

# A Review Of Factors Affecting The Success Of Building Maintenance Projects

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## ABSTRACT

Most countries are facing challenges in building maintenance project, since Maintenance projects are more service work oriented than other building construction projects and works in these projects mostly entail interaction with people, and most of the work is determined according to people's demands. Nowadays, building projects are becoming much more complex and difficult. The project team is facing unprecedented changes. The study of project success and critical success factors (CSFs) are considered to be a means to improve the effectiveness of project. It is believed that a maintenance project is influenced by the three main partners: the owner, the user, and the contractors. Therefore, this paper presents a review of literatures related to the factors affecting the success of building maintenance projects. From literatures, 84 significant factors which affect the project success for maintenance projects will be identified. For future research, questionnaire survey can be conducted to assess the identified factors and also structural equation model can be used to develop model and study the causal relationships between the factors which affect the success of building maintenance projects.

**Keywords:** Building Maintenance Projects, Project Success, Success Factors.

## 1. INTRODUCTION

The success in building maintenance projects is influencing by various factors with varying degrees. The success of projects is a main issue to the most governments, users and contractors communities ( Alriwaimi and Zainal, 2014 ). Literature review highlights the success of construction projects and some studies focus on the role of contractor in project success. According to ( Edmond, 2010 ), there are so many studies conducted on construction projects rather than building maintenance projects and also there are no study conducted to identify the factors that affect the success of building maintenance projects. In case, this gives the opportunity to the author to conduct this study.

Nowadays, building projects are becoming much more complex and difficult. The project team is facing unprecedented changes. The study of project success and critical success factors (CSFs) are considered to be a means to improve the effectiveness of project ( Albert, 2004 ). Various attempts were made by different researchers to determine CSFs in construction. A number of variables influencing project success have been proposed. Some variables are common to more than one list, but there is no general agreement on the variables ( Albert, 2004 ).

Traditionally, a project is considered successful if the building is delivered at the right time, price, and quality. It should also provide the client with a high level of satisfaction ( Albert, 2002 ).

Maintenance projects are more service work oriented than other building construction projects, since works in these projects mostly entail interaction with people, and most of the work is determined according to people's demands. The management of maintenance projects is complicated, and it is influenced by many factors. It is believed that a maintenance project is influenced by the three main partners: the owner, the user, and the contractors ( Al-Arjani, 1995 ).

In Libya, every maintenance project is unique and complex and has risks across many issues during maintenance work. Also the most of building in Libya does not consider the maintenance during design, so these will bring further challenges for both clients and contractors. All projects are reportedly failing across all the key performance measures including cost, time and quality performances. While understanding of the success of building maintenance projects is still area of

investigation at Libya and other countries. This research focuses on identifying the factors affecting the success of building maintenance projects.

Governments all over the world have considerable expenditure directed toward maintenance projects ( Al-Arjani, 2002 ). It is obvious that the need of study the factors affecting the success of building maintenance projects is very important and needed for all sectors including properties sectors. Regard to the highly cost of maintenance it is important to study these factors so that an effective maintenance can be carried out with good quality, not high cost and delivered on time.

