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# Lessons Learned, Barriers, and Improvement Factors for Mega Building Construction Projects in Developing Countries: Review Study

**Yazan Issa Abu Aisheh**

Civil Engineering Department, Middle East University, Amman 11831, Jordan; Yabuaisheh@meu.edu.jo

**Abstract:** A mega-project is a major project or a group of projects of significant cost that attract a high level of public attention or political interest because of substantial direct and indirect impacts on the community, environment, and state budget. Capturing and sharing the knowledge from the performance of the current mega projects is essential in order to avoid losing vital corporate knowledge assets in the construction industry. The learned lessons are gained from experience, success, and failure for improving future performance. This research aims to review and read out the lessons learned from 77 research papers that have dealt with the barriers that hinder the successful performance of mega building construction projects in developing countries, identify and classify the main obstacles, and propose improvements for successful implementation and management of mega building construction projects. The results of this paper will help project owners, construction companies, and other stakeholders in developing countries to overcome the limitations in the execution of mega building construction projects.

**Keywords:** mega building construction projects; developing countries; construction projects barriers; construction improvement factors; contractor; lessons learned in construction; contractor; supervision staff; owner



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## 1. Introduction

Mega building construction projects are very important for all the involved stakeholders because it is the base of the development of the country economically, and environmentally [1,2]. Caldas and Gupta [1] defined mega project as a term that signifies a qualitatively different stage of social and economic development. The success in mega building construction projects is a key topic in project management research, in order to support the growth of a nation [3,4].

In general, the construction industry is considered very complex and complicated due to the dynamic environment and the variety of resources [5,6]. Construction companies gain most of their knowledge from construction sites. In other words, there is no theoretical aspect for their works to fit the projects they carry out [7]. Learning lessons from past experiences in implementing mega building construction projects helps the company avoid the same mistakes, and continue the successes achieved in the past, which enhances a construction company's competitiveness in the marketplace [8]. Project management for the lessons learned involves coordinating various aspects of a project in order to bring out positive results for the overall construction industry [9].

Construction projects suffer several complex conditions and barriers that may cause delays [10,11]. The main factors behind the delay are the lack of resources, the lack of project leadership skills, the increase of material prices, and the poor quality of available equipment and raw materials. Enshassi and Al-Najjar [12] stated that those delay and budget exceedances are significant problems in construction projects in developing countries. Delay reasons and their degree of impact vary from a project to another, and they can last from a few days to years [13].

The main characteristics of the mega-building construction projects are complexity, uncertainty, dynamic interfaces, external influences, and long execution periods [1]. There is huge pressure from the owner to complete a mega project on time with high quality, which imposes the construction companies to compress the duration of the implementation of the tasks without taking into consideration the quality of the project [14].

Ferrada and Núñez [7] mentioned that construction projects are considered the most important source of knowledge of the construction industry. However, the lessons learned from them are not systematically incorporated into subsequent projects. Many small scale companies engage in mega projects, so that there is a gap in the current construction contractors' practices for implementing the mega projects [2,14]. There is a problem with the databases of the lessons learned. It is not widely used because the existing documents tend to focus on the achieved progress by the project team rather than the way of implementing it successfully, or mentioning the used materials [3,7,15].

Based on the above discussions, this study comes to investigate the lessons learned from mega building construction projects executed in developing countries. They have been extracted from 77 research papers in order to discuss the current practice and propose improvements. Extracting the main lessons learned and the barriers that hinder the successful implementation of mega construction projects is essential to develop the current active mega projects, and the future ones. In addition, these lessons will help the decision makers, the designers, and the planners of these construction projects in developing countries to consider them in the early stages of the construction projects. They will also save time and cost in construction projects, mitigating the risk of unforeseen conditions that may negatively affect the incoming mega building construction projects.

## 2. Theoretical Background

### *2.1. Construction of Mega Building Projects*

The construction industry is a dynamic industry. It depends heavily on the input from the stakeholders of construction projects [7]. Amalraj and Hernani [9] defined mega projects as "major infrastructure projects or building construction projects of a significant cost that attract a high level of public attention or political interests because of substantial direct and indirect impacts on the community, environment, and state budget." Mega projects include the creation of oil and gas extraction plants, power plants, and railways [7]. In addition, mega projects consist of construction of airports and processing projects, dams, and cultural events such as the Olympic Games [16]. The failure and the success in mega project depend on the scale of these projects [1].

Capturing and sharing the construction knowledge from current mega projects is essential in order to avoid losing vital corporate knowledge assets in the construction industry [7]. Construction companies need to identify the knowledge from the current construction projects and thereby learn from previously completed projects in order to improve performance and career path of the company [3,14].

The mega projects are considered complex due to (1) a large number of stakeholders and interfaces, (2) challenging project location, (3) insufficient resources, (4) unfamiliar technology, (5) constraints and difficulties in regulations, (6) extensive infrastructure requirements, and (7) geographically dispersed teams [1,3,16]. The investment size of the mega project, the long duration of the implementation, the technological complexity, and the social environment are the main reasons behind the complexity of these projects [16,17].

