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THE ECONOMIC CHALLENGES AFFECTING SUSTAINABLE GREEN BUILDINGS (SGBS) IN JORDAN THROUGHOUT THE PROJECT'S LIFE CYCLE STAGES

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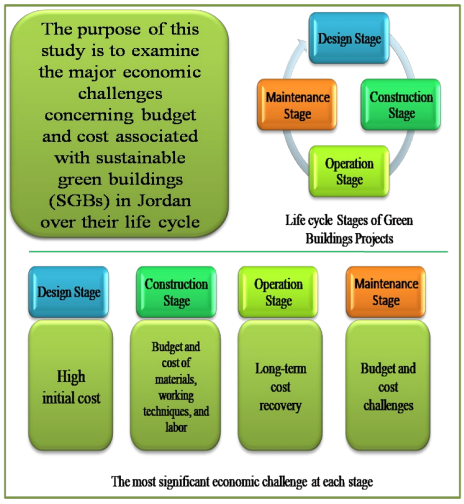
Graphical abstract



Abstract

The purpose of this study is to examine the major economic challenges concerning budgets and costs associated with sustainable green buildings (SGBs) in Jordan over their life cycle. This research is significant because it will add to the literature in this area and give interested parties a glimpse into the current state of economic issues facing SGBs in Jordan and affect the adoption of this building technology there. Based on a thorough review of the literature, data was gathered using a qualitative technique based on in-depth semi-structured interviews with 32 professionals of SGBs in Jordan. According to the findings of this study, the main economic challenge in the design stage is the "High initial cost," the main economic challenge in the construction stage is "Budget and cost of materials, working techniques, and labor," the most significant economic challenge in the operational stage is "Long-term cost recovery," and the main economic challenge in the maintenance stage is "Budget and cost challenges." Despite the importance of this research in terms of adding to the current body of knowledge by examining the economic challenge of SGBs in Jordan as a developing country during the life cycle stages, the findings are based on qualitative data collected from highly experienced specialists in this sector. Therefore, a quantitative data collection using various evaluation approaches is recommended for further research.

Keywords: Budget and costs, Economic challenges, Green buildings, Jordan, Life cycle, Sustainable green buildings.

1.0 INTRODUCTION

Green buildings (GBs) are critical for social advancement, economic growth, and environmental protection, all of which are necessary components of sustainable development [1]. GB is the practice of developing structures and implementing methods that are environmentally responsible and resource efficient, from site selection to design, construction, operation, maintenance, renovation, and deconstruction [2].

GBs and sustainability are terms sometimes used interchangeably in the literatures to express the same idea. They could be defined and categorized in terms of the aspects that they mainly deal with. "Green architecture" includes GBs and green construction. It concerns on both natural environment and human comfort. However, sustainability encompasses a wider perspective. In addition to natural environment protection and human comfort, sustainability also concerns on economic development aspects [3]

SGBs projects are fundamentally different from conventional construction projects in that they need the use of specialized materials and construction methods to produce sustainability, as well as extensive documentation and monitoring, especially if environmental certification is a project goal [4].

Generally, SGB is also known as ahigh-performance building that addresses its influence on the environment and human health while limiting its negative consequences. It's implementation or adoption is intended to reduce energy

utilization and the generation of waste as part of worldwide solutions to environmental issues. It also addresses the issues of water consumption and GHG emissions. These solutions may be accomplished at every stage of SGBs project, from material selection and design to construction and operation. Moreover, SGBs require advanced planning and organization, such as material selection and operating systems, which may impact on the timetable of building projects [5,6].

Since the concept of SGB is considered as new in Jordan, it has attracted a lot of interest and acceptance on a regional and global scale [5], thus Jordan believes that embarking upon the global market and fostering sustainable development is important. This is due to the fact that Jordan is a developing country that faces various global energy issues and rising pollution, primarily due to limited energy resources and inefficient usage of natural resources. Moreover, Jordan suffers from restricted potable water, fuel, and other natural resources. All of these are considered as important factors that might impact Jordanians' well-being, stability, and economic future.

Despite the abundance of technologies available to assist in the development of SGBs [7], countless obstacles and risks impede their practice and implementation in Jordan . Better solutions and increased use of new building technology will be made possible through an understanding of these barriers [8].

Economic barriers to SGBs exist on a variety of levels [9]. In general, budget restrictions such as a high initial cost, lack of incentives, and the high cost of many green materials are the primary economic barriers [10]. On the other hand, the promotion of SGBs in markets continues to face obstacles as a result of perceived higher initial costs for SGBs projects as compared to traditional projects. High upfront expenditures may diminish the public's interest in SGB, hence impacting the market demand for these projects, which is the key driver of the SGBs sector's growth. In order to accelerate the adoption of SGBs within the established industry, all project participants must constantly improve their capacity to bring sustainable and economical products to market [7,11]. The most successful method of stimulating sustainable development is through market-based economic initiatives that affect both short-term and long-term economic agents [12,13].