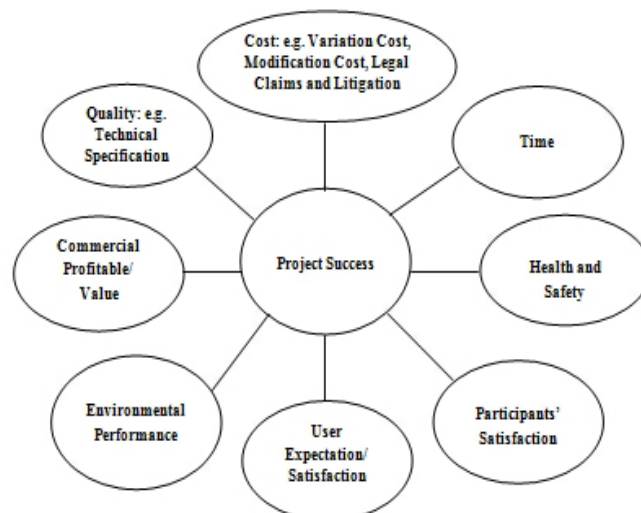
## 2. CRITERIA FOR PROJECT SUCCESS

Project is fundamentally a set of activities which has specific target with defined start and end dates and a limited amount of funding using human and non human resources. Lim and Mohamed (1999) define a criterion as a principle or standard by which anything is judged. The Oxford Dictionary further defines success as a suitable and positive outcome. When these terms are combined together, criteria of project success can be defined as the set of principles or standards by which suitable outcomes can be completed within a set specification (Chan et al 2002). In every industry, every project team or individual has its own idea of project success and its dependent on many sides such as: project size, project type, clients, project participants, experience of owners etc.

In the early 1990s when project was completed within time, cost, achieved the desired objective using the resources effectively and the client was satisfied and accepted, the project was considered as successful project. Time, cost and quality are the main criteria to project success, and were discussed in so many articles on project success, (Belassi and Tukul 1996), (Walker 1995, 1996) and Atkinson (1999). These three basic criteria are called the “iron triangle”. In the modern day there are some additions to the definition of success of a project. Nowadays, a project is considered as successful if it has minimum scope changes, does not disturb the main work flow of organization and does not deviate from the company's culture norms.

In addition to the main criteria, some researches discussed that a project’s success is also dependent on project’s social aspects which refer to the satisfaction of personal relations between the project team. These subjective measures are known as “soft” measures. Pocock et al (1996) highlighted that, absence of legal claims to be a criterion for project success which then called for “safety” to be an important indicator of project success. Kometa et al (1995) suggested that project success has to include safety, economy (construction cost), maintenance cost, time and flexibility to others.

Over the last decade a lot of researches have been done to identify and propose different criteria for project success. Figure 1 shows a comprehensive framework for measuring success of projects.



**Figure 1** Consolidated framework for measuring project success (Source: Chan et al 2002)

According to Edmond et al, (2010) the followings are the problems that affect the success of running building maintenance projects: Constraints of existing buildings, Unclear scope, Inadequate contract and Specifications, Fragmented nature, Short duration, Inefficient communication, Inactive attitude of participants and Lack of expertise. furthermore, he identified some examples of building maintenance knowledge and experience which includes: Project location and proximity, Response time, Nature of repair work, Performance of different materials and techniques over time, Contractors' and suppliers' details, Cost data, Contractors' performance, Latest maintenance technologies and materials. In addition, health and safety issues can be critical for maintenance work.

According to Assaf and Al-Hammad et al, (1996), based on literature review and on a pilot study of interviews with owner and contractors, the main performance criteria are identified as follows: Providing proper planning and scheduling, Procuring materials for site, Providing suggestions on cost cutting, Providing safety precautions at building maintenance site, Subcontracting control, Ensuring efficient administration and supervision to site, Ensuring availability of required equipments and facilities, Ensuring technical competence and workmanship of building maintenance manpower.

According to Edmond et al, (2010), the basic success criteria identified from available literature can be classified into six components, namely: Time; Cost; Quality; Functionality; Safety; and Environmental friendliness. More researchers highlighted and discussed the importance of scope and team management on project success.

### **3. FACTORS AFFECTING THE PROJECT SUCCESS**

There are so many factors affecting the success of project and the following paragraphs explain some studies which conducted to assess the project success. This paper identified 84 factors from literature review and the factors affecting the success of building maintenance projects can be classified into 8 groups. Each group has several variables affecting the project success and these groups are: Management factors, project participants-related factors, environment factors, site-related factors, time factors, quality factors, financial factors, health and safety factors. According to Albert et al, (2004), project management action is central to project success and suggested that by using management tools, the project manager can plan and maximize the chance of project success. Factors related to the project management are very important in assessing the success of Project. One of the most critical management factors for the successful completion of maintenance project is good communication system. Communication is also very important in ensuring effective control and monitoring of maintenance projects. According to Muhammad Saqib et al, (2008), project management plays significant role in achieving project success and they identified 19 variables related to project management as they affect the success of projects. The variables includes communication system, control mechanism, feedback capabilities, troubleshooting, planning effort, coordination effectiveness, decision making effectiveness, project monitoring, developing an appropriate organization structure, implementing an effective quality assurance program, control of sub-contractors' work, prior project management experience, risk identification and allocation, formal dispute resolution process, motivation/ incentives, constructability program, training the hour in the skill demanded by project and overall managerial actions.

