

The analysis of barriers in green building development in Libya



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ABSTRACT

The demand for green development around the world has intensified in the past few years, particularly in relation to environmental health and safety. Governments, institutions, and private construction sectors have adopted green building development as their ethical responsibility in developed countries. Although construction is one of the principal industries in Libya, priority has not been given to green building issues, due to the lack of satisfactory awareness. The study aims to resolve this deficiency of knowledge and awareness related to the impact of green building in Libya, seeking to determine the reasons why Libya lacks sustainable construction and green building methods, thereby removing the barriers for sustainable building in Libya. During the study, a mixed research approach was adopted with outcomes that will be beneficial to both researchers and construction engineers within the region. Data was collected using a questionnaire and analyzed in SPSS statistical computer program. Research findings have been shown that there is an unsatisfactory level of expertise in green construction in Libya. Findings indicated that poor implementation of green buildings in many current construction projects. Results also demonstrated that current encouragements are not sufficiently effective at promoting green construction in Libya; consequently, many construction firms are reluctant to participate in the green building market. Moreover, outcomes explaining the lack of green buildings in Libya include Price, unavailability, products, a supply of green materials, and ignorance about green buildings. Similar research which has been carried out in Singapore indicated that workers' experience, available technology, planning were the most critical factors affecting green building construction projects. Our research results underlined that government incentives and desirable subsidies, such as structural incentives, rebate programs, or voluntary rating systems, tax incentive schemes, low-interest mortgages loans, market and technology aid, improvement of workers' experience could eliminate many barriers and motivate green building development in Libya.

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1. Introduction

One of the major components of the construction industry is green building. It entails the construction of both residential and commercial properties. The premises that house people and facilitate various activities such as sports, commerce, and entertainment, among others, affect the environment in a number of ways, especially if they are not constructed in a manner that conserves the

environment. There are various factors in the green building which affect the environment. These include the location where a premise is built, the design and demolition. All these can potentially affect the environment as well as the people who use them. Buildings produce carbon dioxide, which is a dreaded greenhouse gas that has a chain of effects to the immediate environment. Sources of carbon dioxide from buildings include activities such as the use of electricity and the combustion of fuels, among other activities (Wood, 2007).

Green building has gotten expanded consideration over the previous decade from both ecological, financial specialists, and policymakers (Alnaser et al., 2008). While there is no single meaning of "green structures" or its related arrangement, analysts and associations have a

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tendency to accentuate asset productivity in building and decreasing the effects of structures on human wellbeing and the earth. Therefore, a developing exhibit of building division strategies has been actualized in the United States, and different nations went for vitality proficiency and lessening ecological effects of the structure or site (Matisoff et al., 2016).

The concept of green building cuts across disciplines. It entails an inter-connection of procedures and components that support for healthy and sustainable building activities. Ideally, green building is a concept in environmental conservation that favors the use of environmentally friendly construction materials as well as designs which are eco-habitat friendly. It identifies architectural designs that do not destroy the natural resources (Kibert, 2016). The use of materials that are locally available and eco-friendly in building and construction would go a long way in preserving the environment as well as reducing the usage of natural resources such as water and energy, which are becoming scarce with time due to over-exploitation without proper preservation. Secondly, green buildings will minimize the impact of construction activities on ecology and create a safe indoor environment for the populations (Tamošaitienė and Gaudutis, 2013; Samer, 2013).

Ngab (2010) reported that there is a demand for the development of green building development in Libya. As stated, maintainable building development has risen, which advocates for harmony between nature and the economy. This development has picked up prominence inside the business as of late. Hypothetically, the development business in Libya has been in charge of an extensive extent of the social and monetary improvement inside the nation for more than six decades. In accordance with this statement, Libya has encountered a discernible ascent in development exercises. Currently, the Libyan development industry is unequipped for tending to the continually expanding requests for lodging in the present atmosphere. The components in charge of these troubles incorporate an absence of funds, poor development arrangements, poor administration, and specialized natural difficulties. This study aims to resolve this deficiency of knowledge related to the impact of green building in Libya, seeking to determine the reasons why Libya lacks sustainable construction and green building methods, thereby removing the barriers for sustainable building in Libya.

