold removed Based on the table below, causal relationships between elements are drawn . Threshold value)TSin this research equal (It is 0.055

Table (10): complete deterministic correlation matrix with the removal of lower threshold values

	Energy saving	Save water	water pollution	Emission of greenhouse gases	Waste and waste management	Use of renewable energy	...	Investment and improvement in services and facilities	Business ethics	The cost of repairs and maintenance	Financial performance	Managing the company's relationship with customers	Community ameniti es	Cost imposed on users
Energy saving	0	0.059	0.069	0.08	0.086	0.08	...	0.073	0.084	0.085	0.09	0.089	0.089	0.083
Save water	0	0	0.086	0	0.057	0.075	...	0.067	0.066	0.067	0.084	0.084	0.084	0.066
water pollution	0	0	0	0.077	0.083	0.065	...	0.07	0.069	0.058	0.063	0.087	0.087	0.058
Emission of greenhouse gases	0	0	0.081	0	0.087	0.08	...	0.086	0.074	0.075	0.08	0.079	0.08	0.074
Waste and waste management	0.057	0	0.078	0.066	0	0	...	0.083	0.084	0.084	0.077	0.077	0.088	0.071
Use of renewable energy	0.081	0.072	0.083	0.091	0.088	0	...	0.076	0.064	0.077	0.082	0.081	0.07	0.076
Environmental economics and accounting	0	0	0.061	0.06	0.065	0.061	...	0.065	0	0.066	0.057	0.056	0.057	0.065
Assessing the safety and health of workers	0	0	0	0	0.067	0	...	0.078	0.078	0.079	0.071	0.058	0.082	0.066
Recruitment and management of human resources	0	0	0	0	0	0	...	0	0	0.055	0	0.058	0	0
The capacity of construction	0	0	0	0.057	0.063	0	...	0.062	0	0	0.066	0	0.079	0.062

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infrastructure														
Innovation management	0.07	0.058	0	0	0.072	0.067	...	0.072	0.072	0.074	0.09	0.089	0.077	0.084
Release of particles and dust	0	0	0	0	0	0	...	0	0	0.068	0.059	0.07	0.07	0.067
The amount of noise pollution	0	0	0	0	0	0	...	0	0	0.067	0.072	0.07	0.057	0.066
Cost imposed on society	0	0	0	0	0	0	...	0	0	0	0	0	0	0
Project life cycle cost	0	0	0	0	0	0	...	0	0	0.057	0.06	0.059	0.058	0
Financial benefits of good actions	0	0	0	0	0	0	...	0	0	0	0.058	0.07	0	0
Investment and improvement in services and facilities	0.06	0.06	0.083	0.082	0.089	0.082	...	0	0.087	0.077	0.081	0.081	0.093	0.075
Business ethics	0	0	0	0.06	0.066	0	...	0.065	0	0	0.069	0.081	0.057	0
The cost of repairs and maintenance	0	0	0	0	0	0	...	0.058	0.057	0	0.075	0	0	0
Financial performance	0	0	0	0	0.059	0	...	0	0	0	0	0	0.06	0
Managing the company's relationship with customers	0	0	0.061	0.072	0.064	0	...	0	0	0	0.068	0	0.068	0
Community amenities	0	0	0.072	0.07	0.075	0.058	...	0	0	0	0	0	0	0
Cost imposed on users	0	0	0	0	0	0	...	0	0	0	0	0	0	0

Step 6: Final output and create a causal diagram

The next step is to get the sum of the rows and columns of the matrix$T$ We obtain the sum of .) rows$D$) and columns (R .according to the following formulas (

$$D = \sum_{j=1}^{n} T_{ij}$$

$$R = \sum_{i=1}^{n} \tilde{T}_{ij}$$

Then, according toD andR we obtain the values of ,D+R andDR , which respectively indicate the degree of interaction and the influence of the factors. The final output is shown in the table .below

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Table (11): Final output

Dr	D+R	d	R	
0.755	2.537	1.646	0.891	thrifty joy in consumption energy
0.573	2.341	1.457	0.884	thrifty joy in consumption water
0.366	2.746	1.556	1.19	pollution water
0.548	2.884	1.716	1.168	release Gases greenhouse E
0.251	2.966	1.608	1.357	Management waste and Garbage Hi produced
0.576	2.933	1.755	1.178	use from energy Hi renewable
0.082	2.574	1.328	1.246	economy and Accounting life environmental
0.189	2.616	1.403	1.214	Evaluation safety and health workers
-0.343	2.242	0.95	1.292	Employment and Management Resources human
0.144	2.294	1.219	1.075	Infrastructure capacity made and instrument
0.397	2.879	1.638	1.241	Management Innovation
-0.374	2.342	0.984	1.358	release Particles and round and dust
-0.13	2.057	0.964	1.093	amount pollution Audio
-0.341	2.107	0.883	1.224	the cost imposed on society
-0.539	2.537	0.999	1.538	the cost cycle Hayat Project
-0.501	2.36	0.929	1.431	Benefits finance Actions good
0.428	3.119	1.773	1.345	capital put and improvement in Services and facilities
0.027	2.674	1.351	1.323	ethics commercial
-0.3	2.451	1.076	1.375	the cost repairs and keep you have
-0.496	2.549	1.027	1.523	performance finance
-0.206	2.782	1.288	1.494	Management communication company with Customers
-0.334	2.654	1.16	1.494	Facilities welfare society
-0.773	1.899	0.563	1.336	the cost imposed on Users