Kandelousi et al (2011) this research aims to identify the key success factors of project management in an organization. It is clear that investigating important factors that enhance successful project will help companies to improve and increase the overall profitability. A successful project is one that delivered on time and in good quality and managed within the budget. The result showed that the regression analysis shows that there is no relationship between good leadership of project manager and project performance. Moreover, this study used a self-construct measurement to assess the relationships between project performance and leaderships. The study recommended using questionnaire survey to get more result and obtain the significant relationships between the leadership and project performance.

Chen et al (2012), this study aims at identifying the critical success factor (CSFs) of construction projects and to understand the interrelationships among CSFs based on the structural equation model. To understand the interrelationships among CSFs, this study established a hypothetical model by identifying 62 CSFs of construction projects through a literature review and questionnaire survey was distributed to respondents (experienced contractors) working in various construction projects in China. To establish the model, this study selected 10 subcategories as the latent variables and 44 CSFs as the measurable variables. The structural model showed hypothesized interrelationships among the CSFs subcategories. As result, Chen discovered many underlying relationships among the critical success factors such as (owner's ability) having a positive influence on (contractor's characteristics) and (tendering method) having a positive influence on (number of contractors available in tender) but a negative influence on (cooperation experiences between owner and contractor). Finally, this study recommended for further research to develop a more appropriate SEM method that uses more sample data to explain preferable the interrelationships among the critical success factors (CSFs) and to focus on the interrelationships among the CSFs for different project types.

Hwang et al (2013) identified key critical factors that determine overall project success and identified key CSFs on construction projects in Singapore from the perspectives of different project participants with various objectives. As a result, the study identified 32 success-related factors which are grouped into 4 main categories: project characteristics, contractor's arrangements, project participants and interactive processes.

Chua et al (1999) identified critical success factors for construction projects based on the project objectives of budget, schedule and quality. This study considered 67 success-related factors and categorized under four main project aspects: project characteristic; contractual arrangements; project participants; and interactive process. The data for the study was collected by using questionnaire survey and 20 experienced participants with overall average of 20 years of experience in construction industry. The results showed that all respondents agree that there are different sets of critical success factors for different objectives. Also the study identified the top 10 success factors and these factors are: adequacy of plan and specification; constructability; project manager commitment and involvement; realistic obligations and clear objectives; project manager competency; contractual motivation and incentive; site inspection; construction control meetings; formal communication; and economic risks.

According to Belassi and Tukel (1996), there are many factors outside the control of management which could determine the success or failure of a project. These factors can be grouped into four areas: factors related to the project; factors related to the project manager and team members; factors related to the organization; and factors related to the external environment. The framework shows many of the drawbacks in the literature review. The results showed that project manager's managerial skill, team member's commitment and their technical background, project attributes and environmental factors can be critical as the organizational factors. Also there are many statistically significant relationships between critical success factors and project characteristics identified in the study. Moreover, these relationships explained the interaction among factor groups.

In conclusion, many researchers highlighted the importance of studying project success in public and private sector, however, there are a few studies conducted on the success of maintenance project rather than construction project. The summary of factors affecting the success of building maintenance projects identified through literature review is classified into 8 groups and presents in the following tables. Table 1 is explained the Project Management-Related Factors affecting the success of building maintenance projects and table 2 is illustrated the Quality related factors affecting the success of building maintenance projects. While Table 3 is explained the Project Participants Related Factors affecting the success of building maintenance projects and Table 4 is illustrated the Health and safety Related Factors affecting the success of building maintenance projects. Besides that, Table 5 is clarified the Environment and site related factors affecting the

success of building maintenance projects and Table 6 is explained the Time related factors affecting the success of building maintenance projects. Eventually, Table 7 is illustrated the Financial related factors affecting the success of building maintenance projects and Table 8 is shown the Other related factors affecting the success of building maintenance projects.