### *2.2. Lessons Learned from the Mega Projects*

A lesson learned is defined as knowledge gained from experience, successful or otherwise, for the purpose of improving future performance [7]. Arditi et al. [8] defined the lessons learned as knowledge artifacts, which convey experimental knowledge that is applicable to a task, decision, or process so that this knowledge can then be used to disseminate the validated experimental results and thereby avoid failures.

Lessons learned create a knowledge based on long trials and errors ending with successes and failures in the construction projects [7,8,14,18]. The aim of the lessons learned system is to capture positive and negative aspects of construction projects in order to learn from past experiences, thereby avoiding the repetition of mistakes which may negatively affect the company's performance [8]. Every construction company prepares a lessons-learned database in order to strengthen the relationship between the project team [3,7].

The developed system of lessons learned in the construction industry deals either with design-related problems, or with a specific type of project [8]. Despite the efforts made and the improvement in learning from projects, there are repeated mistakes, failure to learn from projects, and lessons to transfer from one project to another [7]. Paranagamage and Carrillo [14] stated that the lesson learned should incorporate into the work process to: (a) enhance future performance, (b) find the solution to the current problem or make a preventative action, (c) develop the policy or draw the guideline of the companies, and (d) avoid the adverse situation.

Many phenomena should be considered when developing the lessons learned as stated by [7]: (1) professionals identify good/bad practices during the implementation of the construction projects; (2) the frequency of bad practices or failures is much lower than recording good ones. Ferrada and Núñez [7] identified the main benefits from the lessons learned: (1) avoiding repeating mistakes by learning from similar past projects; (2) ensuring that past successes are replicated in future projects; (3) developing the competitive competency over companies, and (4) encouraging innovation inside companies. The lessons learned from the previous mega construction projects could facilitate implementing the new projects, contribute to the improvement of performance and profits of the contractors with less mistakes, and strengthen the project team (stakeholder) relationships [14].

## 3. Methodology

The methodology used in this study was based on three successive stages as follows: Stage 1 'Review', Stage 2 'Analysis', and Stage 3 'Outputs'.

In the first stage, two rounds of literature review were conducted. The first round included sources that have investigated the mega construction projects, the lessons learned system in the construction industry, and the barriers of implementing and managing of the mega construction projects. The literature search was performed in two steps. In the first round of literature search, the titles, the abstracts, and the keywords were searched using a manual search in the databases and web engines. These databases and web engines included Google, Google Scholar, the Scopus database, and the Web of Science database in order to identify relevant previous sources. The research keywords were "Mega Building Construction Projects", "Reasons of Delay in Mega Construction Projects", "Construction Projects Barriers", "Lessons Learned". After completing the search in the databases and web engines, the total number of identified sources was 18. Next, the titles and the abstracts of the sources were reviewed, and the ones identified as relevant to the review were selected to be retrieved and reviewed in full. The sources were chosen based on the following inclusion criteria: (a) the sources that implied mega building construction projects and their barriers, (b) the sources published between 2002 and 2021, (c) the sources available online, and (d) the sources written in English. In total, 69 sources were investigated in stage 1 in order to get an overview of the mega construction projects, reasons of delay in construction projects and the involved barriers that have contributed to the delays, and the lessons learned. At the second round of literature search, the keywords, the titles, and the abstracts were searched using a manual search in the databases and web engines. The research keywords were "improvement factors for implementation and management of mega construction projects". Similar to the first round, the titles, and the abstracts of the sources were reviewed, and the ones identified as relevant to the review were selected. Eight sources were chosen based on the same inclusion criteria mentioned in the first round,

as well as the sources not selected at the first round of literature search. In total, 35 sources were selected.

In step 2, the selected sources were reviewed in order to extract the factors using the content analysis approach. All the sources were categorized based on the barriers categories and year of publishing. Regarding the approach previously mentioned, content analysis is a detailed and systematic examination of the contents of a particular body of material. Furthermore, content analysis is implemented to extract the main barriers of implementing and managing mega building construction projects, and the factors that may enhance the implementation and the management of mega building projects and improve their performance. It consisted of two rounds: the first one resulted in reaching 48 different barriers from 51 related sources to the mega project implementation and management barriers after heavy analysis; the second round resulted in reaching 23 different ways to overcome, from 35 related sources, about ways to improve mega project performance.

Step 3 was the final one. It concluded the outputs of the previous stages. In the first round, there were 14 barriers related to exceeding the contractual period, 7 barriers related to budget, 8 barriers related to communication between stakeholders, 9 barriers related to management experience, and 10 barriers related to contractual issues which, in total, resulted in 48 barriers that hinder the implementation and the success of mega construction projects. In the second round, the results have given 23 different ways to enhance the implementation and the management of mega construction projects.

## 4. Results and Discussion

### *4.1. Main Barriers of Implementing and Management of Mega Projects in Developing Countries*

#### 4.1.1. Main Barrier Groups

Many publications exploring the reasons of delay in mega construction projects have been implemented in developing countries [19,20]. Delay in construction projects is the most common problem that the construction industry faces anywhere in the world [12,19,21]. Mega building construction projects make no exceptions. The results of a quantitative investigation on delays of construction projects in Jordan have been carried out by Sweis et al. [22], indicating that the most of the causes of delay in construction projects have been related to financial difficulties faced by the contractor and too many change orders by the owner.