2.0 LITERATURE REVIEW

Numerous studies on the economic problems associated with SGBs have been undertaken in a number of countries, spanning from developed to developing [14–16]. Nevertheless, there is a lack of integration of SGB economic challenges relating to budget and cost over the course of a project's life cycle in the existing body of knowledge especially in Jordan as a developing country that faces significant difficulties in terms of its sustainable growth [17–19]. This form of integration is crucial for integrating the findings of this study with those of previous studies in order to close the gap at this point. The results of this study will benefit not only Jordan but also all other developing countries with similar social, cultural, environmental, and economic conditions, especially in light of preliminary studies in such countries [20].

Thus, the aim of this study is to examine the economic obstacles regarding the budgeting aspects and the cost of green buildings in Jordan at various stages of the project's life cycle namely design, construction, operation, and maintenance. Specifically, this study intends to provide a response or answer to this research question: What are the most significant budget and cost-related economic barriers that affected SGBs projects in Jordan throughout their life cycle stages?

The data of this study was obtained by performing a qualitative research approach using semi-structured in-depth open- ended interviews. Meanwhile, the data analysis was performed using a computerized tool, ATLAS.ti software version 9. Figure 1 depicts the stages of the life cycle covered in this research.

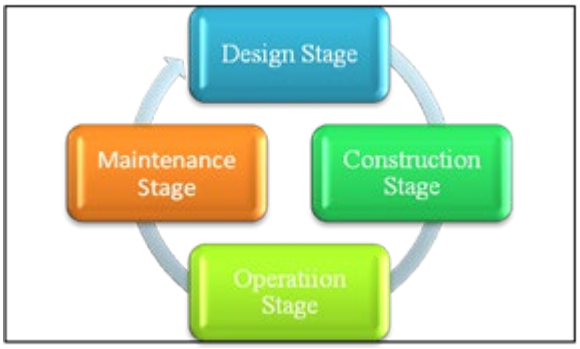


Figure 1 The life cycle of SGBs

According to the literature review, the following sections present the most significant economic obstacles at each stage of SGBs life cycle.

2.1 Economic Challenges of SGBs during the Design Stage

2.1.1 High Initial Cost

Generally, the most significant barrier to GB is higher initial costs. Green construction projects may have higher initial costs than traditional construction projects. As a result, the most important steps toward achieving a sustainable construction project under financial constraints are accomplished during the project's viability and design phases [4]. Due to the scarcity and inadequacy of specialists in this industry, one of the most significant economic barriers in the design stage is the high wages of designers and specialized stakeholders. Furthermore, project designers should be skilled not only in energy-efficiency technicalities such as whole-building energy simulation, cooling, and heating applications, but also in integrating these techniques with appropriate building design and materials, for example the use of natural light and solar heating [7]. On the other hand, the combination of time and budget planning is necessary to control costs and schedules, establish what constitutes an acceptable baseline, and achieve the correct balance of time, budgetary, goals, efficiency, and customer objectives [21].

2.1.2 Lack of Incentives

Despite the numerous impediments to GB market expansion, a government force may help accelerate the adoption of SGBs. The government's role in the SGBs market is primarily to provide financial and non-financial incentives, to develop SGBs legislation and regulations, and to act as an advocate and promoter [22]. A lack of up-to-date and transparent measures by some governments may have an impact on the adoption of SGBs. As GB technology is still in its early stages [23], there is no broad GB culture in many communities, particularly in developing countries. As a result, clients first want incentives to progress toward adopting this building technology, which can be provided by giving viable and encouraging incentives that entice customers to this form of construction [6]. As a result, although increasing public awareness of the advantages of green technology might help overcome market obstacles, providing government incentives to both users and innovators that employ green systems could also be beneficial [24].

2.2 Economic Challenges of SGBs during the Construction Stage

2.2.1 Budget and Cost of, Materials Working Techniques, and Labors

According to GB's decision-making process, project team members make decisions based on various aspects such as location, product or machinery availability, and the equipment they use on projects [25]. Despite the fact that natural materials are normally affordable, there are two more factors to consider when evaluating the price of building materials. The first factor is the treatment of these materials, and the second factor is their processing techniques that are needed to obtain excellent results, thus adding to the cost of green composites [26,27].

In terms of the technical limitations, the economic obstacles facing SGBs during the construction stage include the lack of green product suppliers, a lack of skilled workers, and a lack of green technologies. Therefore, some recognized green technologies and items that require achieving valuable green construction certificates are sometimes unavailable. As a result, all of these factors contribute to the imposition of additional charges at this stage of SGBs projects [7]. On the other hand, accreditation to achieve green certification requires more time and money to prepare complex documentation and hire consultants, which might be another economic barrier for SGBs. Therefore, the GB market is considered in its infancy [23].