Table 1 Project Management-Related Factors affecting the success of building maintenance projects

| N  | Factors   |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|----|---|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|    |   | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1  | Communication system (effective or ineffective communication)   | I            | I           | I            | I             |                 | I              | I            | I           | I              | I          |               | I             |                 | I            | I            | I           |
| 2  | Feedback capabilities   | I            |             |              | I             | I               | I              |              | I           | I              | I          |               |               |                 | I            | I            | I           |
| 3  | Planning effort / project planning  | I            |             | I            | I             |                 | I              |              | I           | I              | I          |               | I             | I               |              | I            |             |
| 4  | Control mechanism / control system (Ex: Worker registration system or site diary)   | I            |             |              | I             | I               | I              |              | I           | I              | I          | I             |               |                 | I            | I            | I           |
| 5  | Troubleshooting   | I            |             |              | I             |                 | I              |              |             | I              | I          |               |               |                 |              |              |             |
| 6  | Coordination effectiveness  | I            |             |              | I             |                 | I              |              |             | I              |            |               |               |                 |              |              |             |
| 7  | Decision making effectiveness   | I            |             | I            | I             | I               | I              |              |             |                |            |               |               |                 |              |              |             |
| 8  | Project monitoring  | I            |             |              | I             |                 |                |              |             | I              | I          |               |               |                 | I            | I            | I           |
| 9  | Developing an appropriate organization structure  | I            |             | I            | I             |                 | I              |              | I           | I              |            |               |               |                 |              |              |             |
| 10 | Implementing an effective safety program  | I            | I           |              | I             |                 |                |              | I           |                |            |               |               |                 |              |              |             |
| 11 | Implementing an effective quality assurance program   | I            | I           |              | I             |                 |                |              |             |                |            |               |               |                 |              |              |             |
| 12 | Control of sub-contractors' work  | I            |             |              | I             |                 | I              | I            | I           | I              |            |               |               |                 | I            |              | I           |
| 13 | Prior project management experience   | I            | I           | I            | I             | I               | I              |              |             | I              | I          |               | I             | I               |              | I            | I           |
| 14 | Risk identification and allocation  | I            |             |              |               |                 | I              |              |             |                | I          |               |               |                 |              | I            | I           |
| 15 | Formal dispute resolution process   | I            |             |              |               |                 | I              |              |             |                |            |               |               |                 |              |              | I           |
| 16 | Motivations / Incentives  | I            |             | I            | I             |                 | I              | I            |             |                |            |               |               |                 |              | I            | I           |
| 17 | Training the HR in the skill demanded by project  | I            |             | I            |               | I               |                |              |             |                |            | I             |               |                 |              |              |             |
| 18 | Managing maintenance works and plan the work (proper work arrangement) (Ex: the planning of manpower for a variety of jobs) | I            | I           |              | I             | I               |                |              |             |                | I          | I             | I             |                 |              |              | I           |
| 19 | Work scheduling (effective or inefficient scheduling)   | I            |             |              | I             |                 | I              |              |             | I              | I          |               | I             | I               |              | I            | I           |
| 20 | The distribution of the maintenance work orders over the two shifts   |              |             |              |               |                 | I              |              |             |                |            | I             | I             |                 |              |              |             |
| 21 | Overall managerial actions  | I            | I           | I            | I             |                 |                |              |             | I              | I          | I             |               |                 |              |              |             |

Table 2 Quality related factors affecting the success of building maintenance projects

| N | Factors  |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|---|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|   |  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1 | Conformance to specification.                          | I            | I           | I            | I             |                 | I              |              |             |                |            | I             |               |                 |              | I            | I           |
| 2 | Quality of equipment                                   |              |             |              |               | I               | I              | I            |             |                |            | I             |               |                 |              |              |             |
| 3 | Quality of raw materials and workmanship               |              | I           | I            |               | I               | I              | I            |             |                |            | I             |               |                 |              |              |             |
| 4 | Quality assessment system in contractor's organization |              |             |              | I             |                 | I              | I            |             |                |            |               |               |                 |              |              |             |