According to Assaf and Al-Hejji [21] only 30% of the large construction projects in the Saudi Arabia have been completed on the planned time. Moreover, Faridi and El-Sayegh [23] have revealed that half of the mega projects in United Arab Emirates (UAE) are not completed without time extension.

Enshassi and Al-Najjar [12] have attributed the delay in construction projects in the Gaza Strip to twelve factors as follows: project-related; contractors' responsibilities; consultants' responsibilities; owners' responsibilities; professional management; design and documentation; materials; execution; labour and equipment; contractual relationship; government relations; and external factors.

Ruqaishi and Bashir [19] have identified seven factors behind the delay in the construction projects in Oman: (1) poor site supervision and management by contractors, (2) conflict with subcontractors, (3) lack of project planning by contractors, (4) poor management staff of contractors, (5) delay in procuring the construction materials, (6) lack of effective communication among project stakeholders, and (7) poor interaction between the vendors of the project.

Memon and Rahman [24] have stated that the cash flow and the financial difficulties of the contractors, bad site supervision and management, lack of the contractor experience, lack of personnel, and inaccurate planning and scheduling by contractors are the main barriers and reasons of delay in the construction industry.

Delay in the mega construction projects in Saudi Arabia may be due to one of following seven groups: client, contractor, consultant, materials, labour, contract, and relationships [25]. Financial issues, contractor inexperience, delays in reviewing design documents,

the shortage of construction materials in the market and other materials required, shortage of manpower and low skill levels, and unrealistic timeframe are considered the main causes of delay for these seven groups.

Al-Emad and Rahman [26] have mentioned 58 failure factors gathered in four groups as the failure factors of Makkah's mega construction projects. These groups are client with 17 factors, contractor with 27 factors, consultant with 10 factors, and external with 4 factors. The top factors that cause the delay in these four groups are the interaction between the client and contractor's responsibilities in choosing the subcontractors, the lack of comprehensive study of the tender documents by the contractors, the lack of staff experience who work in the consultant's organization, and the sudden change of the legislations of the country.

Adam and Josephson [27] have categorized the reasons of delay and cost overrun in mega projects as a literature study for the following factors: (1) communication: lack of communication between stakeholders; (2) financial: delayed payment to contractors; (3) management: poor site management; (4) material: shortage of equipment; (5) organizational: unsuitable management structure; (6) project: project complexity; (7) psychological: optimism bias; and (8) weather: harsh weather conditions.

Zarei and Sharifi [28] have analysed the delay reasons in the mega projects in Iran to main four categories: (1) initial negotiations: absence of industrial feasibility study and capacity planning; (2) contracting processes: delayed payments by owner; (3) planning process: incomplete and ineffective contracts; (4) companies: control process inaccurate or wrong estimation of costs by equipment manufacturing.

Adam and Josephson [27] have agreed on most of the delay groups in construction projects, while Zarei and Sharifi [28] have gone in more detail of the delay reasons. Al-Emad and Rahman [26] have explored the whole factors of delay in reconstruction and they have summarized it in four groups and 54 factors. Adam et al. [27] have concluded their literature review for all the publications in delay of mega projects with seven groups and less than 30 factors. Al-Kharashi and Skitmore [25] and Al-Emad and Rahman [26] have almost similar results because they have targeted the same area, which is Saudi Arabia. The authors of [24,29] have concentrated on the management issues as the main reasons of delay in the mega projects.

As a result, the literature has classified the barriers in mega projects to five groups. These groups are: (1) exceeding the contractual period, (2) budget, (3) communication between stakeholders, (4) management experience, and (5) contractual issues. Table 1 summarizes the barrier groups and the references.

**Table 1.** Reasons of delay in the mega construction projects.

| Group | References |
| --- | --- |
| Exceeding the contractual period | [12,19,24–28] |
| Budget | [12,19,25,27,29] |
| Communication between stakeholders | [12,19,24,26–29] |
| Management experience | [24,26,27,29] |
| Contractual issues | [12,19,24–27,29] |

#### 4.1.2. Main Barrier Factors in the Identified Groups

The sections below extract the main barrier factors from the barrier groups.

a. Exceeding the contractual period

The lack of specified construction materials is considered one of main barriers of implementation of mega construction projects in many countries around the world [28,29]. Without the availability of construction materials when needed, it is impossible to complete the construction activities on time [21]. Even if the basic construction materials are available in the country, they are not enough to complete the project. There are some essential and unique materials that are in the critical path, causing the delay of the project [25,26].

Delay in decision making, either by the contractor or by the supervision team, hinders the progress in the implementation of the construction activities [30]. The delay in taking the decision frustrates the stakeholders and causes a cumulative delay in the time schedule [31]. The delay in taking the decision is mainly referred to the lack of delegation from the top management level to the lowest level in the project [32].

Frequent change orders due to the unforeseen conditions during the execution, or lack of clarity of the tender documents, negatively affect the time schedule of the mega projects [33]. The process of preparing and proceeding the Variation Orders (V.O) and the negotiation with the contractors is not a straightforward process due to the conflict of interest between the stakeholders [34]. Sometimes a debate may occur with the contractor in order to implement such variation order because the contractor considers the V.O as his chance to increase the profit ratio [11,35].

