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## RESEARCH ARTICLE

# Evaluating the Management of Critical Success Factors of Residential Complex's Projects and their impact on Cost, Time, and Quality in Erbil Governorate

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### Abstract:

#### Background:

The characteristics of any project require a specific type of management. Companies and project management associations all over the world started to develop and follow these standards. Best practices in project management, if followed, may increase the chances of success in achieving goals when dealing with projects. Many studies and researchers worked earlier on critical success factors (CSF). Each type of project has its own CSF that should be considered during construction.

#### Objective:

This study focuses on covering the notion of residential complex projects (RCP) success according to two fundamental components (success criteria and critical success factors) by identifying the critical success factors (CSF) on the basis of their large impact on the golden triangle (cost, time, and quality), and calculating the degree of actual practicing of each factor.

#### Methods:

A questionnaire survey has been adopted and distributed to a sample of 142 stakeholders involved in the construction of residential complex projects to calculate their impact on time, cost, and quality. Moreover, a case study for 20 constructed projects has been adopted to evaluate the average fulfillments of 8 identified management success criteria and 8 identified project success criteria using a questionnaire survey. Finally, the degree of management success and project success for each project has been calculated.

#### Results:

The results reveal 17 CSF ranging between large and very large impact on managing residential complex projects. The highest rank is realistic cost estimate and projects completed within the budget, adequate risk identification and management procedures, adequate project management tools, techniques, and standards. The study revealed that project success criteria differ from one project to another and the relative priorities among critical success factors may change for different projects even if they are of same type not only among different types of projects. The results show that management success doesn't guarantee project success because success means different things to different people. User's satisfaction is essential for project success.

#### Conclusion:

A scientific base should be used to identify CSF with a significant impact on the golden triangle and combine it with project success criteria. That is the classic answer for the measurement success, because it could be easily applied and normally gathers consensus within stakeholders. This study will contribute an improvement to the existing management system.

**Keywords:** Construction management, Construction projects, Critical success factors, Project management, Project success, Residential complexes, Success criteria.

### Article History

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## 1. INTRODUCTION

Recent statistics put project work at about one-third of developed countries [1]. Project management is considered one

of the main topics within most organizations. It has increasingly been used in various business fields by different entities, from small companies to large ones.

Vittal defined project management as the art and science of using experience, knowledge, skills, tools, and techniques efficiently and effectively to meet stakeholder expectations [2]. A Guide to the Project Management Body of Knowledge considers project management as one of the main topics within most organizations that serves as a very valuable application platform for the entrepreneurial innovation process, and one of the biggest challenges for organizations is the project team's commitment to project management [3]. According to Project Management Body of Knowledge, project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring and controlling, and closing [4]. Knies and others describe a project as a time-bound set of activities with a defined beginning and end that uses resources in an organized and planned way to reach a certain objective [5]. Project phases are divisions within a project where extra control is needed to effectively manage the completion of a major deliverable. Project success means reaching the objectives and the planned results in compliance with predetermined conditions of time, cost, and performance [6]. The Project Management Institute PMI2000 defines Project Life cycle as "the study progression of a project from its beginning to its completion. Starting from identifying requirements, establishing clear and achievable objectives, adapting specifications, plans, and approaches to meet the expectations of all key stakeholders, including the client and the end-user, and balancing the competing demands of scope, cost, time, and quality. The importance of project management has hastily increased and its rapid development and tendency towards innovation have made it one of the key components of organizations' performance [7]. Each building project's management can be categorized according to its system, scale, location, and accessibility [8]. According to Amir Manzoor [9], managing a project is necessary because it has become a standard way of executing business strategies and deploying project management practices such as: increased competition due to free market philosophy, resource constraints, constraints of cost, time, and scope (quality), knowledge economy, and client focus. Best practices in project management contribute to the achievement of goals, but project managers need to determine which project management methods can be generally applied and which are appropriate in specific situations. Project managers also need to be able to adapt the international standard to the cultural differences which appear in different areas or countries [10]. Project success is a complex, multidimensional concept encompassing many attributes [11]. The concept of project success is approached in relationship with stakeholders' perceptions after the increment of complexity within the last decades [12]. Project success can be classified into two groups: project success criteria (PSC) and project success factors (CSF). It is important to distinguish between the two groups. The critical success factors are those components that are necessary to deliver the project success criteria [13]. Baccarini [14] described CSF as a set of situations, factors, or actions that contribute to the final results or the achievement of success criteria. The PSC are used to

measure project success, while CSF facilitate the achievement of success [15]. A great project management can deliver success by providing clear objectives, ample resources, realistic planning, low risk, high quality deliverables, efficient budget utilization, and on- time delivery of the product [5]. Long-term success in managing projects requires proven and established project management practices and processes and several successful projects to emulate managing project involves identifying requirements, establishing clear and achievable objectives, balancing the demands of time, cost, scope, and quality, and adapting to the expectations of all stakeholders.

## 2. LITERATURE REVIEW

A literature review was carried out by different researchers 'worldwide to evaluate and rank the attributes of success patterns in the construction industry. Many studies attempted to capture the success criteria and CSF for the construction industry. Due to different interpretations of success or failure by different participants in construction projects, the classification of a project into a good project or a failed project is difficult. Viet PHAM and others [16] focused on developing a new CSF to be used to assess the success of project management in Vietnam. Ahmed Aslama and Atif Bilal studied the impact of project management certification on project performance, they revealed that a project management professional certification does have a direct impact on the project performance of the certified individual, whether it be operational or strategic performance. They added that project management is now becoming challenging as projects are multi-faceted and it is necessary to manage teams and this is an art that involves great challenges [1]. Magalhães and others stated that at the beginning of project management, it was possible to execute successful projects only by defining time and costs. However, it is currently observed that this is not enough for the success of the project [17]. Abdou Saed and others studied the project's complicity and its influence on project management, and they stated that the complexity of a project has to be managed effectively to achieve greater levels of project performance. They concluded that managing complexity does not mean avoiding or reducing it entirely. They stated that a good project manager should be able to manage complexity every time by maintaining the upper and lower levels of project complexity [18]. Radujkovic' and M. Sjekavica, studied the project management success factors. The definition of success used in their research study included the components of the scope of the project, cost, management of human resources, stakeholders, quality, satisfaction, schedule, long-term impacts, and benefits of owning an organization, while mention was made to terms such as procurement management, risk, integration of disciplines, communication and integration of disciplines [19]. According to Ilin and others, the specialized skill and knowledge of construction project managers are extremely critical for the management and control of variables that easily affect the timeous and cost-effective delivery of the project [20]. Zwikael and Meredith in their research concluded that projects require the cooperation of many individuals taking on different roles because roles within the funding entity of a project may be distinguished