Table 3 Project Participants Related Factors affecting the success of building maintenance projects

| N  | Factors  |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|----|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|    |  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1  | Project team leader's working relationship with others/ labour relationships |              |             | I            | I             |                 |                |              | I           |                |            |               |               |                 |              |              | I           |
| 2  | Communication among parties (Ex: owner and maintenance contractor)           | I            | I           | I            |               |                 | I              | I            |             | I              | I          |               | I             |                 |              | I            | I           |
| 3  | Mismanagement by the contractor (Ex: financial, supplier, sub-contractor)    | I            |             |              | I             |                 | I              | I            |             |                |            |               |               |                 |              | I            | I           |
| 4  | Negotiation and Mistakes during maintenance.                                 |              | I           |              |               |                 | I              |              |             |                |            |               |               |                 |              |              |             |
| 5  | Changed orders by client during maintenance                                  | I            |             |              | I             |                 |                | I            |             |                |            |               |               |                 |              |              |             |
| 6  | Suspension of work by owner  |              |             |              | I             |                 |                | I            |             |                |            |               |               |                 |              |              |             |
| 7  | Leadership skills for project manager  | I            | I           |              | I             |                 | I              |              | I           | I              | I          | I             |               |                 |              | I            |             |
| 8  | Tensions and conflicts among residents and personal conflicts among labours  |              |             |              |               |                 | I              | I            |             |                |            |               | I             |                 |              |              |             |
| 9  | Congestion and interference between users and workers                        |              |             |              |               |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 10 | Experience of project team (Ex: contractor's experience)                     | I            |             |              | I             | I               | I              |              | I           | I              | I          | I             | I             | I               | I            | I            | I           |
| 11 | qualified project team   | I            |             | I            | I             | I               | I              |              | I           | I              | I          | I             | I             | I               | I            |              | I           |
| 12 | Shortage of skilled labours (Ex: Low level of equipment-operators skill)     | I            | I           | I            |               | I               |                | I            | I           |                |            |               | I             | I               | I            |              | I           |
| 13 | Client ability to make timely decision                                       | I            |             |              | I             |                 | I              |              | I           | I              |            |               |               |                 | I            |              |             |
| 14 | Client ability to participate in different phases of project                 | I            |             |              | I             |                 | I              |              | I           | I              |            |               |               |                 | I            |              |             |
| 15 | Client Satisfaction  | I            |             |              |               |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 16 | A contractor's qualifications and experience in building maintenance field   | I            | I           |              | I             | I               | I              | I            | I           |                |            |               |               |                 | I            |              |             |
| 17 | Low level of collaboration with the contractor by the owner                  |              |             |              | I             |                 |                |              |             |                |            |               | I             | I               | I            |              |             |
| 18 | building owners realize the importance of timely maintenance                 | I            | I           |              |               |                 | I              |              |             |                |            |               | I             |                 |              |              |             |
| 19 | Inactive attitude of participants  |              | I           |              |               |                 | I              |              |             |                |            | I             |               | I               |              |              |             |

Table 4 Health and safety Related Factors affecting the success of building maintenance projects

| N | Factors  |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|---|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|   |  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1 | Application of Health and safety factors in site project                   | I            |             | I            |               |                 |                |              |             |                |            |               |               |                 | I            | I            |             |
| 2 | Unsafe acts and unsafe condition   |              |             | I            |               |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 3 | Project participants need to secure safety performance in maintenance work |              |             | I            |               | I               | I              |              |             |                |            |               | I             |                 |              |              |             |
| 4 | The number of accidents during maintenance work                            |              |             |              |               |                 | I              | I            |             |                |            |               | I             |                 |              |              |             |