The figure below also shows the pattern of significant relationships. This pattern is in the form of a chart, in which the longitudinal axis is based onD + R values and the transverse axis is based onD - R. The position and relationships of each factor are determined by a point with coordinates(D + R, D - R) in the device.

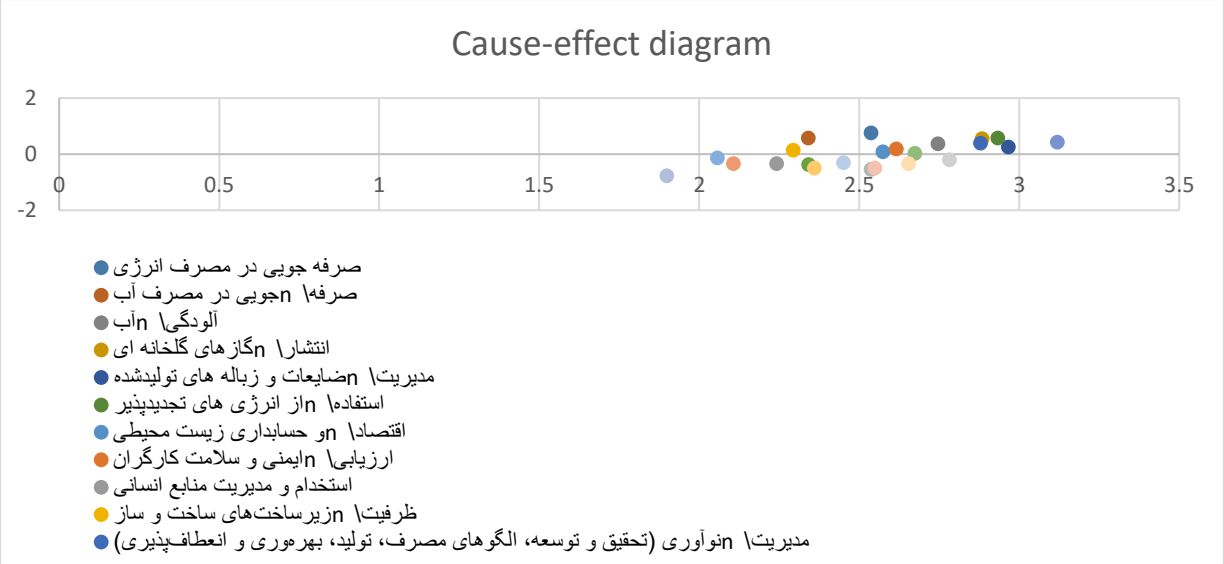

Figure (2): Relationship pattern diagram

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conclusion In this research, after summarizing the opinions of experts, 4 factors were identified, among the main factors affecting sustainable project management in the construction industry, the 4 main factors are environmental factors, social factors, quality factors, and cost factors. Among the main factors affecting sustainable project management in the construction industry, environmental factors with a weight of 0.639 are the most important factors, followed by social factors with a relative weight of 0.154, and the quality factor with a relative weight of 0.120 is the third, followed by the cost factor. It ranks fourth with a weight of 0.084. Also, among the sub-criteria and sub-factors, the weight of the sub-criteria is as follows. Among the cost criteria, the most important sub-criterion is the cost imposed on the society with a relative weight of 0.266. Also, the sub-criterion of project life cycle cost with a relative weight of 0.262 is in the second place and the sub-criterion of investment and improvement in services and facilities with a relative weight of 0.162 is in the third place, the sub-criterion of repair and maintenance cost with a relative weight of 0.147 is in the fourth place and below the criterion Financial performance (return on investment, debt repayment, profitability and liquidity) is ranked fifth in importance with a relative weight of 0.116 and finally below the criterion of cost imposed on users with a relative weight of 0.046 in the sixth rank of importance. Also, among the weight quality factors below the criteria are as follows. The sub-criterion of environmental economics and accounting with a relative weight of 0.378 is in the first place and the sub-criterion of innovation management (research and development, consumption patterns, production, productivity and flexibility) is in the second place with a relative weight of 0.248 and the sub-criterion of financial benefits of good actions (social, environmental, health and safety, job creation, education) with a relative weight of 0.159 in the third place and under the standard of business ethics (fair trade, bribery and corruption, technical and legal requirements) with a relative weight of 0.128 in the fourth place and Finally, under the criterion of managing the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), it ranks fifth with a relative weight of 0.087. The results showed that among the environmental factors, the weight under the criterion of energy saving with a relative weight of 0.210 is in the first place of importance. Also, the sub-criterion of saving water consumption with a relative weight of 0.193 is in the second place, and the sub-criterion of water pollution with a relative weight of 0.176 is in the third place, as well as the sub-criterion of greenhouse gas emissions with a relative weight of 0.124 in the fourth place of importance and the sub-criterion of waste and waste management produced with a relative weight of 0.114 in the fifth rank of importance and under the criterion of the use of renewable energy with a relative weight of 0.106 in the sixth rank and under the criterion of noise pollution with a relative weight of 0.039 in the seventh rank and finally under the criterion of the emission of particles and dust with a weight Relative 0.038 ranks eighth. Among the factors of social factors, under the criterion of worker safety and health evaluation with a relative weight of 0.330, it is in the first place of importance, and under the criterion of recruitment and human resources management, with a relative weight of 0.295, in the second place, and under the criterion of the capacity of construction infrastructure, with a relative weight of 0.288, in the third place. And finally, it ranks fourth under the standard of community

