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MAJOR PROJECT MANAGEMENT FACTORS AFFECTING THE DELIVERY OF GREEN BUILDING PROJECTS: THE CASE OF JORDAN

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Construction projects have significant impacts on the environment. They adversely affect many areas, such as energy consumption, global warming and resource depletion. Green buildings have been found to be the most effective way to reduce these impacts. As a developing country with limited resources, Jordan is giving too much prominence to sustainability in construction projects. However, moving forward with Green Building Projects (GBPs) is a great challenge. Most managers do not have much experience in managing these projects yet. They are not fully aware of the importance of project management factors which can significantly affect the delivery process of GBPs. Research addressing these factors has become a crucial need in the construction industry. The main objective of this study is to identify the major project management factors required to deliver GBPs successfully in Jordan. The questionnaire was distributed to determine the significance of nineteen project management factors and SPSS software was utilized to perform the data analysis. The results show that for GBPs in Jordan to be successfully delivered, there must be clear lines of communication during the design and planning stages. The study concludes with recommendations for improving GBP distribution in Jordan. A further detailed study is needed to investigate and improve communication channels in GBPs. The practical implications of this study are to help the stakeholders in the construction industry understand management activities in the green building industry in a better and more realistic way. In addition, identifying these factors will help control future projects and ensure correct decisions are made from the beginning of the project to maximize the project's success.

Keywords: green buildings, GBPs, construction industry, management, Jordan

1 INTRODUCTION

Construction projects have a substantial environmental impact. It has several negative consequences, including increased energy consumption, climate change, resource depletion, and waste disposal [1–3]. Moreover, the lack of sufficient energy and water resources becomes a critical problem (especially in the developing countries)[4]. Finding solutions to these dilemmas has become a crucial need in the construction industry therefore, sustainable construction has been seen as the most effective way to reduce these impacts [5].

In the modern environment, it is a significant requirement in various development, notably in the construction industry, to place a high value on sustainability. This has enormous implications for the national economy [6]. Green building has come to the forefront of sustainable construction in this century, and it could be considered one of its fundamental pillars. Moreover, green building ensures addressing the economic, environmental, social, and health requirements in a balanced manner [7].

Green buildings (GP) present an opportunity to create environmentally efficient buildings by using an integrated approach to design. Generally, various terms are used to characterize taking a "green" approach in the construction industry, for instance, sustainable design, green building, high-performance building, sustainable building and integrated design. In fact, these terms give an indication of moving forward in understanding buildings‘design, construction and use. It is evident that there is no definite definition of green building, and there is no common way of categorizing a green building. Using the various definitions, and for this research, green buildings can be defined as: “buildings that are designed, constructed and operated in a manner that concentrates on increasing the efficiency of energy, water and material used while reducing the negative impacts on the environment and human health throughout the building‘s lifecycle” [8,9].

In Jordan, as one of the developing countries with limited resources [10], there is a desperate need to move forward with sustainable construction. As a result, the Ministry of Public Works and Housing (MPWH) has established a small committee that aims to develop a draft of the building thermal code known as the Jordan Green Building Guide (JGBG). Furthermore, a group of business leaders and academic professionals had a vision of enhancing and promoting green building principles and concepts in the Jordanian construction industry. To this end therefore, they established in October 2009 a non-profit council that helps them in achieving their vision, which is the Jordanian Green Building Council (JGBC). In addition, the Jordanian government has instituted some research centers for innovation and advanced technologies related to renewable energy in the construction industry [11–13].

The new challenge in the construction industry is how to deliver GBPs. The USGBC's 2013-2015 strategic plan listed the main strategic issues facing green buildings as the lack of education about how to manage green buildings. It is most likely that GBPs will involve more participants, techniques and requirements compared to conventional construction projects [14,15].

Accordingly, moving forward to grow the number of GBPs requires a radical change, which is something that represents a great challenge. Furthermore, most managers do not have sufficient experience in managing such projects and are not fully aware of the importance of project management factors which can significantly affect the delivery process of GBPs.

The aim of this research is to identify the major project management factors required to deliver GBPs successfully in Jordan and to rank these factors according to their importance. Therefore, having research addressing these factors has become a compiling need in the construction industry. Such a study will help managers to understand the management activities in the green building industry in a clearer and more practical way. Moreover, identifying these factors will help all project parties (owner, designer and contractor) to have more control over the project and in taking the right decisions from the beginning of the project to maximize the project's success.