The vague tender documents, and the complexity of the project, have a significant impact on the duration of mega projects [33]. The contractor may spend many hours in illustrating the description in some items and this increases the rework activities due to the misunderstanding of the process [32]. The chance of issuing the V.O is increased due to the complexity of the project and lack of ability to implement some items [29,36].

The top challenge in the construction industry, as mentioned by [25], is the lack of experienced and qualified personnel attributed to the significant and large scale of the construction projects. The poor productivity of the labourers contribute to the increase of the implementation period of the project [29]. The poor management of the construction site causes the lack of the productivity and waste of project resources [37].

Bad weather and climate in the implementation area contribute to delay in execution of some activities [27]. Usually, the period of mega construction projects extends for more than one year, which means that the project will be affected by the weather of all the seasons [19]. The winter or cold weather has a negative impact on the implementation rather than hot weather due to the concrete works and the harsh accessibility to the construction site [28].

The instability of the political situation negatively affects the time schedule of the project and may increase by twice or more [10]. The security issue prevents international experts from contributing to the implementation of some activities and causes difficulties in communication with international companies to procure some items which are not available in the local market [13].

b. Budget

The poor preparation of cash flow by the contractor causes trouble during the implementation between the sub-contractors and the main contractor due to delay in the payments for them [38]. The contractor usually takes a loan from the bank to start the implementation, but after three months he could not commit his obligations due to the poor preparation of cash flow [28]. Ruqaishi and Bashir [19] state that the cost overrun and the contractor loss occur due to rush in preparing the cash flow.

Delay in preparing the payment request from the contractor side causes trouble in the financial progress of the project [37]. The delay in preparing payments, and the calculation errors in the payments, may be attributed to the lack of admin staff of the contractor [39]. Moreover, due to the complexity of the implemented works, the freshly graduated engineers who work on the project may not be able to prepare the payments, so the contractor will not be able to implement some scheduled works [24,40].

Delay in payments to the contractors by the owner hinders the implementation of the project and decreases the trust between the stakeholders [25]. The main delay in this section is the delay without reasons, such as calculation errors. This delay causes problems in the cash flow of the contractor [32]. The contractor may submit a claim to compensate the unjustified delay in transferring the payments to him, which means, accordingly, that the cost of the project will increase [24,41].

Insufficient contractor liquidity is one of the main reasons of cost overrun in construction projects [10]. The contractor is forced to take a loan from the bank to cover the deficit in liquidity, which means that interest will increase and the project cost will increase

too [29]. The sub-contractors may refuse to work with the contractor and the vendors, because he will not pay them on time, and consequently the project duration and cost will increase [36].

The increase in the cost of the construction materials is out of the contractor control, but it is a potential risk in the implementation, and it should be considered [12,42,43]. The cost of the construction materials may be increased due to the political situation or other reasons [25]. The contractor may cheat to compensate this new cost, so that the opportunity of reworking the items will increase [30].

c. Communication between stakeholders

The vagueness of communication channels between stakeholders hinders the effective communications during the implementation, and impedes solving the pending issues [33]. The owner is responsible for defining the communication channels. He/she is the focal point for each stakeholder in order to ensure that the construction works are progressing smoothly [28]. Ramabodu and Verster [35] have pointed out that the miscommunication between stakeholders in the project site results in the failure of the project itself in some cases.

The conflict of interest between stakeholders is one of the critical issues in mega projects, and the construction projects in general [26,36]. The contractor aims to have a sufficient ratio of profit, while the owner aims to reduce the cost as much as possible [43]. The conflict of interest is risky in the construction environment because the owner will not forgive the contractor if a mistake happens, while the contractor will try to find any gaps in the contract documents to gain more money or end up in corruption [44,45].

The lack of owner cooperation with other stakeholders hinders the decision making process and causes a delay in the time schedule [46]. The owner of the project may not be available all the time in the construction site, but all the stakeholders inquiries should be answered because he/she is the end user of the project [30,39]. Without periodic meetings, which are called by owner to organize the work or take the necessary decisions on the pending issue, the construction progress will not go smoothly [44,47].

Conflict of responsibilities in dealing with external parties is one of the critical issues in implementing the mega construction projects [32]. For example, the owner is responsible for dealing with the electricity network company, and failing to inform the supervision team about this will cause a work duplication, causing conflict as well [48].

Frequent changes in supervision and contractor teams may cause a significant delay in the project period and the quality of the implemented works [17]. After understanding the tender documents, which takes several days, and proceeding with the implementation, the overall team may be changed from the contractor side to have effective resources management. This has a bad effect on the project implementation [29]. Moreover, the supervision team will need additional time to know how to deal with the new contractor team and vice versa [28].

The lack of communication between the designer and the project staff causes a significant risk in the execution process because the designer has sufficient knowledge about the owner requirements and specifications that have been prepared by him [21,49]. The communication between the designer and the project teams saves project time and ensures that the implemented works are executed as required by the owner and designer [44].

d. Management experience

Shehu and Akintoye [29] have attributed the delay in the mega construction projects to the failure in implementation and practice of program management. The main challenges of implementing the program management are the lack of strategic focus, human and communication, financial factors, leadership and commitment, strategy and awareness, and benefits understanding [1,50,51]. The poor qualifications of the contractor staff cause bad quality in the implemented works [52].