2.2.2 The Economic Challenge Related to Bids

There is an increasing need for construction professionals to collaborate more cohesively to accomplish GB objectives, based on the exploration of different delivery systems that dictate how different project stakeholders are involved. Project delivery systems influenced the owner's ability to attain sustainability goals, with the level of integration within the delivery process as the prime factor that need to be considered [28]. As a consequence, the least-cost delivery approach, which awards contracts to contractors with the lowest offer prices and based the project on a competitive bidding process, cannot be employed in GB projects due to its frequent failure to satisfy the requirements [29]. In comparison to green construction projects, budget management for traditional building projects is easier [30]. Almost all conventional construction projects are delivered on a low-cost basis, with contractors granted the project based on the lowest tender price determined through competitive bidding. However, such delivery methods are ineffective for GB projects, as green materials, products, and technology are complex and more costly in terms of requirements [31]. Additionally, because traditional construction involves two different teams for design and construction, low-cost delivery methods such as design-bid-build are unable to accomplish this degree of collaboration in GBs [29,32]. Therefore, to ensure the efficiency of GB projects, a close collaboration between the design and construction teams is required. As a result, the lowest cost delivery mechanism will not work for such projects [31].

2.3 Economic Challenges of SGBs during the Operation Stage

2.3.1 Challenges Related to Saving Features

The requirements, the duration of investment return, and the profitability from project implementation are often the investor's key concerns, which affect the performance of construction projects [33]. Therefore, to be sustainable, a building should incorporate high performance attributes, not just in terms of environmental performance, such as energy efficiency, but also in terms of overall durability and effectiveness, as well as occupant safety, security, and productivity [34,35]. On the other hand, making unwise decisions regarding GB technology might have a negative impact on the project's success, performance, outcomes, and efficiency [25]. Generally, if a building performs better, the environmental effects of its energy usage (such as greenhouse gas emissions from energy production) can be minimized, and therefore, operational costs can be reduced [17]. Hence, a thorough evaluation of the GB technology's performance and consequences for its intended use should be carried out prior to its implementation [36,37].

2.3.2 Long Term Cost Recovery

It is widely acknowledged that there are significant differences between building design and its functions. In some circumstances, customers and end-users of these products do not obtain long-term value for their investments, due to a lack of awareness of how these new technologies can be operated and well sustained in the future [34,38]. Additionally, the implementation of new technology is considered as risky without the assessment of its technical viability and its influence on the project's core principles of risk, cost, quality, and schedule [39]. Thus, technology selection decisions should be based on a straightforward understanding and careful consideration of all the possible consequences that could affect the project's economic feasibility. However, many engineering and architectural managers choose to make these decisions

intuitively, based on their own views based on existing professional practice and organizational history [40].

2.4 Economic Challenges of SGBs during the Maintenance Stage

2.4.1 Budget and Cost Challenges

The majority of financial conferences and dialogues on sustainable buildings expressed concern about high construction and maintenance costs [41]. The total of all labor, material, and other expenses incurred in conjunction with those actions and operations is referred to as maintenance costs [42]. The primary goal of any maintenance system is typically to achieve the least expensive system [43,44]. Due to the high operating and maintenance expenses in comparison to the government incentives, which are inadequate to cover them, implementing sustainable growth will be prohibitive, despite the fact that it is environmentally friendly and energy-efficient [45]. Similarly, the major components of building costs are maintenance and operating expenditures, which contribute one-third to one-half of the total cost depending on the kind of building [43,46]. As a result, it is critical that SGBs project managers establish maintenance budgets that include maintenance costs during the early stages of the project [7]. Therefore, in some cases, one of the first costs to be reduced from the overall project budget is maintenance, as the advantages of maintenance tasks are sometimes overlooked by building owners and financial decision-makers [47,48]. Literally, a lack of proper maintenance management practices does not guarantee the cost effectiveness of building projects as it can also result in other issues, such as defective buildings, poor construction functioning, and others. On the other hand, an effective maintenance management of construction or housing projects could reduce operating and maintenance costs by ensuring that the projects continue to work and provide economic advantages accordingly [49]. As a result, it is vital to assess the elements of building projects that affect maintenance costs in order to monitor the maintenance costs GBs in terms of its reduction or cost savings [50–53] . Additionally, materials for green buildings are chosen at the outset of the design process and this have an effect on the cost of maintenance. As a result, it is vital for project participants to consistently support innovation in green materials in order to reduce costs associated with operation, construction, and maintenance activities [7].