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from those in the performing entity [21]. Aghaegbuna Ozumba and others studied the sustainability in project management practice. According to their findings, they suggested that the most significant challenge may be the lack of information among participants and other stakeholders. They stated that one major implication is that other identified difficulties may be traceable to the same lack of knowledge in the subject area [22]. L.A. Peters and Horner argue that project management does not possess the power to control time, cost, or quality [23]. Zulch and Kitshoff considered that these measures are traps, purely to be seen as either self-created or imposed, but rarely objective yardsticks. This point of view is raised from the idea that some projects miss all three parameters and are still hugely successful [24]. According to Ogwueleka, success factors are inputs to the management system which can lead directly or indirectly to project success. They investigated and identified the CSF influencing project performance in Nigeria and examined the important index of these success factors on project performance. Among twenty-two success factors, they selected sixteen which were necessary for true satisfaction of successful project implementation in Nigerian Construction Industry [25]. Assem Al-Hajj and Mario M examined the status of project management methodologies and their influence on the elements of project success. They stated that project success is influenced by many different factors outside the control of project management. According to the results of the

study, the influence of project management tools and techniques on project success depends on the practitioners' training, the timing and level of implementation achieved. They admitted that the human factor plays an essential part in achieving project success. They concluded that project management success represents one of the two essential ingredients for achieving project success [26]. Yong & Mustafa, in their study, grouped successful criteria into seven major categories, into 37 factors, they identified 15 factors accepted as critical to the success of construction projects. According to the results of the study, human-related factors such as competence, commitment, communication, and cooperation towards the success of a construction project have been the core element in relationship-based procurement reinforcing the need and viability of such procurement methods in the Malaysian construction industry [27]. According to T. B. Venczel and others, managing success as part of projects will help to drive the project and organizational success. They also highly recommended to choose an applicable method to define and manage success factors and criteria and concluded that otherwise, project goals could be defined incorrectly [28]. The literature on project management contains many lists of success factors. Table 1 shows an identified and summarized list of 30 critical success factors based on the literature review from the perspective of the authors.

**Table 1. Summarized list of CSF.**

S.No	Factor	2011 [25],	2013 [29]	2014 [30]	2017 [19]	2017 [31]	2011 [32]	2018 [33]	2020 [34]	2021 [35]
1	Project understanding and clear goals		√				√	√	√	
2	Project manager's ability								√	
3	Availability of adequate resources					√	√		√	
4	Adequate resource management		√						√	
5	Effective procurement and tendering methods								√	
6	Adequate communication channels	√	√				√	√		
7	Competent project team		√		√	√				√
8	Stakeholders' involvement and management	√					√		√	
9	Risk identification and management procedure	√		√						
10	Adequate dispute resolution process	√		√					√	
11	Stable framework condition	√					√			
12	Realistic cost estimate and project completed within budget	√	√	√		√	√		√	√
13	Adequate funding and financial support	√	√				√		√	√
14	Adequate project schedule/plan		√	√			√		√	√
15	Commitment and coordination of participants and motivation	√	√	√	√				√	
16	Top management support	√	√			√	√	√	√	
17	Effective planning, monitoring and reporting	√	√			√	√	√		
18	Specification and quality management program and control		√	√		√			√	√
19	project manager competence in implementation	√	√		√		√		√	
20	Adequate project management tools, techniques, and standards	√	√	√	√	√		√	√	√
21	Design complicity, experience and management	√							√	
22	Environmental factors/politics	√	√					√	√	
23	Innovation concept	√		√						
24	Clear Contract strategy, specifications and awareness	√	√			√	√			
25	Availability of feedback mechanism								√	
26	Profitability			√						

(Table 1) contd....

S.No	Factor	2011 [25],	2013 [29]	2014 [30]	2017 [19]	2017 [31]	2011 [32]	2018 [33]	2020 [34]	2021 [35]
27	Client's consultation and involvement		√			√			√	
28	Environmental Sustainability			√			√		√	√
29	Client satisfaction			√		√				√
30	Safety program and Zero accidents			√		√	√		√	√

Table 2. Summarized list of management success criteria and project success criteria.

S.No	Project Management Success	1996 [36]	1998 [37]	1999 [13]	2002 [38]	2002 [39]	2003 [40]	2004 [41]	2004 [42]	2004 [43]	2008 [44]	2009 [45]	2011 [46]	2011 [47]	2012 [48]	2012 [49]	2013 [50]	2014 [51]	2016 [52]	2017 [53]	
1	Finishing project on time	√	√	√	√	√	√	-	√	√		√	√	√	√	√	√	√	√	√	
2	Finishing project within budget	√	√	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√
3	Finishing project in compliance with specified quality standard	√	√	√	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√
4	Absence or minimizing disputes or any legal claims							√	√		√								√		
5	Stakeholder benefits and satisfaction with the project		√	√	√	√				√	√		√	√	√	√		√	√	√	√
6	Project team members' satisfaction with the project							√		√								√	√		
7	Low accident rate										√	√	√		√	√			√		
8	Profitability		√	√		√	√				√		√		√						√
	<b>Project Success</b>																				
1	User's satisfaction with residential complexes project	√	√	√	√	√	√			√	√									√	√
2	Environmental impact and environmental sustainability																			√	
3	Marketability of the completed residential complexes unit										√									√	√
4	Aesthetic appearance of the residential complex's units																			√	
5	Meeting the project's purpose and fulfilling needs		√	√	√					√			√							√	√
6	Competitive advantages												√								√
7	Recognition earned by the project(reputation)										√		√								√
8	Safety							√	√	√										√	√

Based on the literature review, from the perspective of the authors, Table 2 identified and summarized a list of 8 management success criteria and 8 project success criteria.