El-Sabek and McCabe [52] have also mentioned that the delay in the mega project in some parts of the Middle East is due to the poor planning stage and the lack of management

experience of the supervision staff. Corruption will happen if the supervision team is not good enough to manage the work in mega projects [29,53,54].

Lack of controlling and monitoring from the owner encourages the contractor to rush in the execution, submitting bad quality works. In addition, the supervision team will not work perfectly [27,35]. The lack of a staff organization structure damages the communication channels in the project site [25,27,47]. Finally, the difficulties in the management of the human and non-human resources by the contractor cause a real delay in the mega projects, wasting the project budget [28,55,56].

e. Contractual issues

Awarding decision, which is made based on the lowest bidder only, is one of the riskiest issues in mega projects [12,25]. The lowest bidder may not be qualified enough to implement a large scale construction project [24]. It usually puts a low percentage of profit during pricing. Accordingly, he/she may try to implement the work with low quality [25]. El-Sabek and McCabe [52] have pointed out that the awarding process of the lowest bidder encourages contractor corruption to compensate the profit ratio.

When the nature of the contract is not compatible with the size and the budget of mega projects, this causes actual delay in the project [23]. Most of the mega projects are implemented based on the lowest bidder analysis, which is not in line with the size and the budget of the mega project, so that non-qualified contractors submit their offers [41]. The contractor type is essential to provide the flexibility during the implementation [52].

Challenges in securing experts from outside to implement some activities causes some delay in the mega projects. Due to security reasons, some international consultants refuse to work in the project area. Therefore, some items are delayed in the implementation [33]. El-Sabek and McCabe [52] have mentioned that due to the lack of coordination between the contractor and the international consultant, many consultants refuse to work with the contractor.

The contract parties could not adhere contract requirements due to the political situation that hinders the mega projects [40]. Enshassi and Al-Najjar [12] have pointed out that the contractor usually could not implement the works due to error in pricing or lack of cash. The owner sometimes suspends the work in the project or cancels the work due to the lack of funds [12,52].

Without prequalification of contractors before bidding, the conflict will happen between the project stakeholders [52]. Moreover, for the contractors who used to implement small scale construction projects, it is not easy to implement a large scale project [36]. The prequalification process enables the designer to explain what he meant by some items, or clear the conflicts in the tender documents [56].

The designer who has insufficient background about the situation is one of most complex contractual issues [21]. The designer who lacks sufficient experience about the nature of the project area will surely prepare vague tender documents with items that could not be implemented or construction materials that are not available [36]. Some owners trust an international designer rather than a local one, so the cost of the project may be doubled or tripled [12].

Table 2 below summarizes the main barrier groups and the sources associated with them.

**Table 2.** The main barrier groups of the mega construction projects.

| No. | Barrier Factors | Reference(s) |
|---|---|---|
| Section (1): Exceeding the contractual period | | |
| 1. | Lack of construction materials | [21,25,26,28,29] |
| 2. | Delay in decision making | [30–32] |
| 3. | Frequent change orders | [33–35] |
| 4. | Vague tender documents and the complexity of the project | [29,32,33,36] |