Table 5 Environment and site related factors affecting the success of building maintenance projects

| N | Factors  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
|---|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
| 1 | Noise level (control noisy work during maintenance work)   |              |             | I            |               |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 2 | Wastes around the site (Ex: proper handling of waste and pollutants)                                     |              |             |              |               | I               |                |              |             |                |            |               | I             |                 |              |              |             |
| 3 | Weather conditions and its effect on maintenance activities  | I            |             | I            | I             | I               | I              | I            | I           | I              | I          |               | I             | I               | I            |              |             |
| 4 | Traffic control and restriction at job site  |              |             | I            |               |                 | I              | I            |             |                |            |               |               |                 |              |              |             |
| 5 | Constraints of existing buildings (Difficulty of transporting materials to the site and to upper floors) |              |             | I            | I             | I               | I              |              | I           |                |            |               | I             |                 |              |              |             |
| 6 | availability of utilities in site (such as water, electricity, telephone, etc)                           |              | I           | I            |               |                 | I              | I            | I           | I              | I          |               |               |                 | I            |              | I           |
| 7 | Working on confined sites with restricted access   |              |             |              | I             |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 8 | Unexpected problems may exist on the surrounding area  |              |             |              |               |                 |                |              |             |                | I          |               | I             |                 |              |              |             |
| 9 | Overall Site problems (Ex: Equipment breakdowns during maintenance works)                                |              | I           | I            |               |                 | I              | I            | I           |                |            |               | I             |                 | I            |              | I           |

Table 6 Time related factors affecting the success of building maintenance projects

| N | Factors  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
|---|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
| 1 | Time needed to rectify defects / time to execution of maintenance work/ Time needed to implement variation orders                      |              |             | I            | I             |                 |                |              |             |                |            |               |               |                 |              |              |             |
| 2 | Long response time (Ex: delay in claim approval and Long period for approval of tests and inspections)                                 | I            |             |              |               | I               |                |              |             |                |            |               | I             |                 |              |              |             |
| 3 | Delay in regular payments (from owner to contractor)   |              |             |              |               | I               |                | I            |             |                |            |               | I             |                 |              |              |             |
| 4 | Site preparation time (Ex: Deliveries time of materials and equipments/ Availability of resources as planned through project duration) |              |             |              | I             |                 |                | I            |             |                |            |               | I             |                 |              |              |             |
| 5 | More time to liaise with occupants above and below the affected area   |              |             |              |               |                 |                |              |             |                |            |               | I             | I               |              |              |             |
| 6 | Long decision time to decide whether to replace building components or to maintain them  |              |             |              |               | I               |                |              |             |                |            |               | I             |                 |              |              |             |
| 7 | Time availability/ project duration  |              |             | I            |               |                 |                |              |             | I              | I          |               | I             | I               |              | I            |             |
| 8 | Time to access (time to obtain approval from the owner to carry out the maintenance)   | I            |             |              | I             |                 |                |              |             |                |            |               | I             | I               |              |              |             |

Table 7 Financial related factors affecting the success of building maintenance projects

| N  | Factors   |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|----|---|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|    |   | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1  | Shortage of construction materials or replacement parts in market   |              | I           | I            |               |                 |                | I            |             |                |            |               | I             | I               |              |              |             |
| 2  | Changes in material types and specification during maintenance  |              | I           |              |               |                 |                | I            |             |                |            |               |               |                 |              |              |             |
| 3  | Shortage of equipment   | I            |             |              |               | I               |                | I            |             |                |            |               |               |                 | I            |              |             |
| 4  | Conflicts of the drawing and specifications (or the lack of original drawing and specifications)              |              | I           |              |               |                 |                |              |             |                |            |               | I             |                 |              |              |             |
| 5  | Design building problems (Ex: the lack of designing buildings for maintenance considerations)                 | I            | I           | I            | I             |                 |                | I            |             |                |            |               | I             | I               | I            | I            | I           |
| 6  | Social and Cultural attitudes of people   |              |             | I            | I             |                 | I              | I            | I           | I              | I          |               | I             | I               | I            |              |             |
| 7  | Age of buildings  |              |             | I            | I             |                 |                |              |             |                |            |               | I             | I               |              |              |             |
| 8  | The scope and extent of maintenance work/ Type and size of maintenance project                                | I            |             |              | I             | I               | I              |              | I           | I              | I          |               | I             | I               | I            |              | I           |
| 9  | Contract of maintenance project (Ex: Adequate or inadequate contract and discrepancies in contract documents) | I            |             | I            | I             |                 | I              | I            |             |                |            |               | I             | I               |              | I            |             |
| 10 | Economic and Political environment  | I            |             | I            | I             | I               | I              | I            | I           | I              | I          |               |               |                 | I            | I            | I           |
| 11 | Lack of building maintenance standard and policy  |              | I           | I            |               | I               | I              | I            |             |                |            |               | I             | I               |              |              |             |