2. Methodology

The proposed questionnaire has been used in order to collect information about green building issues within the region. The questionnaire categorized into three main sections, namely, the demographical information, the company's background, and barrier analysis. The demographical information section was used for statistical analysis by categorizing gender and age. 5 items were assigned to the demographical

information section, while 3 items were assigned to the company's background and 3 items for the barrier analysis, making a sum of 11 things on the whole. The hindrance examination segment has some sub-areas which were utilized as a part of noting the exploration inquiries of the parts of partners in green working in Libya, supportable improvement objectives in Libya, and the components of the absence of green building advancement in Libya.

2.1. The sample

During this study, a total number of 20 construction companies were selected for data collection. The survey was conducted between September 2016 and December 2016 from these 20 Libyan companies. As shown in Table 1, 17 out of 20 respondents were male, and the 3 were female. Females can hardly be found working in construction companies in Libya. Thus the 85% ratio of survey respondents was male, and the rest 15% were female. According to the frequency analysis, most of the respondents were between 20 to 30 years of age, while 45% were between 30 to 50 years of age, and the remaining 10% were older than 50.

Table 1: Respondents' demographic information (n)

| Gender | Frequency | Percentage |
|-------------|-----------|------------|
| Male | 17 | 85% |
| Female | 3 | 15% |
| Age | | |
| 20 - 30 | 9 | 45% |
| 30 to 50 | 9 | 45% |
| 50 or above | 2 | 10% |

The Table 2 shows that 6 (30%) of companies' main scope was architecture, 2 (10%) affirmed to be specialized as consultants, only 1 (5%) were involve as subcontractors, while the rest 11 (55%) has a mixture of all construction services.

Table 2: Main scope of companies

| Companies scope | Frequency | Percent |
|-------------------------------|-----------|---------|
| Architecture | 6 | 30.0% |
| Consultants | 2 | 10.0% |
| Subcontractors | 1 | 5.0% |
| Mixture Construction Services | 11 | 55.0% |

3. Results

3.1. Company's background

Companies' years of experience in the construction sector are another essential factor to be considered while reviewing the company's background. Thus, Table 3 consists of the companies' experience in this sector. Hence, as shown 4 (20%) had 1-5 years of experience, 11 (55%) of them had between 5-10 years of experience, while 3 (15%) affirmed to have 10-15 years of experience. However, the rest 2 (10%) confirmed to have more than 15 years of experience in the construction sector. Table 4 presents the level of experience in

green building each responded has in their field of specialization in construction.

Table 5 consists of a very important factor in our study. This defines the level of green development skills among the Libyan construction industry. All the respondents replied with having 'NO' (100%) training related to green building development.

Table 3: Companies' number of experience in the construction sector

| No of Experience | Frequency | Percent |
|------------------|-----------|---------|
| 1-5 | 4 | 20.0% |
| 5-10 | 11 | 55.0% |
| 10-15 | 3 | 15.0% |
| 15 or more | 2 | 10.0% |
| Total | 20 | 100.0% |

Table 4: years of experience in green building

| Year of experience | Frequency | Percent |
|--------------------|-----------|---------|
| No Experience | 13 | 65.0% |
| Less than 3 | 5 | 25.0% |
| 4-6 | 2 | 10.0% |

Table 5: Green building training (n=20)

| Response | Frequency | Percent |
|----------|-----------|---------|
| No | 20 | 100.0 |
| Yes | - | 0 |

As shown in Table 6, only 4 (20%) of the respondents' companies had green building projects currently. On the other hand, the rest of the 16 (80%) refused about having any green building project in their company.

Table 6: Green building projects

| Response | N | Percent |
|----------|----|---------|
| Yes | 4 | 20.0% |
| No | 16 | 80.0% |
| Total | 20 | 100.0% |

3.2. Barriers analysis

As the main purpose of this study is to evaluate the main causes, factors, and influencers, they lack green building development. Stakeholders are the individual entities who have an indirect or direct influence on any other entity, firm, process, project, or individual. Like other industries in stakeholders have an important impact on the construction industry as well. According to Table 7 results, most of the respondents, 45% claimed that the government is the strongest influential stakeholder by marking it as critical, and 35% of them marked it as major.