Furthermore, most of the previous research focuses on the drivers, obstacles, and other technical aspects faced by the green building construction industry. However, the non-technical aspect is particularly important for delivering GBPs successfully. The scope of this research has been limited to the project management factors affecting the delivery of GBPs, and it excludes other types of factors like social, environmental or technical factors.

This study is divided into five sections, including this one, section two includes the literature review as well as various related works done in this area of study. Section three outlines the methodology that was used to achieve the research objectives, and section four presents the data analysis. Finally, section five discusses the result, concludes the study and compares its findings with those of many other relevant studies. It also presents the limitation of this study and offers recommendations to improve the delivery process of GBPs in Jordan.

2 LITERATURE REVIEW

2.1 Definition and rating system

There are various terms that are used to characterize taking a "green" approach in the construction industry; for instance, sustainable design, green building, high-performance building, sustainable building and integrated design [16–18]. In fact, these terms give an indication of progress in understanding buildings' design, construction and use.

The United States Environmental Protection Agency defined a green building as "The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction; this practice expands and complements the classical building design concerns of economy, utility, durability, and comfort "[5]. Additionally, they are buildings that feature natural ventilation capabilities i.e., low-energy or free-running building [19]. The necessity of defining, implementing and measuring green building in a more practical way including feature in the design, construction, and maintenance suggests a reason to develop a rating system [20].

There have been various rating systems developed around the world. Three systems are currently available and could be applied to buildings worldwide. The first one is "The Building Research Environmental Assessment Method (BREEAM)", which was developed in the United Kingdom (UK) in 1990. The second is the "Leadership in Energy and Environmental Design (LEED®) was developed in 1998, and the third one is the "Green Building Initiative (GBI)", which was developed in 2005.

Nowadays, the awareness of green building has increased; for instance, some countries in the Middle East have started to develop their own local rating system, such as Qatar Sustainability Assessment System (QSAS), the Pearl Building Rating System(PBRS), the Green Pyramid Rating System (GPRS), and ARZ Building Rating System. Likewise, Jordan has started developing its local guideline under the name "Green Building Guideline and Rating System of Jordan". It contains credits that reflect Jordan's climate, legislation, resources, policies, building techniques and strategies. In fact, the rating system of Jordan is still not compulsory, but it is linked to an incentive scheme through which the government gives [21,22].

On the other hand, the LEED system, which was developed by the U.S. Green Building Council (USGBC), is the most popular rating system around the world [23]. Jordan, as well as many other countries, are adopting this rating system. It should be noted that despite the existence of various rating systems, most of them share the same features of green buildings in their structures: Site sustainability, water efficiency, energy efficiency, healthy indoor environment, material sustainability and waste reduction/ recycling [24].

2.2 Design of green buildings vs conventional buildings

A green building will likely involve more participants, techniques and requirements, bringing changes to traditional project management practices [25]. The integrated design process is the main characteristic of green building design. It makes the design more complicated compared to the one used for conventional buildings. In a conventional building, a traditional design approach is followed, which it could be described as a linear process because of the successive contribution of the design team. The process often begins with the architect's and the client's approval of the concept design. Design engineers are then asked to implement the proposed design. The design process appears simple and quick, but the outcome of this process are often poor energy performance and a high operating cost structure that surprises the owners, users and operators. If the design engineers in this process suggest efficient systems, their involvement will be at a late stage in the design process, resulting in the only marginal improvement of the performance combined with a capital cost increase [26].

In contrast, the integrated design process includes inter-disciplinary design work between design engineers, architects, project managers, contractors and operations professionals at the preliminary stages of the design process. The outcome of this design process is a highly efficient system with a minimal capital cost increase [27]. Conventional buildings consume considerable amounts of water, land, energy, and raw materials for their construction and operation. Moreover, conventional buildings generate substantial amounts of construction waste, and they contribute to increasing greenhouse gas emissions. In contrast to conventional buildings, green buildings' design seek to conserve the usage of water, energy and land in an efficient way as well as improve both the indoor and outdoor environment quality [7].

2.3 Project Management in Green Building

A green building is likely to involve more participants, more techniques and more materials, bringing changes to traditional project management practices [25]. A project management framework in green building construction should be developed to overcome the barrier [28–31]. In addition, modification of the traditional project management practices are needed, such as the early involvement of a multi-disciplinary team for a cost-efficient green project delivery [26].