Table 8 Other related factors affecting the success of building maintenance projects

| N | Factors  |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              |              |             |
|---|--|--------------|-------------|--------------|---------------|-----------------|----------------|--------------|-------------|----------------|------------|---------------|---------------|-----------------|--------------|--------------|-------------|
|   |  | Saqib (2008) | Baba (2013) | Ehson (2012) | Albert (2004) | Akinsola (2012) | Neringa (2013) | Assaf (2004) | Chan (2004) | Belassi (1996) | Rao (2011) | Zainal (2011) | Edmond (2010) | Al-Arjani(1995) | Young (2012) | Hwang (2013) | Chua (1999) |
| 1 | Cost of rework   |              | I           | I            |               |                 |                | I            |             |                |            |               |               |                 |              |              |             |
| 2 | Regular project budget update  |              |             |              |               |                 |                |              |             |                |            |               |               |                 |              | I            | I           |
| 3 | Cash flow of maintenance project   | I            |             |              | I             |                 | I              | I            |             |                |            |               | I             |                 |              |              |             |
| 4 | Liquidity of maintenance contractors (or company)  | I            |             |              | I             |                 | I              | I            |             |                |            |               | I             |                 | I            |              |             |
| 5 | Fluctuation in prices of materials, equipments and labours (Ex: Escalation of material prices) |              |             | I            |               |                 |                |              |             |                |            |               |               |                 | I            |              |             |
| 6 | Material, equipment and labour cost  |              |             |              |               |                 | I              |              |             |                |            |               | I             |                 | I            |              |             |
| 7 | delay penalties (ineffective or effective)   |              |             | I            |               |                 |                | I            |             |                |            |               |               |                 |              |              |             |
| 8 | Funding (Adequate or inadequate funding)   | I            | I           | I            |               | I               | I              |              |             |                |            |               | I             | I               | I            | I            | I           |

### 3. CONCLUSION

Building maintenance projects are more complex and difficult from other projects, since maintenance projects are more service works and works in maintenance projects mostly entail interaction with people. This paper identified 84 factors affecting project success of building maintenance in Libya and any other parts of the world. 84 factors grouped into 8 main groups and each group has several variables as shown in tables 1 to 8. The main groups are: The Project Management-Related Factors, The Quality Related Factors, The Project Participants Related



Factors, The Health and Safety Related Factors, The Environment and Site Related Factors, The Time Related Factors, The Financial Related Factors, and The Other Related Factors. The success of building maintenance project can be assessed by using 84 factors in 8 groups. For future research, questionnaire survey and structural equation modelling SEM can be used to investigate the relationship among the identified variables and project success.