### 3. METHODOLOGY

The research methodology consists of designing a questionnaire based on the findings from the literature review and interviews that also nominated a list of factors during site visiting. Face-to-face interviews for two months have been

conducted by the author with (5) managers of large construction projects, 4 partners of design consultants, and 6 directors of contractors who were experienced in construction engineering projects. Interview's person-to-person verbal communication in which one person or a group of people is interviewed at a time. The advantage of ensuring probing for more information, clarification and capturing facial expression of the interviewees. The purpose of the exploratory interviews was to elicit their views regarding the CSF of RCP management.

**Table 3. Respondent's profile.**

Years of Experience	Number of Responses Received				No
	Project Engineer	Design Consultant	Contractor	Site Engineer	
1 – 5	0	0	2	5	7
6 - 10	4	2	8	9	23
11 -15	12	4	14	10	40
16 -20	10	8	14	10	42
More than 20	8	6	8	8	30
Total number	34	20	46	42	142

After the exploratory interview, a pilot survey questionnaire contained 40 project management success factors grouped under eight categories. Stratified random sampling was adopted for this study. According to Kothari [54], this method of sampling is used where the population embraces a number of distinct categories, and the frame can be organized by these categories into separate "strata." A researcher selects a small group as a sample for study. This subset represents the larger population. Organizing a population into groups with similar characteristics helps researchers save time and money when the population being studied is too large to analyze on an individual basis. Each stratum is then sampled as an independent sub-population, out of which individual elements are randomly selected. Selection of respondents from each stratum was based on simple random sampling.

The questionnaires were sent to over 180 personnel working for different construction companies specialized in constructing RCP. Out of the 180 questionnaires, 142 have been returned, including 34 project managers, 20 design consultants, 46 contractors, and 42 site engineers as shown in Table 3 with their years of experience. These groups have been used to measure the significance of CSF.

Qualitative and quantitative methods have been used in this research. The questionnaire was based on findings from the literature review. For the framework, the following assumptions were made:

Successfully delivered residential complex projects utilize tools and techniques of project management practices. Project failures have patterns related to the methods adopted in the implementation of these tools and techniques. Thus, the most critical project management factors have an influence on project success and affect the golden triangle of time, cost, and quality in different ways.

This method is based on seven steps and guided by the following objectives:

- 1- To identify critical success factors in residential complex projects from pre-identified list of critical success factors and interviews.
- 2- Pilot survey for a prepared questionnaire based on 1.
- 3- Relative Importance Index (RII) analyses for identified CSF of residential complex projects.
- 4- Identifying the impact of CSF obtained from 3 on the golden triangle (time, cost, and quality)
- 5- Evaluate the percentage of practicing CSF during the construction of RCP.

6- Adopting a case study for 20 constructed residential complex projects to evaluate the average management success criterium by the construction team and the average project success criterium by clients.

7- Calculating the management success and project success depending on 6.

The questionnaire is divided into three main parts. Part 1 is related to general information for respondents. As for part 2, an extensive checklist for CSF was prepared through an extensive literature review presenting eight groups or categories that include 40 identified sub-CSF as the major deciding factors of the success of any residential complex project, which mainly impact the three major units of any project (cost, quality and time). The eight groups are developed based on their characteristics and discussion with professionals in the construction management field as follows:

1-Project related factors: type of the project, size of the project, project understanding and clear goals, design complicity, and top management support.

2-Project manager related factors; project manager competence, project manager communication channels, project manager's capability for innovation, and project manager leadership capabilities.

3-Resource related factors; availability of adequate human resources, equipment and materials, adequate funding and financial support, and adequate resource management techniques.

4-Team related factors; technical competence, efficiency and experience of the project team, commitment, motivation and coordination of project team participants, ability of the team to make critical decisions, and availability of innovation concepts in the work team.

5-Technical related factors; adequate project schedule/plan, stable framework condition, adequate project management tools, techniques, and standards, realistic cost estimate and projects completed within budget, effective planning, monitoring and reporting, adequate dispute resolution process, availability of feedback mechanism, clear contract strategy, specifications and awareness, adequate quality control program and adequate risk identification and management procedure.

6-Contractors related factors; contractor experience and professional ability, contractor's financial potential, providing suitable working conditions, the

existence of a safety program, and the absence of accidents at work, and controlling subcontractors' subcontractors.

7-Client related factors; client experience in construction, client's consultation and involvement, and client speed in decision-making.

8-External related factors: political and environmental conditions, country economic conditions, client satisfaction, environmental sustainability, profitability, and competition.

As for part 3, a checklist was prepared for pre-identified management success criteria and project success criterium based on Table 2.

Fig. (1) shows the framework of the research.

**4. ANALYSIS AND RESULTS**

The first-round questionnaire surveys were sent to the selected experts. The respondents were asked to rate various preidentified success factors of residential complex projects. The Relative Importance Index RII has been used to rank various critical success factors that influence the achievement of project objectives that are perceived as being likely to contribute to the success of the construction project. The four groups of respondents were asked to give ratings from 1 (least significant) to 5 (most significant) by using a five-point point

Likert scale as follows:

1= no impacts, 2 = negligible impact, 3 = marginal impact, 4 = moderate impact, and 5 = major impact.

The higher the value of RII, the more significant is the factor.