The particular contribution provided by [19,32] in classifying management practices for successful LEED projects implementation according to the six Malcolm Baldrige National Quality Award criteria (Leadership, Strategic Planning, Customer Focus, Measurement, Analysis and Knowledge Management, Workforce Focus, and Operation Focus). To achieve green building objectives, the project management process, including managing people, organizational structure, building commissioning, and performance documentation, cannot be neglected [30]. Additionally, existing literature has clearly identified factors that affect the management of green construction projects. [16] discussed the high premium cost associated with green building construction, together with the lack of communication and interest between project members, lack of expressed interest from clients or market demand, lack of credible research on the benefits of green buildings and high cost of green building practices. These were the biggest barriers encountered by professionals when managing GBPs. There are five main groups of factors to successfully implement green-marked certified projects namely: human resource–oriented factors, technical and innovation-oriented factors, support from designers and senior management, project manager's competence, and coordination of designers and contractors [33]. In addition, many studies discuss the factors affecting the delivery of GBPs [17,28,30,34–38]. Through the literature review and after in-depth study of project management factors affecting construction project success and by reviewing the special needs of GBPs, nineteen factors were identified and grouped into four major categories as presented in Table 1.

Table 1: Major project management factors affecting the delivery of GBPs

Factors		Code	Reference
Project Objectives Related Factors (PO)			
1	Adequacy and clear of plans and specifications	PO1	[33,34,39–44]
2	Clear green design goal	PO2	[34,39,44–46]
3	Accurate initial cost estimates	PO3	[11,33,34,36,41,47]
4	No major changes in the scope of work during construction/design	PO4	[29,34]
5	Enough time for project planning	PO5	[33,41]
Integration Related Factors (IF)			
6	Integrative charrette	IF1	[17,29,33–35,40,48,49]
7	Cooperation between architects and engineers	IF2	[17,29,33,36,50]
8	Designers involved in construction stage	IF3	[17,29,33,36,50]
9	Contractors involved in design stage	IF4	[17,29,33,36,50]
Human Resource Related Factors (HR)			
10	Design team experience in green building	HR1	[34,41,51,52]
11	Client experience in green building	HR2	[34,41,51,52]
12	Mistakes/delay in producing design document	HR3	[17,29,33,41,50]
13	Contractor staff experience in green building	HR4	[34,41,51,52]
14	The client's ability to make decisions	HR5	[34,36,41,50]
15	Project manager experience and skills	HR6	[33,34,50,52]
16	Project manager ability to manage cross-discipline	HR7	[34,36,41,50]
Communication Related Factors (CF)			
17	Clear communication channel during the planning phase	CF1	[17,30,33,40,41,44,46,49,50,52,53]
18	Clear communication channel during the design phase	CF2	[17,30,33,40,41,44,46,49,50,52,53]
19	Clear communication during the construction phase	CF3	[17,30,33,40,41,44,46,49,50,52,53]

3 METHODOLOGY

3.1 Data collection

The main objective of this study is to identify the major Project Management factors affecting the delivery of GBPs, therefore, the study is considered a quantitative research method. The quantitative method depends on data collection, which is generally numerical data that could be analyzed using statistical methods [54]. A questionnaire survey is the most popular form used by researchers to collect data since it is economic, quick and simple. Therefore, a questionnaire was prepared to examine the factors of project management that affect the successful delivery of GBPs. The questionnaire was divided into two parts; the first asked for general information about respondents, such as their position and relative work experience, and the second contained nineteen factors identified in the literature research that affect the delivery of GBPs, as shown in Table 1. These factors were ranked according to their importance on a Likert scale ranging from 1 to 5, with 1 representing factors that have no impact on project success and 5 representing those with a significant impact.

To determine the validity of the proposed questionnaire, a pilot study was conducted with the participation of two academic experts and four construction professionals to make the necessary modifications for the questionnaire to be compatible with the combined and reworded to adopt local construction terminology.

3.2 Validity and Reliability

The validity test is used to ensure that the questionnaire measures what is designed to measure [55]. The validity test was established through an in- depth literature review and conducting a pilot study. The reliability test was performed using Cronbach alpha, which measures the internal consistency of the construct. The minimum acceptable and recommended limit of reliability coefficient (alpha) for a scale is 0.60 [56]. Table 2 lists Cronbach alpha test results values for each group in the questionnaire. The result showed a value of 0.74 for all variables. In addition, the value of alpha for each group was greater than the accepted minimum percentage.