## REFERENCES

- [1] Alriwaimi, H. M. R., & Akasah, Z. A. B. (2014). Management factors in building maintenance projects. 13th Management in Construction Researchers' Association (MiCRA) Annual Conference & General Meeting 2014, 6th November, 2014, International Islamic University, Gombak, Selangor.
- [2] Edmond W.M. Lam, Albert P.C. Chan, and Daniel W.M. Chan, (2010). Benchmarking success of building maintenance projects.
- [3] Albert P. C. Chan, David Scott and Ada P. L. Chan. Factors affecting the success of construction projects, (2004). Journal of construction engineering and management ASCE.
- [4] Ahmed H Al-Arjani. Impact of cultural issues on the scheduling of housing maintenance in Saudi Arabian urban project, (1995). International journal of project management Vol. 13, No. 6, pp. 373-382.
- [5] Al-Arjani, A.H. (2002). Type and size of project influences on number of bidders for maintenance and operation projects in Saudi Arabia. International journal of project management.
- [6] Lim C S and Mohamed M Z. Criteria of Project Success: an exploratory reexamination, (1999). International Journal of Project Management.
- [7] Chan, A.P.C. and Chan, A.P.L (2002), "Key performance indicators for measuring construction success".
- [8] Belassi W and Tukel O I. A New Framework for Determining Critical Success/Failure Factors in Projects, (1996). International Journal of Project Management.
- [9] Walker D H T. An Investigation into Construction Time Performance, (May 1995). Construction Management and Economics. Walker D H T. The Contribution of the Construction Management Team to Good Construction Time Performance – an Australian Experience, (November 1996). Journal of Construction Procurement.
- [10] Atkinson, R. (1999), "Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria", International Journal of Project Management.
- [11] Pocock J B, Hyun C T, Liu L Y and Kim M K. Relationship between Project Interaction and Performance Indicator, (June 1996). Journal of Construction Engineering and Management.
- [12] Kometa S, Olomolaiye P O and Harris F C. An Evaluation of Clients' needs and Responsibilities in the Construction Process, (March 1995). Engineering, Construction and Architectural Management.
- [13] Sadi Assaf, Abdul-Mohsen and Al-Hammad, ASCE, 1996. Assessment of work performance of maintenance contractors in Saudi Arabia.
- [14] Muhammad Saqib, Rizwan U. Farooqui and Sarosh. H. Lodi. Assessment of critical success factors for construction projects in Pakistan, August 4-5, (2008). First international conference on construction in developing countries.
- [15] Nader Sh. Kandelousi, Ooi. J., Abdollahi. A. Key Success Factors For Managing Projects, (2011). World Academy of Science, Engineering and Technology.
- [16] Yong Qiang Chen, Yang Bing Zhang, Jun Ying Liu, and Peng Mo. Interrelationships among critical success factors of construction projects based on the structural equation model, (2012). Journal of management in engineering ASCE.

- [17] Bon-Gang Hwang and E-Sin Janicia Lim. Critical success factors for key project players and objectives: case study of Singapore, (2013). *Journal of construction engineering and management ASCE*.
- [18] D. K. H. Chua, Y. C. Kog and P. K. Loh. Critical success factors for different project objectives, (1999). *Journal of construction engineering and management*.
- [19] Baba Shehu Waziri and Buba Abraham Vanduhe. Evaluation of factors affecting residential building maintenance in Nigeria: users' perspective, (2013). *Civil and environmental research ISSN 2224-5790 (paper), Vol.3, No.8*.
- [20] Ehsan Saghatforoush, Bambang Trigunarsyah and Eric Too. Assessment of operability and maintainability success factors in provision of extended constructability principles, (2012). 9th international congress on civil engineering. Isfahan university of technology, Iran.
- [21] Akinsola O. E., Hussaini P. O., Oyenuga S.O. and Fatokun A. O. Critical factors influencing facility maintenance management of tertiary institutional buildings in southwest Nigeria, (2012). *Mediterranean journal of social sciences*.
- [22] Neringa Gudiene, Audrius Banaitis, Nerija Banaitiene and Jorge Lopes. Development of a conceptual critical success factors model for construction projects: a case of Lithuania, (2013). *Science direct*.
- [23] Sadi A. Assaf, Sadiq Al-Hejj. Causes of delay in large construction projects, (2006). *Journal of Project Management*, 349–357.
- [24] A, P. C. Chan, Edmond W.M, Lam, and Daniel W.M. Chan. Qualitative survey on managing building maintenance projects, (2010). *World academy science, engineering and technology*.
- [25] Rao Aamir Khan and Konrad Spang. Critical success factors for international projects, (2011). *The 6th IEEE international conference on intelligent data acquisition and advanced computing systems: technology and applications*.
- [26] Akasah, Z. A., Abdul, R. M. A., & Zuraidi, S. N. F. (2011). *Maintenance Management Success Factors For Heritage Building: A Framework*.
- [27] Yong Qiang Chen, Yang Bing Zhang, Jun Ying Liu, and Peng Mo. Interrelationships among critical success factors of construction projects based on the structural equation model, (2012). *Journal of management in engineering ASCE*.