3.0 METHODOLOGY

The qualitative method was selected for this study because it appears to be the most appropriate method for addressing a variety of sources, including journal publications and conference papers, regarding the study's issues and measures, in which the data interpretation approach is used to define the study's real essence [54,55]. Qualitative research is distinguished by its goals, which are concerned with comprehending some aspects of life, and by its techniques, which in general produce words rather than numbers as data for analysis, with the goal of measuring something [56]. In a qualitative research, interviews remain the most frequently used data collection method because they provide a familiar and flexible method of inquiring about people's opinions and experiences. One of the appeals for researchers is that despite the efforts that are required to set up and analyze the interview sessions, a one- or two-hour interview session can generate a large amount of data [54,57].

In this study the qualitative research method was used to obtain a greater understanding on the conceptualization of the research since the number of SGBs in Jordan is limited. In addition, the number of experts and other stakeholders who are well-verse, experienced and exposed to this construction technique with extensive experience in this field in Jordan is also limited [8,17,58].Thus, the primary goal of this strategy is to obtain detailed information on economic challenges related to the budget and costs aspects of green building projects in Jordan's current condition as a developing country.

Data collection of this study is separated into two stages. The first stage is the abstraction of information from the literature of economic challenges that affected SGBs at various stages of their life cycle to assist in the development of interview questions. Next, the construction stakeholders participated in the second phase of this study, which consists of semi-structured open-ended in-depth interviews.

The data collection process of this study was performed through face-to-face semi-structured interviews between October and November 2021. The research participants were selected from a list of construction professionals in the field of GB in Jordan.

The interview question was designed using an adapt and adopt method based on the literature reviews. The questions are planned ahead of time and developed using the interview guide. The interview guide covers the study's primary subjects. It provides a focused structure for the interview conversation and should not be precisely followed. The goal of this interview guide is to investigate the study topic by gathering comparable forms of information from each respondent and directing them as to what to discuss [59]. Appendix A shows some samples of interview questions for each phase of the GB project's life cycle.

Each interview lasted 50 to 60 minutes and was recorded. The interview questions offer respondents the optimum opportunity to provide effective answers since they are restricted in number and well-structured to elicit ideas and views from their experience [60].

Qualitative data obtained in this study were analyzed using content analysis methodologies. Coding and other data analysis procedures were carried out using Atlas. ti software version 9. Atlas. ti is a computerized software, which allows for the systematic organization, storage, and modification of all data, subjects, categories, findings, and research notes [61–63].

3.1 Population Definition

Generally, only a small sample size is necessary for qualitative techniques [64,65]. The sampling strategy of this study employed a purposive sampling technique to identify

individuals with expertise in the subject of the study [66]. A smaller sample of individuals with specific features related to SGBs in Jordan was highly considered to attain the research objectives of this study, rather than a larger sample size with participants who are specificity with inadequate information. Specificity refers to participants who belong to a defined target group with some varieties in their experiences to be investigated which includes individuals from a certain target group having experiences that have not previously been recounted [64,65,67].

As various research examine the dynamic features of a situation (rather than revealing the proportional connections among its parts), sample size and representativeness have minimal influence on the project's core rationale [68].

As shown in Table 1. The respondents of this study represent a diverse range of specialists with experience in SGBs projects in Jordan of various sizes and at various stages of the life cycle. In this study, GB architects, project managers, civil engineers, and contractors were interviewed in semi-structured, in-depth open- ended interview sessions. The interview survey comprised of samples from different construction stakeholders because each sample has the experience of main interaction and exposures in particular stages of SGB life cycle. During the process of interview analysis, a special code was given to each participant in the interviews, to ensure his or her privacy by not disclosing their real names, as shown in Table 1.

Table 1 Data summary of the stakeholders in this study

Participants specialist	Participants' name codes	Numbers of participants	Years of experience Respectively	Field of experience	The particular experience in GB stages	Participant gender Respectively Mail (M)/ Femail (F)
Architect	Arc1, Arc2, Arc3, Arc4, Arc5, Arc6, Arc7, Arc8,	8	8,10,6,6,6,12,5,5	GB architecture design and consultancy	Design and operation stage	F, M, F, F, M, M, F, F
Project manager	P1, P2, P3, P4, P5, P6, P7, P8	8	10,12,10,9,11,6,6, 8	GB project consultancy and managements	Construction, operation, and maintenance stage	M, M, M, M, M, M, M, M
Civil engineer	C1, C2, C3, C4, C5, C6, C7, C8	8	5,4,4,8,7,5,8,8	GB construction design and consultancy	Design and construction stage	M, F, M, M, M, F, M, M
Contractor	Co1, Co2, Co3, Co4 Co5, Co6, Co7, Co8	8	11,12,10,10,8,6,6, 5	GB implementation	Construction, and maintenance stage	M, M, M, M, M, M, M, M
Total number of participants		32				

4.0 RESULTS AND DISCUSSION

4.1 Results

Section 3 presents the following subsections that consists of the study's findings and discussion.