Table 2: Cronbach Alpha value

Group Factor	Cronbach Alpha value
Project Objectives Related Factors	0.64
Integration Related Factors	0.65
Human Resources Related Factors	0.76
Communication Related Factors	0.69
All Factors	0.74

3.3 Sample size

The research scope encompasses the GBPs in Jordan, and the respondents included consultants and contractors. The sample of contractors was selected from first, second and third-grade companies in Jordan as classified by the Ministry of Public Works and Housing MPWH is a system of six categories depending on the value of work that a company can afford. The consulting companies in Jordan are classified into three grades: A, B, and C. However, the consultant sample was selected from "Grade A& B".
The population size was determined, and the relative required sample size was calculated based on the following equations [57].

$$ss = \frac{Z^2 \times P \times (1-P)}{C^2} \quad (1)$$

Where:

Z = Z value (e.g., 1.96 for 95% confidence level)

P = percentage picking a choice expressed as decimal (0.5 used for sample size needed)

C = Maximum error of estimation (0.07), confidence interval (7)

$$ss = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.07^2} = 196$$

And the correction as the below:

$$\text{SS new} = \frac{\text{SS}}{1+\frac{\text{SS}-1}{\text{pop}}} \quad (2)$$

Where:

Pop= population

When the population (Consultant Grade A and B). According to Jordan Engineering Association (JEA), it is equal to 146 consulting companies. So that:

$$\text{SS new} = \frac{196}{1 + \frac{(196-1)}{146}} = 84$$

When Pop is the population (Contractor first, second, and third class). According to the Jordanian Construction Contractor Association (JCCA), it is equal to 367 contracting companies. So that:

$$\text{SS new} = \frac{196}{1 + \frac{(196-1)}{367}} = 128$$

The total number of distributed questionnaires was 212 and the number of received ones was 178 with a 83.96% response rate from both contractors and consultants, the sample size of respondents and their average years of experience is shown in Table 3.

Table3: Population and Sample Size

Response	Sample distributed	Number of Respondents	Percent
Consultants	84	66	
Contractors	128	112	
Total	212	178	83.96%

4 RESULTS AND DATA ANALYSIS

4.1 The Demographic Profile

Table 4 illustrate the demographic profile of the respondents that fill the questionnaire, 63% from different consultants' companies, and 37% from different contractors' companies. In addition, the major of the respondents had an experience from 6-10 years, while 8% have experienced more than 15 years. Moreover, it is important to mention that around 57% of the respondents had experienced between 0-3 years in the green building while 43 % had experienced more than 3 years in GBPs.

Table 4: The demographic profile

Respondents' companies' type		
	Frequency	Percent
Consultant	66	37
Contactor	112	63
Academic qualification		
PhD	4	2
MCs	18	10
BCs	150	84
Diploma	6	3
Experience		
1-5 Years	32	18
6-10 Years	77	43
11-15 Years	55	31
More than 15 Years	14	8
Experience in GBPs		
0-3 Years	101	57
More than 3 Years	77	43

4.2 Project management factors affecting the delivery of GBPs

4.2.1 Mean Score

To rank the most frequent project management factors affecting the delivery of GBPs the Mean score method was used. This method was adopted by [58] to establish the relative importance of the causes of delay in large building projects in Saudi Arabia. The five-point Likert scale was transformed to the mean score for each factor to determine the ranks of the factors. These rankings made it possible to cross-compare the relative importance of the factors as perceived by the two groups of respondents. Hence, all the numerical scores of each identified factor were transformed to mean scores to determine the relative ranking of the factors. The Mean Score (MS), for each factor, was computed by the following formula:

$$MS = \frac{\sum(f * s)}{N} \qquad (1 \leq MS \leq 5) \tag{3}$$

Where:

S: is a score given to each factor by the respondents and ranges from 1 to 5;

f: is the frequency of responses to each rating (l-5), for each factor; and

N: is the total number of responses concerning that factor.

The mean score for each factor was calculated. Table 5 below tabulates the minimum and maximum values, mean score and standard deviation. The factors are ranked according to the calculated mean score. The rank of the factors is also tabulated in Table 5 and presented graphically in Figure 1.