Table 7: Investor's influence (n=20)

| | Critical | Major | Moderate | Neutral | Minor |
|--|----------|-------|----------|---------|-------|
| Client | 40% | 20% | 5% | 20% | 15% |
| Architect | 25% | 45% | 20% | 5% | 5% |
| Engineering (Civil, mechanical, and etc.) | 15% | 25% | 20% | 20% | 20% |
| Government | 45% | 35% | 10% | 10% | - |
| Education Units (Universities and etc.) | 20% | 35% | 30% | 10% | 5% |
| Non-Governmental Organizations | 5% | 5% | 15% | 20% | 35% |

The second most critical influencer was 'client' as marked by 40% of respondents. 20 % of respondents marked it as a major influencer. The 3rd highest ratio for critical stakeholders was architects as rated by 25% of respondents. The ratio of 9 respondents also stated engineers as the major influencer. 35% of respondents agreed that non-governmental firms (NGOs) have no influence on the construction industry at all, while 30% of 20 respondents said that educational units have a moderate impact on the construction industry. Thus, the government considered critical stakeholders with the highest influence. Clients were second in the critical ranking, while architects were on the 3rd. In the case of major stakeholders, the scenario was vice versa. According to respondents, architects have a major role in the

construction domain, while the government and education units have an equally major role as well. The intention and willingness of sustainable development indicate the interest and efforts level of the construction industry towards sustainable goals. If sustainable development is not part of their business objectives, it has shown that one of the barriers that lack green development.

Table 8 contains the respondents' feedback regarding green building goals. 45% of 20 respondents agreed that there is a greater need for the availability of green materials in the Libyan construction industry. 35% of respondents also marked green materials availability as a major goal. The rest mark it as moderate, but there was no minor marking for this goal.

Table 8: Sustainable goals (n=20)

| | Critical | Major | Moderate | Neutral | Minor |
|--|----------|-------|----------|---------|-------|
| Economic incentives (tax credits, utility rebates, etc.) | 40% | 25% | 20% | 15% | - |
| Educational programs | 45% | 15% | 25% | 10% | 5% |
| Government policy | 45% | 40% | 5% | 10% | - |
| Greater availability of green materials | 35% | 30% | 10% | 15% | 5% |
| Increased awareness of benefits | 45% | 35% | 20% | 5% | - |

The similar ratio of respondents 45% claims that there is a higher need for educational programs as well as government policy that can help in creating

sustainable development awareness and produce skillful individuals (architects/engineers). Three respondents also chose educational program goals

as a major factor. 40% out of 20 respondents mentioned economic incentives such as taxes, utility rebates, and other incentives as a critical goal. 25% out of 20 respondents marked economic incentives as a major factor as well, while the rest chose it as a moderate factor. However, no single respondent marked it as a minor goal, while 30% of them marked it as a major factor and rest as a non-important goal. Awareness regarding the benefit of green development needs to be creating in the construction industry not just at the professional level but at educational and government levels as well, and it was stated as a critical goal by 45% of respondents.

When the reasons for lack of green building development are considered, despite the fact that the advantages of green buildings and exacerbating natural conditions are known by the development segment, there are still hindrances to the selection of green building advances and frameworks.

In this study, the deterrents of green buildings are investigated in the wording of individual to organizational factors. Table 9 consists of the respondent's feedback regarding the reasons or causes of lack of green building development in Libya. All mentioned reasons or barriers were taken based on the previous synthesis in this domain.

Table 9: Reasons for lack of green building development (n=20) in Libya

| | Critical | Major | Moderate | Neutral | Minor |
|---|----------|-------|----------|---------|-------|
| Lack of Knowledge | 45% | 30% | 10% | 10% | 5% |
| Lack of interest of Construction Industry | 25% | 35% | 15% | 10% | 15% |
| Political Issues | 20% | 20% | 15% | 25% | 20% |
| High Cost | 15% | 30% | 40% | 10% | 5% |
| Unavailability of sustainable resources | 20% | 30% | 25% | 10% | 15% |
| Lack of Skillful construction engineers | 30% | 30% | 25% | 10% | 5% |
| Lack of infrastructure construction | 30% | 15% | 40% | 10% | - |
| Lack of training/education in sustainable design/construction in architectural and engineering schools? | 35% | 35% | 10% | 20% | - |
| Lack of communication between contractor, subcontractors, suppliers, manufacturers | 25% | 30% | 40% | - | - |
| Lack of technical understanding of "green" technology | 30% | 50% | 20% | - | - |
| Complicated design then traditional one | 10% | 15% | 10% | 45% | 20% |
| Difficulty in maintenance | 5% | 20% | 25% | 20% | 30% |