4.1.1 Interviews Analysis and Findings

The following steps were taken to analyze all of the information gathered:

1. Data organization: This study collected data in the form of interview transcriptions. After that, the recorded interviews ware transcribed and emailed to each respondent for verification purposes.
2. Familiarizing with the data: Understanding the overall context by reading through the raw data to identify the main concepts and repeating themes [69].
3. Creating codes: Identifying codes for the key concerns that appeared in the transcriptions and classifying the data into meaningful groupings that are logically related to one another [69]. The repetition number of codes counted whenever the code was detected.
   Qualitative researchers normally analyze codes that appear in transcripts by finding short quotations, the more frequently the codes appear in the data set, the more likely they are to implicitly indicate their importance and relevance to specific issues [65,70,71].
   During the interview, if a participant provided more than one quotation relating to the same code, it was counted each time. And when a single quotation has information for more than one code, the quote can be cloned and separated into multiple codes. This is frequently required since a single quotation may include more than one topic [72].
4. Analyzing and summarizing qualitative data: Interpreting and explaining the findings by utilizing graphs to define ideas and visually map the links

between codes in order to give explanations and construct the final report [73]. ATLAS. ti version 9 computing tool was used for data integration and summarization. This program assists the researcher throughout the process of data analysis, in which texts were analyzed and interpreted based on coding and annotation activities, and it allows for instant search and retrieval functionalities. This program also has a network-building tool that lets users graphically connect chosen phrases, notes, and codes using diagrams [61–63].

Figure 2 shows a screen shot from Atlas.ti software for the analysis procedure of the quotations related to each code of economic challenges related to budget and cost in the construction stage and Figure 3 shows a screen shot from the Atlas.ti software for the number of repetitions of each code in the construction stage, as examples of data analysis and coding by using Atlas.ti software.

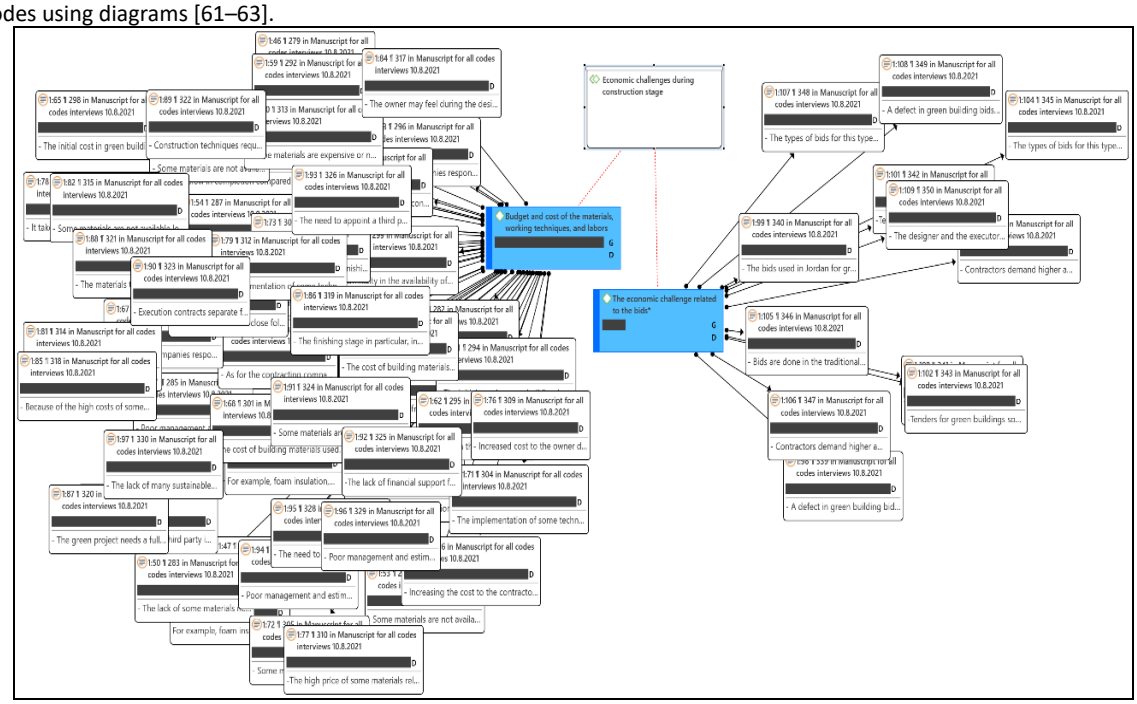


Figure 2 The analysis procedure of the quotations related to each code of economic challenges related to budget and cost in the construction stage