The same approach has been used by various researchers to analyse the data collected from a questionnaire survey, as indicated in the literature [55].

$$RII = (\sum W / (A * N)) * 100 \tag{1}$$

Where:

W = the weightage given to every single factor by the respondents (from 1 to 5).

A = the highest weight (*i.e.*, 5 in this case).

N = the total number of respondents (142 in this case).

During the second-round, a short list of 35 CSF was summarized based on the first-round ranking. The respondents were asked to rate the impact of the 35 CSF on time, cost, and quality according to their experience in constructing residential complex projects using the previously mentioned Likert scale. The results of CSF impact on the golden triangle were ranked.

The significance of each CSF was calculated as follows:

$$\text{Significance} = \text{Time} * \text{Cost} * \text{Quality}$$

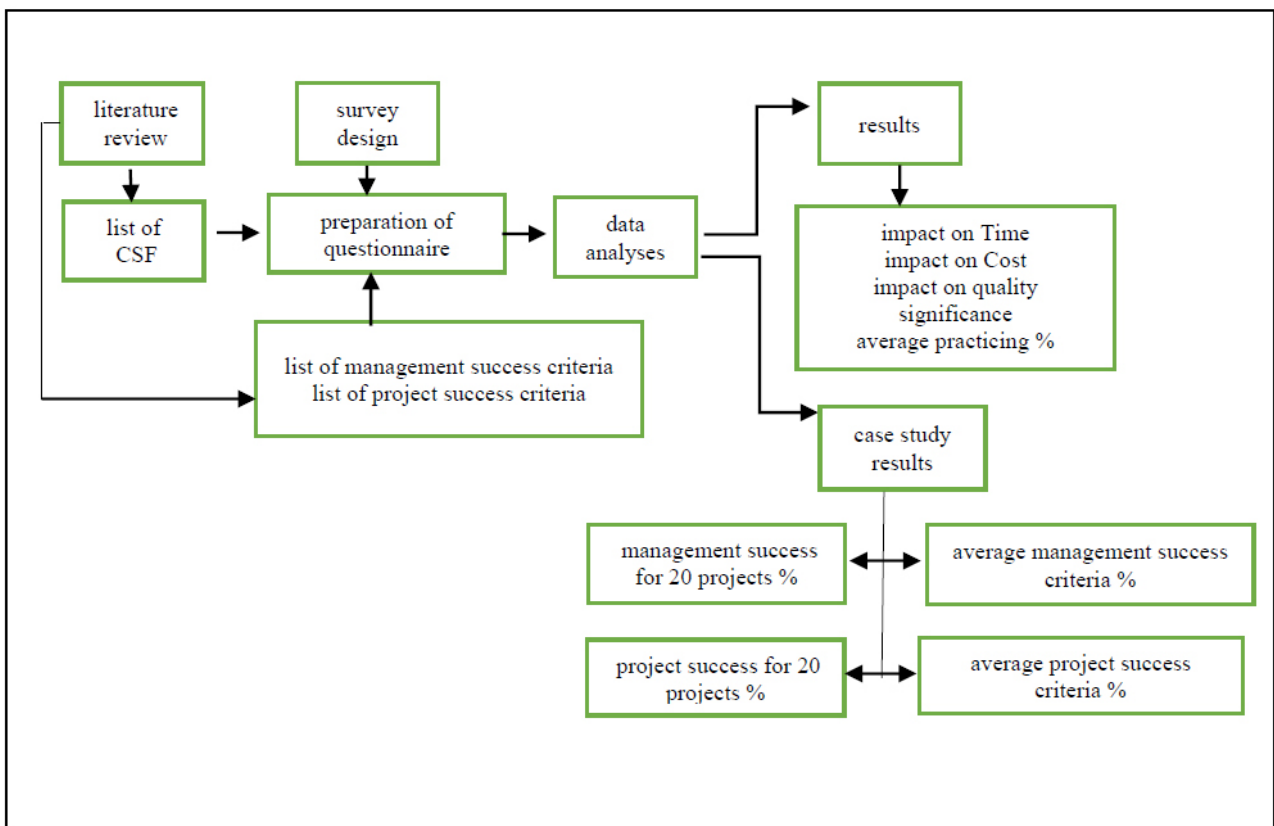


Fig. (1). Research framework.

The purpose of the third round was to calculate the percentage of practicing of the project management success factors. The respondents were asked to evaluate the practice of CSF during the construction of different residential complex projects. Each practiced item was given the full weight of 100% according to ISO standards, 0% weight for never practiced. For the partially practiced, as long as it is difficult to estimate the real percentage, average between 0 and 100 was taken by giving a half weight of 50%. This method is adopted for a similar study to determine the percentage of practicing [56].

The purpose of the fourth round is to evaluate the management success and project success of residential complex projects that have been constructed in Erbil Governorate during 2012-2019.

Erbil Governorate is the Capital of Kurdistan Region of Iraq. During the last 12 years, about 50 residential complex projects have been constructed in Erbil Governorate with a lot of complaints from residents regarding these projects. Out of 50 projects, 20 projects have been selected to conduct a case study which means 40% of constructed projects as a sample size for that period. The number of units in residential projects ranged between 300 and 1100. The projects have been coded

from 1 to 20.

Data was obtained through face-to-face interviews with project managers of residential complex projects related to the case study. The managers were asked many questions related to project management criteria to figure out the fulfillment of each management success criterium based on Table 2 to give their opinion about their rate of satisfaction regarding the management success of projects. On the other hand, the residents of each project have been asked to rate their satisfaction regarding the constructed project. Furthermore, a sample of (100) residents for each residential complex (which mean at least 10% for each residential complex) was chosen to rate their satisfaction with projects by giving a full weight of 100% to the partially satisfied half of the weight 50%, and the not satisfied 0% weight. The weights for each success criterium were calculated depending on the degree of satisfaction of each item of the project success criteria. Also, the average of each criterion was calculated, as shown in Fig. (2). Data was collected and statistically analysed by the author using Microsoft Excel program.