Table 5: Mean Score and the rank of factors

Code	Factor	Min.	Max.	Mean	SD	Rank
PO1	Adequacy of plans and specifications	2.00	5.00	4.00	0.703	8
PO2	Clear green design goal	1.00	5.00	3.38	1.146	15
PO3	Accurate initial cost estimates	2.00	5.00	3.97	0.901	9
PO4	No major changes in the scope of work during construction/design	1.00	5.00	3.13	1.233	17
PO5	Enough time for project planning	3.00	5.00	4.04	0.764	6
IF1	Integrative charrette	1.00	5.00	2.91	0.990	19
IF2	Cooperation between architects and engineers	1.00	5.00	3.88	0.805	10
IF3	Designers involved in construction stages	2.00	5.00	3.07	0.892	18
IF4	Contractors involved in design stages	2.00	5.00	3.33	1.121	16
HR1	Design team experience in green building	2.00	5.00	4.19	0.877	5
HR2	Client experience in green building	1.00	5.00	3.79	1.053	11
HR3	Mistakes/delay in producing design document	1.00	5.00	4.01	0.883	7
HR4	Contractor staff experience in green Building	2.00	5.00	3.67	0.742	12
HR5	The client's ability to make decisions	2.00	5.00	3.58	0.713	13
HR6	Project manager experience and skills	3.00	5.00	4.29	0.703	3
HR7	Project manager ability to manage cross-discipline	1.00	5.00	4.20	0.838	4
CF1	Clear communication channel during the planning stage	2.00	5.00	4.35	0.965	2
CF2	Clear communication channel during the design phase	2.00	5.00	4.50	0.791	1
CF3	Clear communication during the construction phase	1.00	5.00	3.45	1.009	14

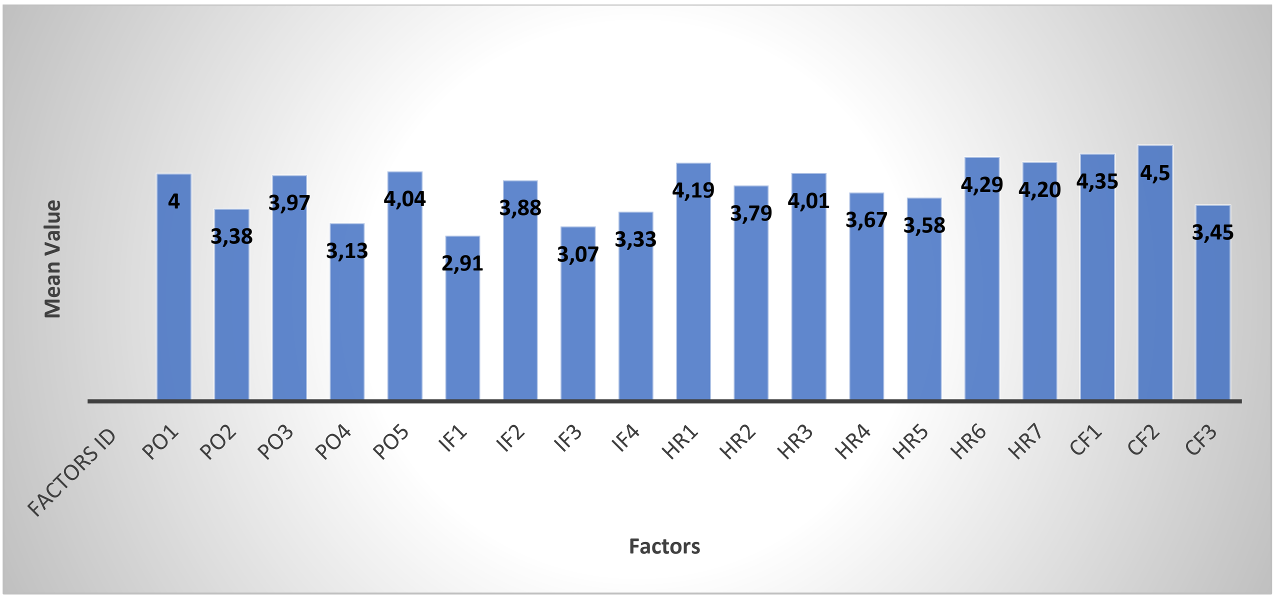

Figure 1: Mean Score and The Rank of Factors**.** Graphically displaying the ranking of the factors affecting the delivery of GBPs.