**Table 2.** *Cont.*

| No. | Barrier Factors | Reference(s) |
|---|---|---|
| 5. | Poor productivity and re-work | [25,29,37] |
| 6. | Bad weather and climate | [19,27,28] |
| 7. | Instability of political situation | [10,13] |
| 8. | The existence of some unexpected and invisible obstacles in the site that have not been considered | [18] |
| 9. | The siege and the closure of the crossings on a continuous basis and the occurrence of incursions and strikes | [57] |
| 10. | Owner's inability to coordinate the entry of multi-use material from outside the country | [4] |
| 11. | Delay in obtaining financial dues of contractors from financiers | [11] |
| 12. | Absence of competent courts to settle disputes between contracting parties | [58,59] |
| 13. | Non-compliance by the donor with any damages resulting from any changes of the political or economic situation | [57] |
| 14. | Difficulty in obtaining permits and licenses for the work of the project from the government agencies | [57] |
| Section (2): Budget | | |
| 15. | Poor preparation of cash flow | [19,28,38] |
| 16. | Delay in preparing the payment request from the contractor side | [24,37,39,40] |
| 17. | Delay in the payments to the contractors | [24,25,32] |
| 18. | Insufficient contractor liquidity | [10,29,36] |
| 19. | Increase in the cost of the construction materials | [12,25,30] |
| 20. | Instability in the currency exchange rate | [60,61] |
| 21. | Contractor's pricing policy and low profit due to competition and increased administrative expenses | [60,61] |
| Section (3): Communication between stakeholders | | |
| 22. | Vagueness of communication channels between stakeholders | [8,33,35] |
| 23. | Conflict of interest between stakeholders | [26,36,43–45] |
| 24. | Lack of owner cooperation with other stakeholders | [30,39,44,46,47] |
| 25. | Conflict of responsibilities in dealing with external parties | [32,48] |
| 26. | Frequent changes in supervision and contractor teams | [17,28,29] |
| 27. | Lack of communication between the designer and the project staff | [21,44,49] |
| 28. | Lack of local community and beneficiaries participation in the design stage | [15] |
| 29. | The lack of clarity and delays in decisions making because of its centrality | [11] |
| Section (4): Management experience | | |
| 30. | Lack of experience of the contractor staff | [1,29,52] |
| 31. | Lack of management experience of the supervision staff | [29,52] |
| 32. | Lack of controlling and monitoring | [27,35] |
| 33. | Lack of staff organizational structure | [25,27,47] |
| 34. | Difficulties in management of human and non-human resources | [28,55,56] |
| 35. | Lack of control of subcontractors and the absence of express contracts with them | [6] |
| 36. | Lack of archiving and documentation system of the company | [60] |
| 37. | Individual management and its concentration to the owner of the company leading to the difficulty of managing its human resources | [60] |
| 38. | lack of interest in safety and security rules during project implementation | [62–67] |
| Section (5): Contractual issues | | |
| 39. | Awarding decision is made based on lowest bidder only | [12,24,25,52] |
| 40. | Nature of contract is not compatible with size and project budget | [23,41,52] |
| 41. | Challenges in securing experts from outside to implement some activities | [29,33,52] |
| 42. | The contract parties could not adhere contract requirements | [12,41,52] |
| 43. | No pre-qualifications of the contractors before bidding | [37,52,56] |
| 44. | The designer has insufficient background about the situation | [12,21,37] |
| 45. | Hiring an external designer who is not familiar with the nature of the implementation of the country | [60] |
| 46. | Adopting a foreign language in a non-professional manner helps to make contradictory interpretations | [60] |
| 47. | Bad owner's policy of compensation in the event of the circumstances of the force majeure | [60] |
| 48. | Failure in the estimation of the contractual duration of the project | [60] |

### *4.2. Improvement Factors for Implementation and Management of Mega Projects in Developing Countries*

This section exhibits the main improvement factors that may contribute to the development of implementation and management of mega building construction projects.

#### 4.2.1. Contractor

Assigning teams with extremely good skills enhances the opportunity to implement the mega projects smoothly [13]. Highly skilled engineers not only ensure that the implemented activities match the specifications, but they also provide creative implementation methods [26]. Acharya and Lee [33] have highlighted that good contractor teams have a good relationship with the consultant or supervision teams and conflict in the project site approaches zero. Mega projects are not like small projects in management of resources, therefore, an extremely high skilled staff is needed in order to manage the resources effectively [23].

Adequate cash is one of the most critical success factors in implementation of mega projects. In other words, without sufficient cash to implement the projects, many conflicts will result [27]. The cash is needed to pay for sub-contractors and in the procurement process of the needed goods, especially the electro-mechanic items [39,40]. El-Sabek and McCabe [52] have mentioned that the liquidity in the project facilitates the coordination between the project's parties and stakeholders.

Establishing a venture between contractors is essential to implement the mega projects in order to share the human and the physical resources [39]. The venture between the contractors expedites the progress in the implementation and preparation of payments [19]. Acharya and Lee [33] have pointed out that, although the venture between the contractors causes a conflict between them sometimes, successful cases are dominant.

A fixed team of the contractor staff during the implementation will guarantee that the number of conflicts during the implementation will be decreased [68]. The contractor teams who have been working since day one of handing over the site are more qualified and have more experience than those who will join the contractor's team later [38,43]. The communication between the fixed contractor's team goes smoothly with the same staff of the project [36].

Preparing the interim payments on a monthly basis is fundamental in order to avoid any obstacles or delays in implementing the activities [40]. Preparing the interim payments on time enhances the follow up process and organizes the flow of the works [37]. Kwak and Walewski [69] have pointed out that the contractor should dedicate an engineer and an accountant for preparing the interim payments in order to ensure that these payments will be issued and paid on time.

Studying and understanding the tender documents, including the micro details, help the contractor implement the works smoothly and on time [70]. Choudhry [68] has stated that understanding the tender documents well reduces the conflict in the project site between the stakeholders and facilitates the works. The proper understanding of the tender documents enhances the time schedule and completes the project on time [71].

Adding a good profit ratio during the pricing stage supports the contractor during the implementation and facilitates the works [56]. When the profit ratio is sufficient for the contractor, he will not go for corruption to secure additional profit [72]. The risk allocation is decreased since there would be space for unforeseen conditions as well as for contingencies [39,57].

#### 4.2.2. Supervision Staff

Assigning a technical and admin team with good experience has a significant impact on the implementation method, time and budget of the project [49]. The highly skilled supervision engineers not only ensure an acceptable quality of implemented work, but they may also help the contractor's staff in explaining some unclear items in the contract [26].

Acharya and Lee [33] have mentioned that a good supervision team tries to forecast the potential risks.

Retaining the same supervision team during the construction stage is the best way to ensure that the implemented works are of the same quality [32]. This means that it is not suitable to replace all the supervision team with a new team because this will cause a delay in the implementation of the project since the supervision teams need a sufficient period for handing over process and understanding the tender documents [39,49]. Moreover, they will need additional time to build a good relationship with the contractor's teams [47].