Table 4 shows the ranking of CSF impact on time, cost and quality. And the significance of each factor with the degree of practicing them during the implementation of RCP.

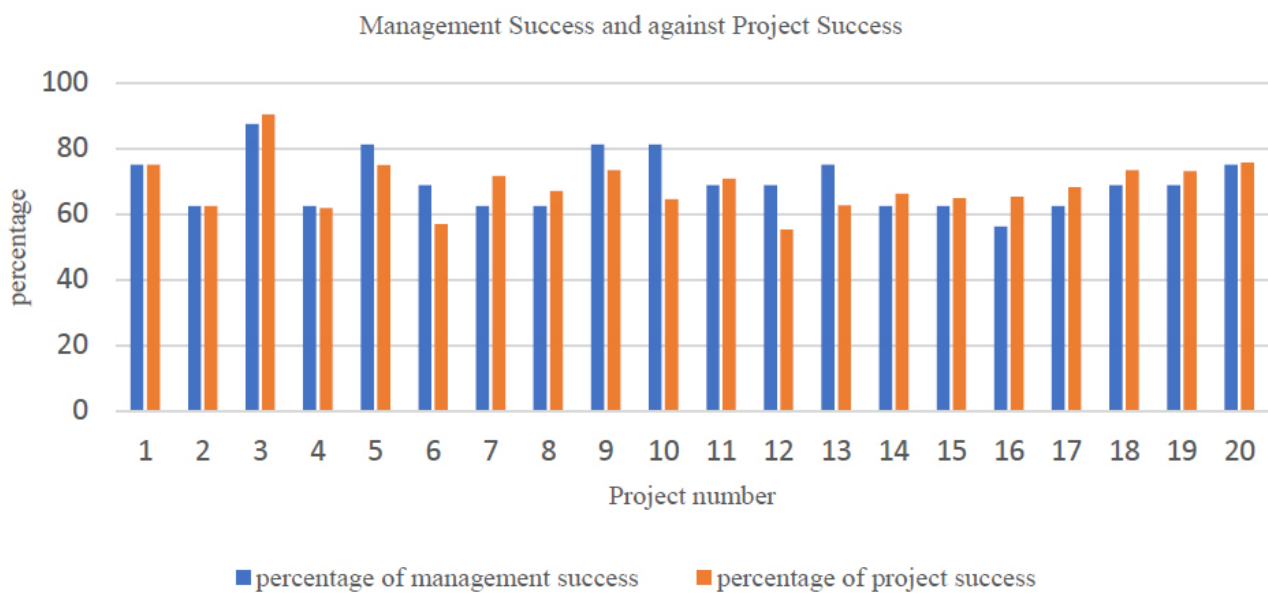


Fig. (2). Management success and project success.

Table 4. Ranking the impact of CSF on time, cost and quality and the average percentage of practicing.

	Top CSF According to Respondents	Impact on Time	Rank	Impact on Cost	Rank	Impact on Quality	Rank	Significance	Rank	Average Practice %
1	realistic cost estimate and project completed within budget	4.45	5	4.73	1	4.65	3	97.87	1	80.28
2	adequate risk identification and management procedure	4.45	1	4.52	4	4.45	7	94.13	2	62.32
3	adequate project management tools, techniques and standards	4.54	3	4.37	9	4.71	1	93.44	3	54.92
4	contractor experience and professional ability	4.45	5	4.40	8	4.67	2	91.43	4	75.35

(Table 4) contd....

	Top CSF According to Respondents	Impact on Time	Rank	Impact on Cost	Rank	Impact on Quality	Rank	Significance	Rank	Average Practice %
5	availability of adequate human resources, equipment and materials	4.23	9	4.44	5	4.60	5	<b>86.39</b>	5	72.88
6	profitability	4.28	7	4.58	3	4.33	11	<b>84.87</b>	6	83.09
7	adequate funding and financial support	4.25	8	4.62	2	4.28	14	<b>84.03</b>	7	66.19
8	clear contract strategy, specifications and awareness	4.13	12	4.37	9	4.60	5	<b>83.02</b>	8	71.12
9	contractor's financial potential	4.21	10	4.43	6	4.44	8	<b>82.80</b>	9	71.95
10	controlling subcontractors	4.21	10	4.42	7	4.45	7	<b>82.80</b>	9	62.67
11	project understanding and clear goals	4.19	11	4.44	5	4.45	7	<b>82.78</b>	10	76.40
12	adequate quality control program	4.00	16	4.40	8	4.67	2	<b>82.19</b>	11	65.49
13	client satisfaction	4.00	16	4.28	11	4.60	5	<b>78.78</b>	12	63.38
14	efficiency and experience of the project team	4.19	11	4.23	13	4.39	10	<b>77.80</b>	13	62.32
15	project manager competence	4.07	14	4.24	12	4.48	6	<b>77.31</b>	14	75.35
16	stable framework condition	4.33	6	4.23	13	4.14	16	<b>75.82</b>	15	65.49
17	top management support	4.05	15	4.24	12	4.31	12	74.01	16	71.95
18	competition	3.96	17	4.04	17	4.61	4	73.75	17	67.25
19	country economic condition	3.91	19	4.62	2	4.05	19	73.16	18	59.50
20	commitment, motivation and coordination of project team participants	3.88	20	3.74	21	3.94	20	72.26	19	54.57
21	ability of the team to make critical decisions	4.21	10	4.28	11	3.94	20	70.99	20	59.85
22	availability of feedback mechanism	4.28	7	3.94	18	4.08	18	68.80	21	82.74
23	client consultation and involvement	3.21	24	4.28	11	4.43	9	60.86	22	48.23
24	adequate project schedule/plan	4.58	2	4.35	10	2.90	22	57.77	23	60.91
25	design complicity	4.00	16	3.21	24	4.18	16	53.67	24	71.83
26	client experience in construction	3.74	21	4.05	16	3.25	21	49.22	25	71.95
27	project manager ability for innovation	3.94	18	2.70	25	4.19	15	44.57	26	39.08
28	environmental sustainability	2.38	25	4.07	15	4.14	17	40.10	27	47.53
29	effective planning, monitoring and reporting	4.08	13	3.85	19	2.54	23	39.89	28	75.35
30	environmental and political condition	3.91	19	3.50	23	2.90	21	39.68	29	69.71
31	project manager leadership capabilities	4.13	12	2.20	26	4.30	13	39.06	30	68.66
32	adequate resource management techniques	4.47	4	4.22	14	1.52	26	29.12	31	67.25
33	adequate dispute resolution process	3.25	23	3.81	20	1.76	25	21.79	32	47.53
34	project manager communication channels	3.40	22	1.88	27	2.02	24	12.91	33	71.83
35	the existence of a safety program and the absence of accidents at work	1.99	26	3.65	22	1.2	27	8.71	34	74.64