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amenities with a relative weight of 0.087. The sum of the elements of each row (D) for each factor indicates the degree of influence of that factor on other factors of the system. In this research, saving energy consumption has the most impact, and saving water consumption, water pollution, greenhouse gas emissions, waste and waste management, use of renewable energy, environmental economics and accounting, safety assessment. and workers' health, employment and human resource management, construction infrastructure capacity, innovation management (research and development, consumption patterns, production, productivity and flexibility), particle and dust emissions, noise pollution, cost imposed on society, cost Project life cycle, financial benefits of good practices (social, environmental, health and safety, job creation, education and training), investment and improvement in services and facilities, business ethics (fair trade, bribery and corruption, technical and legal requirements) , repair and maintenance cost, financial performance (return on investment, debt repayment, profitability and liquidity), managing the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), community amenities and the cost imposed on users are in the next degrees of influence.

The sum of the elements of the column (R) for each factor indicates the influence of that factor on other factors of the system. In this research, the life cycle cost of the project has the most impact and financial performance (return on investment, debt repayment, profitability and liquidity), community amenities, company relationship management with customers (marketing and brand management, market share, management opportunities, risk management and pricing), financial benefits of good practices (social, environmental, health and safety, job creation, education and training), repair and maintenance costs, particulate and dust emissions, waste and waste management, capital Investment and improvement in services and facilities, cost imposed on users, business ethics (fair trade, bribery and corruption, technical and legal requirements), recruitment and human resource management, economics and environmental accounting, innovation management (research and development, consumption patterns , production, productivity and flexibility), the cost imposed on the society, the evaluation of the safety and health of workers, water pollution, the use of renewable energy, the emission of greenhouse gases, the amount of noise pollution, the capacity of construction infrastructure, saving energy and economy Water consumption is in the next degree of influence. The horizontal vector (D + R) shows the influence of the desired factor in the system. In other words, the higher the D + R value of an agent, the more interaction that agent has with other system agents. In this research, investment and improvement in services and facilities have the most impact, and waste and waste management, use of renewable energy, greenhouse gas emissions, innovation management (research and development, consumption patterns, production, productivity and flexibility), managing the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), water pollution, business ethics (fair trade, bribery and corruption, technical and legal requirements), community amenities , worker safety and health assessment, economics

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and environmental accounting, financial performance (return on investment, debt repayment, profitability and liquidity), energy saving, project life cycle cost, repair and maintenance cost, financial benefits of good practices. social, environmental, health and safety, job creation, education and training), emission of particles and dust, saving water consumption, capacity of construction infrastructure, employment and management of human resources, cost imposed on society, amount of noise pollution and the cost imposed on users are in the next degrees of influence.