As illustrate from the histogram of the mean value the CF1 and CF2 that related to communication factors occupies the highest mean value (4.5, and 4.35) then followed by human resource factor HR6, HR7, and HR1with the mean value (4.29, 4.20, and 4.19)

As it is shown in figure 1 the most ranked five factors affecting the delivery of GBPs are: clear communication channel during the design phase, Clear communication channel during the planning phase, Project management experience and skills, Project manager ability to manage cross-discipline, and Design team experience in green building

4.2.2 Kappa test

In order to test the agreement between the contractors and consultants in ranking the factors, the Cohen's Kappa test was used. Cohen's Kappa correlation coefficient is a commonly used tool to measure the correlation between two sets of rankings. The Kappa value is standardized to lie on a -1 to 1 scale, where +1 implies a perfect positive relationship (agreement), while 0 is exactly what would be expected by chance, and a negative value represents agreement less than chance [59]. Cohen's Kappa correlation is used to measure and compare the association between the rankings of the two parties. Below is the interpretation of Kappa Value:

Kappa Agreement [59]

< 0 less than chance agreement

0.01–0.20 Slight agreement

0.21– 0.40 Fair agreement

0.41–0.60 Moderate agreement

0.61–0.80 Substantial agreement

0.81–0.99 Almost perfect agreement

Kappa test was run to test if there is an agreement between the contractor and consultant in ranking the factors. The following Hypothesis was tested:

H01: There is an insignificant degree of agreement between contractor and consultant.

Table 6 shows Kappa's test results, the results indicate a moderate agreement between contractors and consultants, the k value ranges between 0.293-0.783. In addition, the p-value is smaller than 0.05 (the level of significance), therefore; the null hypotheses are rejected. Hence, there is a significant degree of agreement between consultants and contractors.

Table 6: Kappa test results for the agreement between contractor and consultant

Factors	Kappa	
	Value	Sig.
Project Objectives Related Factors	0.336	0.00
Adequacy of plans and specifications	0.783	0.00
Clear green design goal	0.499	0.00
Accurate initial cost estimates	0.641	0.00

Factors	Kappa	
	Value	Sig.
No major changes in the scope of work during construction/design	0.339	0.00
Enough time for project planning	0.577	0.00
Integration Related Factors	0.387	0.00
Integrative charrette	0.306	0.00
Cooperation between architects and engineers	0.686	0.00
Designers involved in construction stages	0.733	0.00
Contractors involved in design stages	0.672	0.00
Human Resource Related Factors	0.472	0.00
Design team experience in green building	0.626	0.00
Client experience in green building	0.598	0.00
Mistakes/delay in producing design document	0.644	0.00
Contractor staff experience in green building	0.582	0.00
The client’s ability to make decisions	0.694	0.00
Project manager experience and skills	0.665	0.00
Project manager ability to manage cross-discipline	0.636	0.00
Communication Related Factors	0.382	0.00
Clear communication channel during the planning stage	0.293	0.00
Clear communication channel during the design phase	0.704	0.00
Clear communication during the construction phase	0.665	0.00

On the other hand, the was run to determine if there is an agreement between respondents who have years of experience between 1-3 years (Group 1) and respondents who have more than 3 years’ experience in green building (Group 2):

H02: There is an insignificant degree of agreement between Group 1 and Group 2

The test result shows that there was an insignificant agreement between the two groups, k range between -0.075 and 0.146 and the p-value is larger than 0.05 (the level of significance), the null hypothesis is accepted. Hence, there is an insignificant degree of agreement between the two groups. Table 7 below presents these results.

Table 7: Kappa test results for the agreement of respondents based on their years’ experience in green building.

Factors	Kappa	
	Value	Sig.
Project objectives related factors	0.146	0.051
Adequacy of plans and specifications	0.059	0.447
Clear green design goal	0.083	0.174
Accurate initial cost estimates	0.124	0.064
No major changes in the scope of work during construction/design	0.069	0.261
Enough time for project planning	0.126	0.101
Integration related factors	-0.05	0.217
Integrative charrette	-0.010	0.867
Cooperation between architects and engineers	0.024	0.751

Factors	Kappa	
	Value	Sig.
Designers involved in construction stages	-0.015	0.835
Contractors involved in design stages	-0.017	0.792
Human resource related factors	0.057	0.109
Design team experience in green building	-0.034	0.636
Client experience in green building	0.051	0.418
Mistakes/delay in producing design document	-0.039	0.581
Contractor staff experience in green building	0.111	0.155
The client's ability to make decisions	0.108	0.148
Project manager experience and skills	-0.052	0.513
Project manager ability to manage cross-discipline	-0.006	0.929
Communication related factors	-0.075	0.118
Clear communication channel during the planning stage	0.055	0.416
Clear communication channel during the design phase	-0.085	0.308
Clear communication during the construction Phase	-0.013	0.840