The most important critical success factors ranked by respondents affecting time are; adequate risk identification and management procedure (rank1), adequate project schedule/plan (rank2), adequate project management tools, techniques, and standards (rank3), adequate resource management techniques (rank4), contractor experience and professional ability, and realistic cost estimate and project completed within budget (rank5), stable framework condition (rank6), profitability and availability of feedback mechanism (rank7), adequate funding and financial support (rank8), availability of adequate human resources, equipment and materials (rank9), contractor's financial potential, controlling subcontractors and ability of the team to make critical decisions (rank10), project understanding and clear goals and efficiency and experience of the project team (rank11), clear contract strategy, specifications and awareness and project manager leadership capabilities (rank12), effective planning, monitoring and reporting (rank13), project manager competence (rank14), top management support (rank15), adequate quality control program, client satisfaction and design complicity (rank16),

competition (rank17), project manager ability for innovation (rank18), country economic condition and environmental and political condition (rank19), commitment, motivation and coordination of project team participants (rank20), client experience in construction (rank21), project manager communication channels (rank22), adequate dispute resolution process (rank23), client consultation and involvement (rank24), environmental sustainability (rank25), and the existence of a safety program and the absence of accidents at work (rank26), respectively.

The top critical success factors that affect cost are; realistic cost estimates and projects completed within the budget (rank1), adequate funding and financial support, country economic conditions (rank2), profitability (rank3), adequate risk identification and management procedure (rank4), project understanding and clear goals, and availability of adequate human resources, equipment and materials (rank5), contractor's financial potential(rank6), controlling subcontractors (rank7), contractor experience and professional ability and adequate



quality control program (rank8), adequate project management tools (rank9) and adequate project schedule/plan (rank10), client satisfaction, ability of the team to make critical decisions and client consultation and involvement (rank11), project manager competence and top management support (rank12), efficiency and experience of the project team and stable framework condition (rank13), adequate resource management techniques (rank14), environmental sustainability (rank15), client experience in construction (rank16), competition (rank17), availability of feedback mechanism (rank18), effective planning, monitoring and reporting (rank19), adequate dispute resolution process (rank20), commitment, motivation and coordination of project team participants (rank21), the existence of a safety program and the absence of accidents at work (rank22), environmental and political condition (rank23), design complicity (rank24), project manager ability for innovation (rank25), project manager leadership capabilities (rank26), project manager communication channels (rank27), respectively

The critical success factors ranked by respondents that affect quality are; adequate project management tools, techniques, and standards (rank1), contractor experience and professional ability, adequate quality control program (rank2), realistic cost estimate and project completed within budget (rank3), competition (rank4), clear contract strategy, specifications and awareness, availability of adequate human resources, equipment and materials, and client satisfaction (rank5) project manager competence (rank6), adequate risk identification and management procedure, controlling subcontractors, and project understanding and clear goals (rank7), contractor's financial potential (rank8), client consultation and involvement (rank9), and efficiency and experience of the project team (rank10), profitability (rank11), top management support (rank12), project manager leadership capabilities (rank13), adequate funding and financial support (rank14), project manager ability for innovation (rank15), stable framework condition and design complicity (rank16), environmental sustainability (rank17), availability of feedback mechanism (rank18), country economic condition (rank19), commitment, motivation and coordination of project team participants and ability of the team to make critical decisions (rank20), client experience in construction, and environmental and political condition (rank21), adequate project schedule/plan (rank22), effective planning, monitoring and reporting (rank23), project manager communication channels (rank24), adequate dispute resolution process (rank25), adequate resource management techniques (rank26), and the existence of a safety program and the absence of accidents at work (rank27), respectively.

The results of this study identified 17 significant critical success factors that ranged between large and very large impacts on time, cost, and quality at the same time. The respondents ranked the realistic cost estimates and projects completed within budget as the most CSF leading to project success (rank1), followed by adequate risk identification and management procedure (rank2), adequate project management tools, techniques and standards (rank3), contractor experience and professional ability (rank4), availability of adequate human resources, equipment and materials (rank5), profitability

(rank6), adequate funding and financial support (rank7), clear contract strategy, specifications and awareness (rank8), contractor's financial potential and controlling subcontractors (rank9), project understanding and clear goals (rank10), adequate quality control program (rank11), client satisfaction (rank12), efficiency and experience of the project team (rank13), project manager competence (rank14), stable framework condition (rank15), and top management support (rank16), respectively. These factors need special attention.

## 5. DISCUSSION

The average practice of the 17 critical success factors ranges between moderate and good. Realist cost estimate is the most significant factor for continuous construction. It increases the probability of success and finishing the project on time within the required quality. This factor was rated as 80.28%, aligning at 83.09% for profitability, which means that construction companies always strive to gain profit despite of material difficulties. Although identifying risks and having adequate management procedures ranked as the second significant factor, the rate of practicing was low 62.32%.