Proceeding with payments as soon as they are submitted by the contractor is critical in order to ensure that the cash flow is in-line with the actual implemented activities [28]. The delay in reviewing the payments causes an indirect delay in the scheduled activities because there is no liquidity to implement it [43]. Proceeding with payments on time increases the trust between the contractor and the supervision team [32].

The contribution of some external experts in the supervision works enhances the quality of the implemented works, and indirectly supports the skills of local staff [29]. The consultant is responsible for implementing this work effectively and for approving the payment to the contractor [46].

Avoiding the delay in decision making by the higher management team of the project ensures that the project progresses smoothly [49]. For example, the approval on the variation orders should be secured shortly in order to increase the trust between the stakeholders and encourage the contractor to do their best to implement the project on time [71]. The top management level of the project should delegate some of their responsibilities to the senior staff in order to avoid the unneeded loop of communications during the decision-making process [32].

Helping the contractor in understanding the tender documents is the main role of the supervision team. They should not stay at their offices and wait the contractor to make a mistake and then take contractual action [46]. The supervision team should hold periodic meetings with the contractor's staff in order to discuss the critical issues in the implantation [36]. Moreover, the supervision team should advise the contractor with the potential suppliers for procuring the goods to facilitate the works [49].

Developing the skills of admin staff through training courses inside or outside the projects improves the quality of works and the management of mega projects in a proper way [17]. The supervision teams may suggest a specific subject like the implementation method for anti-fire items. They may suggest training courses on it in order to ensure that the added value of the training is as required [39]. The training course is better when it has theoretical and practical subjects [27].

#### 4.2.3. Owner

Identifying the responsibility of each contract party contributes to facilitation and coordination of works in the project and avoiding delay [26,27]. Moreover, identifying the responsibility of stakeholders expedites the progress in the project and prevents conflict between parties [12,52]. Fainstein [72] has pointed out that the contractor should take the lead in order to identify the responsibility of each party at the beginning of project to enable completing the accountability process smoothly.

Coordination between stakeholders is the main responsibility of the owner, in order to ensure success in mega projects [55]. El-Sabek and McCabe [52] have stated that coordination means ensuring that there is no conflict between stakeholders. The coordination role is essential to link between the stakeholders and ensure that the progress in the project stages is going smoothly [21].

The owner should hold a periodic meeting in order to discuss the main challenges in the implementation of mega projects [52]. The meeting may be held on a weekly, biweekly, or monthly basis, even if there are no critical issues in the project [37,39]. The discussions during the meetings expedite the process of solving the pending issues and increasing the trust between the stakeholders [48,72].

Conducting direct communication channels between the designer and the implementer is essential in order to clarify the specifications and item descriptions [52]. Memon and Rahman [24] have mentioned that the contractor and the supervision team may consult the designer about the implantation method if the owner has established a direct communication channel between them.

#### 4.2.4. Contractual Issues

The rigidity in the contract clauses has a negative impact on the implementation and the development of mega projects since these projects vary from the small scale projects and have their unique conditions [33]. Altayeb and El Sawalhi [13] have pointed out that obtaining the local staff to prepare the tender documents with the help from external experience is better than getting the design ready from abroad. The local staff has more experience than the outsourced one regarding the implementation methods and the construction materials in the country [17]. Sun and Zhang [55] have mentioned that the best way to have a good design for mega projects is to establish a partnership between local and international staff and avoid the complexity in the tender documents.

The awarding process should be based on technical evaluations more than financial evaluations in order to enhance the quality of the executed works [48]. Faridi and El-Sayegh [23] have stated that spending adequate time in the awarding process through analysing the submitted bidder technically has a positive effect on the construction stage. If all the contractors failed in the technical evaluation, the project should be retendered and the contractors should pass through the prequalification process [43]. The transparency in the awarding criteria increases the trust between the stakeholders [73].

Technology enhances the quality of works in the mega projects [37,46]. The engineering programs mitigate the risk in the construction stage and facilitate implementing works with good quality [74]. The preparation of the time schedule and the requested updates could not be visible without the engineering programs [39].

The development of external auditing to check the implemented works from a third party contributes to solve the disputes in the project site [55]. Shokri and Safa [48] have mentioned that the local government should act as an auditor in order to ensure that the mega projects are implemented according to the standards, since these projects are considered an investment to the country [47].

Choosing the type of contract based on the nature of works is a key issue to implement the mega projects smoothly [17]. According to Fallahnejad [40], the unsuitability of the contract type in the mega projects is considered the main reason of delay in these projects. The flexibility in the contracts of mega projects is essential to cope with uncertainty in public–private partnerships [75].

Table 3 below summarizes the main factors that may enhance implementing and management the mega projects.