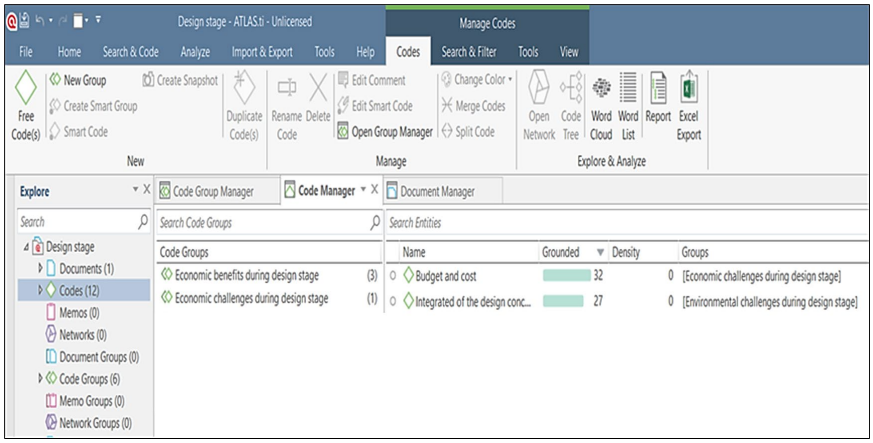


Figure 3 *The number of repetitions for each code in the construction stage*

According to the analysis of the interviews, there are major economic impediments to SGBs in Jordan at each stage of the life cycle. Table 2 presents the summary of the analysis and the results of the interviews, and Figure 4 depicts the results of economic challenges faced by SGBs in Jordan throughout the life cycle stages.

Table 2 The analysis and the results of the interviews

Life Cycle Stages	Codes Related to the Economic Challenges	Number of Code Repetition	Some Examples from Interviews
Design stage	High initial cost	29	"The high initial cost of design and implementation is the main challenge of green building in this stage, as the designer asks for additional costs for the design of green buildings, or due to the need to use software and simulation, which raise the price of the design ..." (Arc3)
	lack of incentives	25	"Weak incentives that encourage customers to adopt green building technology..." (P1)
Construction stage	Budget and cost of materials, working techniques, and labors	27	"... The prices of some green building materials are high when compared to traditional construction materials and some materials are not available locally..."(P7)
	The economic challenge related to bids	24	"...The bids used in most countries for green buildings are design-bid-build bids, and the bid is awarded to the lowest-priced contractor, and green building projects must be design-build, meaning that the designer is the same as the implementing party ..." (Co6)
Operation stage	Challenges relating to saving features	25	"...Misuse by end-users reduces the efficiency of the systems and thus green building does not obtain the desired savings benefits to the full degree which leads to increases the costs." (P2)
	Long term cost recovery	28	"Cost recovery needs a long time to appear..." (Arc2)
Maintenance stage	Budget and cost challenges	27	"The high prices of some maintenance materials or the high wages of technicians who specialize in periodic maintenance…" (C5)

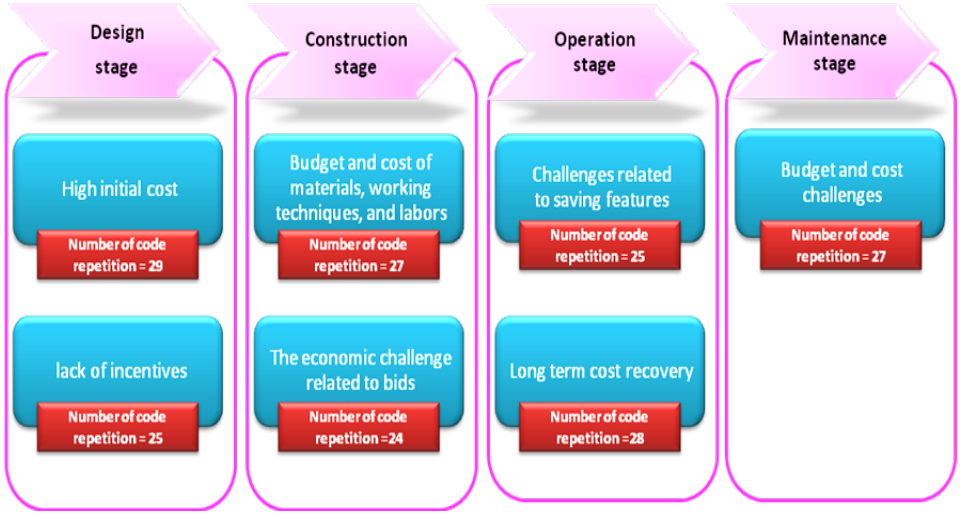


Figure 4 *The outcomes of SGBs' economic challenges throughout their life cycle stages*

4.2 Discussion

According to the findings of the study, the adoption of SGBs in Jordan during their life cycle stages (Design, construction, operation, and maintenance) was influenced by economic difficulties. Details of the findings are as follows:

4.2.1 Design Stage

In terms of the economic challenges throughout the design phase, it was discovered that "High initial cost" is the most significant difficulty, as indicated by the majority of respondents, as shown in Table 2 and Figure 4. The number of repetitions of statements related to this code was 29 times based on different participants.