- According to the analysis, the lack of knowledge was marked as the most critical reason by 45% of respondents. Two respondents marked it as a moderate barrier while rest marked as neutral and minor.
- Regarding the lack of interest in the construction industry in green development, 25% of respondents marked it as a critical reason, while 35% marked it as a major factor. 15% of respondents choose it as a moderate factor, 10% as neutral, and 15% as minor.
- Political issues were rated as critical by 20% of respondents. Also, a similar number of respondents, 20% marked political issues as a major factor. 25% of remaining respondents were not sure either this is one of the barriers or not. While 15% marked it as moderate barriers and the rest, 15% marked it as a minor barrier.
- According to the respondents, high cost is not the main reason, as green development rather reduces the cost. Thus, only 15% out of 20 respondents considered high cost as a critical factor, while 30% of them said it's a major factor. 40% of respondents claimed high cost a moderate factor, and the remaining 10% did not consider high cost as an effective factor. Only 5% of respondents choose high cost as a minor factor.
- Unavailability of sustainable resources is also one of the important barriers. The feedback regarding this factor was as follows: 20% out of 20 respondents marked this factor as critical, 30% of them marked it as a major, while 25% marked it as moderate, and the rest 25% said it either matters or not at all.
- Skillful construction engineers play an essential role in the success of the construction industry. The lack of these engineers can also be a reason for the lack of sustainable development. According to the data collected in this regard, 30% of respondents marked it as a critical barrier, and the similar number of respondents 30% marked it as a major factor, while 25% choose it as a moderate factor. 25% said it neutral matters, and only 5% of them said it has a minor effect on the lack of development of the green building.
- If the infrastructure of construction is effective and well-formed, the industry will definitely succeed. Hence, the feedback from respondents in this regard was quite controversial. 30% out of 20 respondents stated that lack of infrastructure could be a critical factor, while 15% of them mentioned it as a major reason. 40% of respondents marked it as a moderate factor, 10% marked as somehow, whereas there was no feedback received marking this factor as minor.
- Training or education is a continuous need for any organization to equip its employees or firm updated in their field or domain. Thus, training is also important in the construction industry, especially for green development. In the research survey, 35% of respondents marked a lack of training as a critical reason. A similar ratio of respondents (35%) said it's a major reason. 10% of respondents said it has a moderate impact, while only 20% said lack of training is not an important factor.

An effective communication considered as the backbone of any successful industry, firm, or individual project. In the construction sector lack of communication among contractors, suppliers, manufacturers and engineers can cause a huge loss which has 25% as critical, 30% major impact, 5% minor and the highest with 40% moderate indicates that lack of communication has a moderate impact in green building projects.

Technical understanding or expertise of green technology can bring more chances to develop green buildings. Thus, a lack of technical understanding comes out as a major reason in Libyan construction. 30% of respondents marked this factor as critical, and 50% of them said it's a major cause of lack of green development. However, only 20% of respondents said it's a moderate factor.

According to two respondents, the complicated design of green development is one of the reasons for the lack of green building. 15% of them sated it as a major reason, while 10% marked it as a moderate factor. The higher ratio of 45% of respondents said the complicated design could either be or not be an issue. Only 20% of respondents said complicated

design does not make any difference to not go for green development.

Maintenance difficulty was not considered an issue as responded by 30% of respondents. 20 % of them don't consider it a major issue, while 25% marked it as a moderate issue. However, 20% said it's a major issue, and only 5% mentioned it as a critical factor.

3.3. The reasons mostly affecting the development of green buildings in Libya

To fully understand the reasons that mostly affect green building development in Libya, an illustrative investigation was completed. The accompanying table exhibits the mean and standard deviation of each got to build. The outcome acquired of the vast majority of the development was normal because of the way of mean, which was inside 3.0. Table 10 shows the mean and standard deviation of the gathered answers, which depended on a Likert of 5-point scale in the questionnaire.