5 DISCUSSION AND CONCLUSION

The primary objective of this study was to identify and investigate the project management factors contributing to the successful delivery of GBPs in Jordan according to the judgment of the consultants and contractors. Nineteen factors were identified and ranked. The analysis of the data collected from the survey was conducted using the "Mean Score" method and correlated using Kappa's Test. The results of this survey gave the following findings:

- The Kappa test indicates moderate to a strong agreement between contractors and consultants on ranking the identified factors.
- The highest-ranked factors affecting the successful delivery of GBPs in Jordan, according to the respondents, were (i) clear communication channel during the design phase, (ii) clear communication channel during the planning phase, (iii) project manager experience and skills, (iv) project manager ability to manage cross-discipline and (v) design team experience in green building.

Due to the strong agreement between the two parties, the top five factors are considered dependable as a result of this study, and they will be discussed here:

Clear communication channels during design and clear communication channels during the planning phase were considered the first and the second key factor affecting the delivery of the GBPs. This fact is supported by the literature. Project Management Institute PMI's Pulse communication research finds that effective communication leads to a more successful project. Moreover, PMI's Pulse research 2013 states that fifty-five percent of project managers agree that effective communication with all stakeholders is the most critical success factor in project management. Failure to communicate would be the root cause of many project failures [60]. In GBPs, a higher level of communication is required among the project team members compared to a more conventional project. This is because the green building design is more complicated than what is required in the conventional building [30]. Green building requires more interdisciplinary coordination due to the interdependence of the green system design[17]. In addition,[26,36] identified in their study the lack of communication between the project members is one of the top five obstacles facing managers when managing GBPs.

Additionally, the interview with LEED Building team members and LEED APs emphasized that communication within the team is a crucial factor in Jordan. The interviewer concluded that effective communication between involved parties leads to the success of construction projects. The interviewer argued that designers with strong relationships could complete work faster since they know each other and know how to communicate effectively.

Project manager experience and skills, the project manager's ability to manage across disciplines and design team experience in green building were ranked as the third, fourth and fifth key factors, respectively. The findings support the assertion that resources, skills, knowledge and experience of the professionals involved are becoming the main driver for project success. This finding is also supported by many researchers who indicated that knowledge and education in green building is one of the factors that affect the project performance and one of the barriers to implementing the GBPs [28,34,36–38]

In addition, much literature emphasized the role of the project manager and his/her competencies in the successful achievement of the project goals. [29,34] stated that the commitment of the project manager and his/her ability to build teams and motivate workers is one of the secrets that stand behind the project's success. [36] in their study concluded that people play secrets that stand behind the project’s success.

Furthermore, the interviewer conducting this research, found in Jordanian design firms, a lack of green building knowledge. This is because most managers and designers are engineers with an excellent work experience but without enough training and education levels in green building techniques.

According to the research results, some of the recommendations are proposed to deliver the GBPs successfully in Jordan. First, the selection criteria of project team members must receive serious attention in GBPs. Secondly, education and training in green building are becoming a vital need in the Jordanian construction industry. Thirdly, the Jordanian construction industry must keep abreast of the latest communication technologies. Fourth, there is a need, within project to establish an effective communication system, which enables everyone within the project to communicate, receive, and share information clearly. Fifth, it is important to hire an experienced GBPs manager who is familiar with green building concepts and green building rating systems. Sixth, design team members need to be trained in green building techniques and knowledge to be able to translate green requirements into design documents. Seventh, integrate the green building management concept into Jordanian universities education syllabuses.

A recommendation for a future study would allow more information to be obtained to investigate the communication channel in GBPs in Jordan. Moreover, further research is needed to determine if the recommendations for GBPs in Jordan could benefit traditional construction projects. Further studies could be performed using a larger number of responses to replicate and assure the results of this study. The focus of this research was on the preconstruction phase, whilst further studies could examine the construction and closing phase.

Within the green building industry, there is still the question of modification of the traditional project management practices; further studies could be conducted to identify these modifications.

This study is limited by the low response rate and low average years of experience in green building, as well as the small number of certified GBPs in Jordan, which may have affected the ability to draw conclusions.

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