GBs have become increasingly popular to achieve long-term development in the built environment. Accordingly, the high cost of SGBs is the greatest impediment to the development of GBs. GBs have to confront numerous challenges, mainly due to their high initial costs [74].

This is due to a condition where this type of building requires additional costs during the design process, represented by the need to conduct an in-depth environmental study, and make an economic feasibility study, which requires a lot of time, effort, and as a result, additional costs. Moreover, the need to simulate the building design in most cases, requires additional costs for the designer [75]. It is also important to consider that the approvals, transactions, and licenses related to these buildings also require greater costs as compared to the traditional constructions. Thus, all these economic challenges which were related to the budget and cost during the design phase significantly affected the adoption and development of SGBs in Jordan.

Accordingly, it was discovered that "lack of incentives" is another economic challenge facing the adoption of SGBs in Jordan during the design stage, as indicated by majority of the respondents (see Table 2 and Figure 4). The repetitions number of statements related to this code was 25 times based on inputs from different participants.

In many developing countries like Jordan, a lack of incentives to encourage customers to embrace green design principles presents several obstacles in the design phase. SGBs are a relatively new building technique and as a result, clients will need incentives to embrace this unique building technique. Thus, inadequate incentives given to building projects becomes a hurdle to adopting SGB approaches and influence the spread of these building practices in communities [76,77].

4.2.2 Construction Stage

According to the economic challenges throughout the construction stage, it was found that "Budget and cost of materials, working techniques, and labor" are the most significant challenges at this stage, as indicated by most respondents (see Table 2 and Figure 4). The repetition rate of statements related to this code was 27 times based on different participants.

Most of the participants mentioned that the reasons for this situation was related to the costs of environmentally friendly building materials that are needed for accreditation requirements were high as compared to traditional materials [78]. Moreover, the materials were not available in Jordan and had to be imported from abroad, which raised their costs. In addition, there were only few experts and technicians working in the field of GB, thus the costs of hiring them during the construction phase also contributed to additional costs [26]. The participants explained that these obstacles could prevent the progress of innovation and creativity in green construction and the achievement of environmental sustainability in this field due to the limited options available for materials and technologies used, besides their high prices [23], which affected the adoption of SGBs in Jordan.

The "Economic challenge related to bids" on the other hand, was discovered to be another challenge related to the economic pillar during the construction stage, which influences the adoption of SGBs, as most respondents

claimed. The results of these statement repetitions were 24, as illustrated in Table 2 and Figure 4.

According to the viewpoint of the research participants, most of them agreed that the bidding system used in traditional construction was not suitable for SGBs, as sustainable construction requiring the presence and involvement of all project members in the early stages of GB projects [79]. It was preferable that the designing and implementing team to be of the same entity. GBs had to focus on all the details of GBs design to fully apply them during the implementation stage. Therefore, the adoption of traditional building bids would be costly when it is used for GB projects and this would contribute to various issues and problems during the implementation stage of SGBs [28]. Excellent coordination between the design and construction teams is needed for the project to be well-performed. Moreover, as two different teams are involved in the control task of design and construction stages, lower-cost delivery systems such as design-bid-build are unable to achieve this level of coordination [79].

The participants also added that this situation also had caused various obstacles to achieve economic feasibility and recovering the initial costs as soon as possible, which affected the adoption of SGBs in Jordan.

4.2.3 Operation Stage

Regarding the economic barriers in the operation stage, most of the participants highlighted that the most significant economic challenge in the operation stage was "long-term cost recovery". As illustrated in Table 2 and Figure 4, the number of repeated statements related to this code was 28.

The majority of the participants discovered that one of the economic barriers encountered during the operation phase of SGBs is the time required to recover initial costs, which can take up to five years for commercial buildings and significantly longer for residential buildings. This statement is also supported by these studies [80,81]. In general, findings related to cost-benefit aspects from the literature reveal that the payback period for GBs normally takes a longer duration. However, the calculation of project payback periods is unable to account for the opportunity costs that green investment premiums imposed on developers are based on limited financial resources [82].

Additionally, it was found that the "Challenges relating to saving features" are one of the challenges in this stage, as indicated by most of the respondents. As illustrated in Table 2 and Figure. 4, the number of repetitions on statements related to this code was 25 times based on inputs from different participants.

The difference between actual and predicted building performance is generally named as building performance gap or energy performance gap when only energy consumption is considered in assessing a building performance. When a gap of building performance occurs, it shows that GBs cannot save as much energy as what they are designed to or, even worse, may consume more energy than non-GBs thus, GBs benefits will not be well utilized [80,81].