The lowest percentage of practicing was for adequate project management tools, techniques, and standards. The practice of this factor was rated as 54.92%, although there is a flaw in using such techniques. However, the construction companies are still gaining profit. Using a strong command of project management tools and techniques with adequate quality control programs relevant to produce the project life cycle phase deliverables. This factor controls the management procedure through the cycle of project construction. Thus, it needs special attention.

The rate of quality control practice is 65.45% and despite being the 11<sup>th</sup> CSF, it was not practiced properly and resulted in a bad quality RCP. That is the main reason for the low competition rate of 67.25% despite client's appropriate experience in construction with a rate of 71.95%. The client consultation and involvement were rated as 48.23%. This explains the client satisfaction low rate of 63.38%.

What is noticeable that despite both project manager compliance and contractor experience rated as 75.35% and project manager leadership capabilities rated as 68.66%, still the adequate dispute resolution rate was 47.53%, which is below acceptable rate. Unfortunately, the respondents underestimated this factor for critical success and ranked it as 32.

The availability of suitable resources is of great importance as being in the 5<sup>th</sup> position according to respondents ranking, but unfortunately, it is rated as 72.88%. According to the respondents, despite the feedback mechanism rate was 82.74%, clear contract strategy and specifications rate was 71.12%, and the adequate resource management techniques rate was 67.25%, there were frequent changes in the framework conditions. Stable framework conditions rate was 65.49%, and adequate schedule or plan rate was 60.91%. All that could be the reason of the frequent claims and disputes.

Contractor's financial potential and controlling subcontractors were rated as 71.95% and 62.67%, respectively.

There is a shortage in funding and financial support which is rated as 66.19%. This explain why the respondents rated the realistic cost estimate as the CSF rank 1.

The efficiency and experience of the project team were rated as 62.32%, and there was a poor commitment, motivation, and coordination among participants with a rate of 54.57%. That may explain the low rate of their ability to make critical decisions with 59.85%. It is noticeable that a lot of the team members are newly graduated and lack experience. The respondents rated project manager communication channels as 71.83%, and ranked top management support as the 16<sup>th</sup> CSF with an average rate of practicing 71.95%. This factor is significantly improving project success, although the respondents underestimated it.

The project manager's ability for innovation is rated as 39.08%, and ensuring environmental sustainability as 47.53%, both of which are below the acceptable rate. Not taking environmental sustainability into account may lead to future environmental problems.

The existence of a safety program and the absence of accidents at work were rated as 74.64%. Despite the importance of the country's economic conditions and the environmental and political conditions, the respondents ranked them as 18<sup>th</sup> and 29<sup>th</sup> significant factors with a rate of 59.50%, and 69.71%, respectively. Competition among construction companies is 67.25%, while it should be one of the main goals for the company and project management success. This indicates that clients in general have lots of notes regarding most projects.

### 6. CASE STUDY RESULTS AND DISCUSSION

The results in Fig. (2) show that the management success of RCP range between 56.25% and 87.5%, while the project success ranges between 55.25% and 90.31%

For project 10, the management success is 81.25% but project success is 62.56%. That means despite a good management, the project success is low. This pattern continues for projects 4, 5, 6, 9, 12 and 13. On the other hand, the management success of project 7 is 62.5%, while the project success is 71.62% which indicates that project success is highest than management success. This pattern continues for projects 3, 8, 11, 14, 15, 16, 17, 18, 19 and 20. As for projects 1 and 2, the management success and project success are equal.

This indicates that project management and project success are not always the same. Some projects failed to meet the original goals of golden triangle criteria (time, cost, and quality) but are considered successful. Other projects were completed on time within a budget but were considered a failed project. Therefore, there is no stable pattern to evaluate project success according to management success.

The results in Fig. (3) show that the management success criteria in RCP range between 52.5% and 87.5%.

The findings show that 47.5% of project managers failed to minimize claims and disputes due to a lack of management techniques. About half of the projects exceed the planned schedule with a rate of 45%. This indicates that project managers failed to keep their projects within schedule. Only 70% of the projects are finished within the estimated budget and 70% comply with the quality requirements as per contract terms and conditions. That explain the low user satisfaction for RCP with a rate of 67.82% in Fig. (4). One-third of the project team members showed their dissatisfaction with the projects. This alignment failed to keep their projects within the golden triangle. Stakeholder benefits and satisfaction were rated as 65%. The highest rate of project success is 87.50% for profitability, that is considered the core goal for companies. The low accident rate of 15% indicates the existence of a good safety program.

The results in Fig. (4) show that the project success criteria ranges between 45.95% and 85.57%.

According to residents, the safety requirements and the rate for RCP 85.57% are considered significant. Only 65.56% of the projects meet project purpose and fulfilling residential needs. This means there was a lack during the design phase for not setting the exact requirements for residents. 67.70% of residents are satisfied with the aesthetic appearance. Although this factor is essential and should be taken into consideration during design but the construction companies did not take enough effort to improve its aesthetic appearance which has a great impact on recognition and reputation. That is the main reason for earning only 68.32% of recognition, 68.85% of competitive advantages, and 67.82% of user satisfaction. However, the marketability is good 72.77%. 45.95% of the respondents agreed that there is no environmental sustainability procedure has been taken. The overall results indicate the residents have many complaints against these complexes.

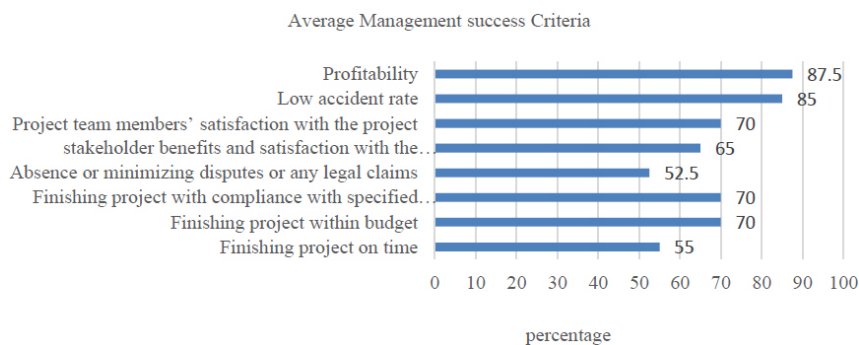


Fig. (3). The average management success criteria.