The vertical vector (D - R) shows the influence of each factor. In general, if D - R is positive, the variable is considered a causal variable, and if it is negative, it is considered an effect. In this research, saving energy, saving water, water pollution, emission of greenhouse gases, management of waste and generated waste, use of renewable energy, economics and environmental accounting, assessment of workers' safety and health, infrastructure capacity Construction, innovation management (research and development, consumption patterns, production, productivity and flexibility), investment and improvement in services and facilities, business ethics (fair trade, bribery and corruption, technical and legal requirements) are causal. Also, the recruitment and management of human resources, the emission of particles and dust, the amount of noise pollution, the cost imposed on society, the cost of the project life cycle, the financial benefits of good actions (social, environmental, health and safety, job creation, education and training), Repair and maintenance cost, financial performance (return on investment, debt repayment, profitability and liquidity), management of the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), community amenities, Fees imposed on disabled users are considered. In this research, saving energy consumption has the most impact, and saving water consumption, water pollution, greenhouse gas emissions, waste and waste management, use of renewable energy, environmental economics and accounting, safety assessment. and workers' health, employment and human resource management, construction infrastructure capacity, innovation management (research and development, consumption patterns, production, productivity and flexibility), particle and dust emissions, noise pollution, cost imposed on society, cost Project life cycle, financial benefits of good practices (social, environmental, health and safety, job creation, education and training), investment and improvement in services and facilities, business ethics (fair trade, bribery and corruption, technical and legal requirements) , repair and maintenance cost, financial performance (return on investment, debt repayment, profitability and liquidity), management of the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), community amenities and the cost imposed on users are in the next degrees of influence. In this research, the life cycle cost of the project has the most impact and financial performance (return on investment, debt repayment, profitability and liquidity), community amenities, company relationship management with customers (marketing and brand management, market share, management opportunities, risk management and pricing), financial benefits of good practices (social, environmental, health and safety, job

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creation, education and training), repair and maintenance costs, particulate and dust emissions, waste and waste management, capital Investment and improvement in services and facilities, cost imposed on users, business ethics (fair trade, bribery and corruption, technical and legal requirements), recruitment and human resource management, economics and environmental accounting, fashion Innovation rate (research and development, consumption patterns, production, productivity and flexibility), cost imposed on society, assessment of workers' safety and health, water pollution, use of renewable energy, greenhouse gas emissions, noise pollution, construction infrastructure capacity and Instrument, saving energy consumption and saving water consumption are in the next degrees of effectiveness. In this research, investment and improvement in services and facilities have the most impact, and waste and waste management, use of renewable energy, greenhouse gas emissions, innovation management (research and development, consumption patterns, production, productivity and flexibility), managing the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), water pollution, business ethics (fair trade, bribery and corruption, technical and legal requirements), community amenities , worker safety and health assessment, economics and environmental accounting, financial performance (return on investment, debt repayment, profitability and liquidity), energy saving, project life cycle cost, repair and maintenance cost, financial benefits of good practices. social, environmental, health and safety, job creation, education and training), emission of particles and dust, saving water consumption, capacity of construction infrastructure, employment and management of human resources, cost imposed on society, amount of noise pollution and the cost imposed on users are in the next degrees of influence. In this research, saving energy, saving water, water pollution, emission of greenhouse gases, management of waste and generated waste, use of renewable energy, economics and environmental accounting, assessment of workers' safety and health, infrastructure capacity Construction, innovation management (research and development, consumption patterns, production, productivity and flexibility), investment and improvement in services and facilities, business ethics (fair trade, bribery and corruption, technical and legal requirements) and recruitment and Human resource management, particle and dust emission, noise pollution level, cost imposed on society, project life cycle cost, financial benefits of good practices (social, environmental, health and safety, job creation, education and training), repair cost and maintenance, financial performance (return on investment, debt repayment, profitability and liquidity), management of the company's relationship with customers (marketing and brand management, market share, management opportunities, risk management and pricing), community amenities, the cost imposed on Disabled users are considered.

The executive proposal based on the results includes limiting the technical offices of departments and employers to very limited people to do the administrative work of the projects and assigning the technical and executive affairs to the consultants and contractors with all its responsibilities. Implementing network and virtual methods to do things in today's modern ways by dividing the project into different departments and teams, working a project from

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different fronts under one management, industrializing the implementation of buildings related to schools in the factory and at the place of implementation to increase the quality and reduce wastage. In creating garbage, preserving the environment with relevant methods, for example, using dry mortars in the workshop. Production of building materials with new technologies and reducing costs and increasing quality and durability, increasing the speed of implementation and reducing the waste of related materials in the implementation of the said building. Application of integrated management in the implementation of the building along with compliance with the project charter. Application of workshop training for experts and managers according to their level of responsibility. Training of technical workers in the implementation of buildings and other structures (welders, masons, architects, concrete workers, carpenters, work facilities, etc.) Similar projects in different political and social conditions. Creation of a specific basis to identify the main factors of achieving sustainable project management in the country with the help of the results of the present research. Determining the response strategy to the main factors of achieving sustainable project management in the construction industry For the studied project, identifying the risks of construction projects and classifying them based on the dimensions of the sustainability of construction projects.

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