During the operation phase of SGB projects, the building must achieve a high level of performance and efficiency in order to achieve the desired benefits in terms of cost savings and recovery aspects. This requires the use of building materials with specific building techniques which need additional costs in the early stages of SGBs that need to be recovered after a certain period of their operations. Subsequently, the inefficiencies of SGBs operations had resulted in additional costs or the failure of utilising the benefit of SGBs systems in terms of their economic features. Overall, all these obstacles have affected the adoption of SGBs in Jordan during the operation stage of these projects.

4.2.4 Maintenance Stage

In terms of the economic pillar throughout the maintenance stage, it was found that the most significant difficulties are "Budget and cost challenges," as confirmed by the majority of participants based on the results of this study as illustrated in Table 2 and Figure 4. The number of repeated statements related to this code was 27.

The "Budget and cost" challenge in the maintenance stage of SGBs is due to the high prices of some GB materials for maintenance purposes besides the scarcity of GB material supplies. Accordingly, this challenge is also based on the high wages of staffs specializing in periodic maintenance or maintenance operations due to the small number of these specialists and technicians [83]. Thus, these obstacles, related to the "Budget and cost" during the maintenance stage, affected the adoption of SGBs in Jordan.

Overall, the high initial cost of SGBs in Jordan was discovered during the design stage, followed by a lack of incentives at this stage. Accordingly, the budget and cost of materials, working techniques, and labour were key economic challenges throughout the construction stage, and followed by an economic challenge related to bidding aspects at this stage. The major economic challenge for SGBs in Jordan, based on the operational stage of SGBs, was long-term cost recovery. This is followed by an economic challenge related to saving features. In relation to the maintenance stage, the economic issues were linked to budget and cost challenges because of the high costs of various GB materials used for SGBs maintenance and the high pay level of workers who are specializing in periodic maintenance or maintenance activities.

5.0 LIMITATIONS AND RECOMMENDATIONS

The findings of this study are subjected to some limitations, and they are as follows:

1. In Jordan, the number of professionals in the field of GBs is still limited, and only a few engineering firms and contracting firms specializing in this sector or have significant and lengthy expertise in it. As a result, identifying the samples to conduct the interviews was an inspiring task.
2. The researchers had difficulty reaching out to the respondents since they work in fast-paced environments and their professions require a lot of meetings and transportation. As a result, scheduling meetings with them according to their hectic schedule was challenging.
3. As there were few previous studies in the published literature that looked at the economic challenges of GBT, acquiring helpful information from the researchers took a lot of time and effort, particularly in the built environment of Jordan.

Despite the importance of this research in terms of adding to the current body of knowledge by demonstrating the economic challenges of SGBs in Jordan during the life cycle stages, the findings are based on qualitative data collected from experienced specialists in this sector. As a result, quantifiable data by using various evaluation approaches are recommended for further research. On the other hand, this research is a starting point for other research based on the concept of GBs. Therefore, this research will be a useful basis for future research that will propose a suitable solution for the economic issues of SGBs in developing countries and for future research that will address the concept of the Circular Economy (CE) for GBs. Finally, future studies should cover a larger geographical region to gain additional insight from a broader viewpoint.

6.0 CONCLUSION

Throughout their life cycle, SGBs face numerous challenges. These challenges can be classified as environmental, economic, or social. The purpose of this study is to highlight the economic challenges that SGBs face over their whole life cycle, which are restricting the adoption of this construction technology in Jordan. GBs have developed with the primary goals of mitigating environmental degradation, saving money, and increasing occupant comfort. Being green in the built environment entails taking ownership of these objectives [84]. The results of this study will benefit not only for Jordan, but all other developing countries with similar social, cultural, environmental, and economic conditions, especially in light of the preliminary studies on the field of SGBs in these countries.

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Appendix A

Some samples of interview questions for each phase of the GB project's life cycle

Economic Challenges of the Design Stage	
Q1.	What are the main reasons that make the initial cost of SGBs higher than traditional buildings?
Q2.	How might this challenge affect the adoption of SGBs in Jordan?

Economic Challenges of the Construction Stage	
Q1.	What are the things that make an increase in the cost of the SGBs in the construction stage?
Q2.	What the kind of bidding takes to construct the SGBs projects and how does it affect the cost? *(Design-bid-build or Design-build)
Q3.	How do the budget and cost challenges in the construction stage affect the adoption of SGBs in Jordan?

Economic Challenge of the Operation Stage	
Q1.	What are the economic challenges regarding the SGBs in Jordan, at the operational stage that prevents them to be like what planned in the design stage?
Q2.	How these challenges affect the adoption of SGBs in Jordan?

Economic Challenges of the Maintenance Stage	
Q1.	What are the main challenges that may affect the budget and cost of the maintenance stage of SGBs?
Q2.	How do these challenges in the maintenance stage of SGBs affect the adoption of SGBs in Jordan?
Q3.	Any Proposed Solution for these challenges?!