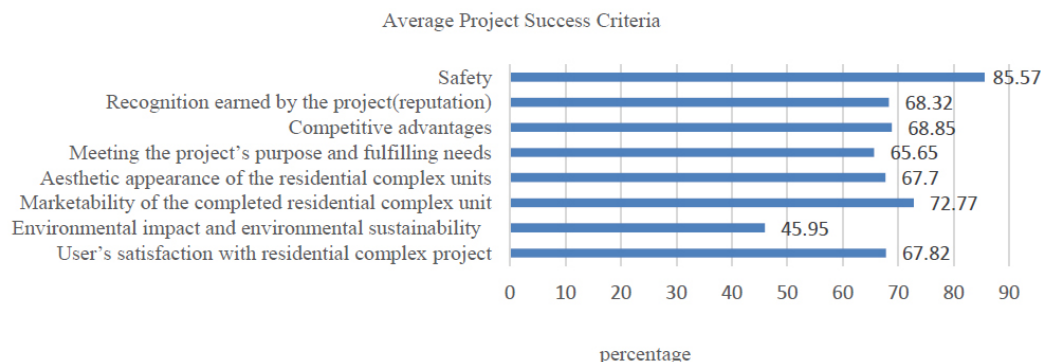


Fig. (4). The average project success criteria.

## CONCLUSION

The characteristics of residential complex projects require a specific type of management because it is in direct touch with the different tastes and requirements of residents and stakeholders who aim to have an adequate service with a suitable price no matter their material situation.

The study identified 17 significant critical success factors that ranged between large and very large impacts on time, cost, and quality at the same time. These factors should be taken into consideration during the construction of any residential complex project.

The highest average of practicing was for profitability with a rate of 83.09%. Project managers ranked profitability as the sixth CSF, as their main goal is to achieve profit. Although they always complain that they do not gain the planned profit. While, the lowest average percentage of practicing was for adequate project management tools, techniques, and standards that rated 54.92%. The interesting thing here, although there is a flaw in using such techniques. However, the construction companies are still gain profit. Project managers complain that the average rate of adequate funding and financial support was 66.19%, which is essential to keep maintaining the work schedule for the company and contractors as well.

The residents are not fully satisfied with the constructed projects. They have a lot of complaints about not ensuring their needs. Only 65.65% of their needs have been fulfilled. The client consultation and involvement were rated as 48.23%. This explains the client satisfaction low average rate of 63.38%.

Despite the bad quality of RCP, the marketability is good that is 72.77% because the competition is weak with a rate of 68.85%. The study revealed that in general, half of the projects have been delayed and not finish on time. The average rate of finishing projects on time was only 55%.

For residential projects, project success is not always meaning management success. Some projects used the management success concept, but still, the expected success is not achieved because of many other variables that have not been taken into account. A project can be completed on time within budget but considered a failed project if it does not satisfy the client or end users. Project reputation plays a big role in marketing regardless of project success.

The result confirms that project success can be evaluated based on the overall objectives of RCP, while project management success is mostly evaluated based on the golden triangle. Still, a competent contractor with good professional ability and experience is essential to achieve the golden triangle goals because the construction is implemented directly by them. Thus, not all project management tools and techniques are directly associated with project success. Even a literature review could not identify any successfully completed project because there are several other factors that influence project success in combination with management practices. A project should be managed by a competent project manager with a qualified team that has the ability to make critical discussions on time. But it is noticed that a lot of team members are newly graduated with low experience.

The results show that considering cost, time, and quality as primary success measures appear insufficient to assess the success of a project, even for the same type of project. Therefore, additional parameters should also be considered for evaluating project success.

There should be a clear contract strategy that supports the objectives to minimize claims and disputes with a stable framework to keep the project within time and minimize variation orders. It is noticeable that client satisfaction ranked as 12, which indicates that the main aim of construction companies is to gain more profit.

The contractor's professional ability and controlling subcontractors has a direct impact on project success; therefore, it is essential to be careful during the choice of contractor within the tendering evaluation procedure. Work is hard to be managed without the availability of adequate human resources, equipment, and materials because it is an essential element for the quality of work. Any project performed with lack of adequate resources will be time and cost-consuming for improper work removal and reimplementation. The identification of CSF on a scientific base of time, cost, and quality to meet all parties and stakeholder's requirements by ensuring the quality and increasing the possibility and of project success. The real practice of CSF should be studied to disclose the shortages and identify what is needed to be focused on and managed in a proper way by providing a realistic cost estimate with realistic planning, risk identification, clear objectives, adequate management tools and

techniques, ample resources, high-quality deliverables, and on-time delivery of the product.

These results of this study may contribute an improvement to residential complex projects by improving the existing management system based on evaluating the practice of critical success factors for residential complex projects focusing on the factors of significant impact on cost, time, and quality to avoid firms from falling in many troubles and challenges.

## RECOMMENDATION

It is recommended to focus on the 17 significant CSF as essential factors during the construction of future projects. Also, client's satisfaction regarding residential complex project should be considered as an essential element for evaluating project success. Putting special standards for construction companies to ensure client needs and requirement before giving permission for construction of such projects will improve the quality and management procedure. In addition, it is essential to put some restrictions on environmental sustainability.

## CONSENT FOR PUBLICATION

Not applicable.

## STANDARDS OF REPORTING

COREQ guidelines were followed.

## AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available on request from the corresponding author [A.J.M].

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None.

## CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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