Table 10: Factors for the most affecting green building development

| Factors | Mean | SD |
|---|------|------|
| 1. Lack of knowledge | 4.00 | 1.21 |
| 2. Lack of interest in the construction industry | 3.45 | 1.39 |
| 3. Political issues | 3.00 | 1.41 |
| 4. High cost | 3.40 | 1.04 |
| 5. Unavailability of sustainability resources | 3.30 | 1.34 |
| 6. Lack of skillful construction engineers | 3.70 | 1.17 |
| 7. Lack of infrastructure construction | 3.68 | 1.05 |
| 8. Lack of training/education in sustainable design /construction in architectural and engineering schools? | 3.85 | 1.13 |
| 9. Lack of communication between contractor, subcontractors, suppliers, manufactures | 3.70 | 1.03 |
| 10. Lack of technical understanding of "green" technology | 4.10 | .71 |
| 11. The complicated design than the traditional one | 2.50 | 1.27 |
| 12. Difficulty in maintenance | 2.50 | 1.27 |
| Total | 3.43 | 1.16 |

According to the obtained result total (M=3.43; SD=1.16) from Table 10. It can be seen that the reasons that affect green building development in Libya are very strong based on the constructed Likert scales because of all the responses are above the average (>3).

The highest mean recorded from Table 10 was item 10, "Lack of technical understanding of green technology" (M=4.10; SD=0.710). Hence, this indicates that this is the reason that affects green building development the most out of the remaining reasons in Libya.

4. Conclusion and Discussion

It is known that buildings in many developed countries are consuming significant percentages of their nations' energy sources (Pérez-Lombard et al., 2008). Therefore, governments in many developed countries have passed new laws to make green building measures mandatory. However, the importance and structuring of green buildings have not yet been brought to the agenda in developing or underdeveloped countries (Hwang and Tan, 2012).

The construction industry is one of the principal generators of revenue for local governments in Libya. The impact of this sector on the economy is substantial due to the fact that it is a significant consumer of many of the local natural resources. Unfortunately, some of these natural resources are not renewable. This makes it significantly important that firms in the construction industry adopt sustainable building practices in order to achieve sustainable development.

In addition, sustainable construction practices have a wide array of advantages. Unfortunately, the implementation of such practices has been beset by a series of challenges, predominantly in third world countries such as Libya. To foster sustainability in the construction industry, it is critical that a robust plan for sustainable development in the construction industry is developed. This research paper is primarily a report based on a questionnaire survey that was conducted in Libya to determine the bottlenecks that have negatively impacted the green construction industry.

The findings of the study reveal that the level of expertise in the green construction industry has been behind the poor implementation of green

building in many construction projects. Similar research which has been carried out in Singapore indicated that workers' experience, available technology, construction planning were the most critical factors affecting green building construction projects (Hwang et al., 2017). Also, the study also revealed that the current incentives were not effective in promoting the green building industry among construction firms based in Libya. In addition, the already existing financial incentives have not been able to fully address the hefty cost of green buildings. Therefore, construction firms in Libya find it being utterly expensive to adopt green building practices. Azad and Akbar (2015) conducted studies to determine the major impediments to green building. They found out that high upfront costs (construction methods, design, and technology) were a major bottleneck for the development of a culture of green building. However, the different obstructions to the accomplishment of supportable building rehearse included generous advances, material cost, nonattendance of protection strategies, considerable introductory cost, the poor experience of development firms in green building, trouble in discovering green materials lastly the boundaries to the framework and item development altogether of significance.

Additionally, the lack of technical understanding of green technology is the primary factor affecting green building development in Libya, where no significant gender difference significant, which can be addressed by the Government. Furthermore, the Libyan government has the greatest influence on specifications for prospective green building development in Libya. Many of these obstacles to the development of sustainable green buildings can be addressed through adequate research and government support besides education. Many construction firms who have expressed a preference to invest in the green building have complained that the government does not support them appropriately. According to them, support in the form of tax abatements, fiscal incentives, and policy instruments would be an important step in encouraging green building practices.

Based on the respondents' comments, it is important for the government of Libya to establish important yet mandatory regulations to encourage green building. Moreover, there should be policies in place that will increase the market demand for green buildings. The Libyan government could also fund education and research in green building. Construction firms that utilize non-environmentally friendly materials, such as fossils fuels, should be taxed heavily, while those who engage in green

buildings should be incentivized accordingly. The government should also foster competition in the green building industry.

Conclusively, it is recommended that stakeholders in the construction industry should be more informed by local authorities. This will encourage them to shift their attention to green building issues.

Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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