**Table 3.** The main factors that may enhance implementation and management of mega projects.

| No. | Development Factors | Reference(s) |
|---|---|---|
| Section (1): Contractor | | |
| 1. | Assigning teams with extremely good skills | [13,23,26,33] |
| 2. | Availing the adequate cash | [27,39,40,52] |
| 3. | Establishing a venture between contractors | [19,33,38] |
| 4. | Retaining a fixed team during the implementation | [36,37,43,68] |
| 5. | Preparing the interim payments on monthly basis | [37,40,69] |
| 6. | Studying and understanding the tender documents in full details | [68,70,71] |
| 7. | Adding a good profit ratio during the pricing stage | [39,56,70,72] |
| Section (2): Supervision team | | |
| 8. | Assigning a technical and admin team with good experience | [17,26,33,49] |
| 9. | Retaining the same supervision team during construction | [32,39,47,49] |
| 10. | Proceeding with payments as soon as possible | [28,32,43] |

**Table 3.** *Cont.*

| No. | Development Factors | Reference(s) |
|---|---|---|
| 11. | Contribution of some external experts in supervision works | [29,46] |
| 12. | Avoiding the delay in decision making | [32,49,71] |
| 13. | Helping the contractor in understanding the tender documents | [36,46,49] |
| 14. | Developing the skills of admin staff | [17,27,39] |
| Section (3): Owner | | |
| 15. | Identify the responsibility of each party | [12,26,27,52,72] |
| 16. | Coordination with stakeholders | [21,52,55] |
| 17. | Holding a periodic meeting | [37,39,48,52,72] |
| 18. | Conducting direct communication channels between the designer and the implementer | [24,52] |
| Section (4): Contractual issues | | |
| 19. | Obtaining the local staff to prepare the tender document with help from external experience | [13,17,33,55] |
| 20. | The awarding process should be based on technical evaluation more than financial evaluation | [23,43,48,73] |
| 21. | Forcing the contractor to use the updated engineering programs | [36,39,44,74] |
| 22. | Development of external auditing system to check the implemented works | [47,48,55] |
| 23. | Choosing the type of contract based on the nature of works | [17,40,75] |

## 5. Conclusions and Recommendations

This research has investigated and discussed the main obstacles and the success factors of implementation and management of mega construction projects. The research has provided a wide explanation of the main failures and critical success factors and has discussed the current practice of conducting the mega construction projects. While 48 barriers and 23 improvement factors have been reported in the literature, the author has concluded that the most important barriers of implementing the mega building construction projects in developing countries and the improvements associated with them are as follows:

### *5.1. Research Conclusion*

The main challenges, limitations, and barriers of implementing the mega projects are:

1. Lack of sufficient liquidity/capital for the contractor.
2. Dependence on the banks, which impose high interest in loans.
3. The contractor's pricing policy and low profit due to competition and increased administrative expenses.
4. Irregularity and difficulty in obtaining payments due to owner's policy.
5. Lack of communication and coordination between the designer and the project staff.
6. Lack of clarity and delays in decisions making because of its centrality.
7. Lack of experience of the contractor's staff in implementing the project leading to bad quality workmanship.
8. Owner's policy in evaluating bids, which are usually based on the lowest prices.
9. Failure in the estimation of the contractual duration of the project.
10. Lack of experience of the supervision team in the project management and inefficient number of staff.

The proper improvements for the implementation of mega projects are to present how mega projects succeed during difficult circumstances. These improvements are as follows:

1. Studying and understanding tender documents accurately during bid pricing and during implementation.
2. Providing adequate liquidity to implement the project and avoid dealing with banks with high interest.
3. Immediate transfer of payments to the contractor after the review according to the contract conditions.
4. Hiring a specialized administrative and engineering staff with high experience and competencies.

5. Determining the requirements of the owner accurately in front of the designer and during the work of the project.
6. Developing the system of monitoring and tracking of works through permissions to ensure the quality of work.
7. Choosing the contract type based on the nature of the work and its size, commensurate with the nature of the project.

### *5.2. Recommendations*

Some recommendations for best practice to manage mega construction projects successfully are:

1. The organizations that work in the construction projects should work to develop their capacity and staff.
2. The owner should facilitate the coordination of the construction materials.
3. The employees in the organizations who are working in the construction projects should have sufficient experience in order to understand the project documents.
4. The owner should utilize the suitable type of contract to implement the construction projects, and hire a specialized administrative and engineering staff with high experience and competencies.
5. Determining the requirements of the owner accurately in front of the designer and during the work of the project, paying progress payments regularly to consultant, and minimizing change orders throughout design phase in order to avoid delays to the project.
6. Reviewing and approving the design documents within the agreed schedule.
7. The consultant should manage financial resources and plan cash flow by utilization.
8. Stakeholders should work together for a coordinated project delivery in a more friendly and trustful environment.

In addition, collaborating should be encouraged; collaborative contracts should be promoted where the responsibilities of any delay are shared. When teamwork is entirely missing where the bigger picture of timely project delivery appears lacklustre, and stakeholders should have consistent management system framework to avoid frequent changes made by new appointed management.

### *5.3. Study Limitations*

This study draws its conclusions from 77 research papers available in the literature with a particular focus on developing countries regarding the mega building construction projects without indicating which particular project type is summarized. The mega projects, in addition to building construction, involve infrastructure, oil and gas, dam, transportation, etc., and each different field has its own characteristics. Therefore, it is recommended for future research to focus on each type of mega project with its associated barriers and required improvement factors in order to provide a special guided manual for each one.

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