

Analysis of Critical Success Factors in Design-Build Projects; a Case study of Karaj Urban Projects

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Abstract

In recent years, complication and specialization of large construction projects has led into wide recruitment of specialist contractors and division of such projects into smaller parts. Shift from traditional to innovative project delivery systems is a resultant of the complexity of modern projects. As such, Design and Build (D&B) as an innovative technique has gone popular due to its time and cost saving nature. Basic concept of Design and Build requires the project to be contracted to a single organization that will be responsible for design, procurement, engineering, and commissioning of it. This paper aims to determine primary factors supportive of successful application of D&B Project Technique in Karaj Urban projects. In order to identify these factors, study was planned and performed in three stages. At first stage, review of both field literatures is done. At second stage, a semi-structured interview with construction experts was delivered and at last one, a questionnaire was designed based on knowledge obtained in first two stages and distributed among 50 people of staff managers, project managers and technical experts of Karaj urban projects to identify the critical success factors. Finally data obtained through questionnaires was analyzed by using SPSS 21 software.

Keywords: *Critical success factors, Design Build, Project delivery, Project success*

1. Introduction

Construction projects are currently progressing slowly around the world as a result of the recent global economic crisis. The main reasons for the unfavorable construction project outcomes mostly fall into several categories. Construction projects rely on integrated efforts of several hierarchically linked parties (including architects, engineers, surveyors, general contractors, subcontractors and suppliers) using their differentiated skills, knowledge and technology. These parties are generally independent organizations with separate objectives and goals, management styles and operating procedures. Due to the fragmented nature of construction, communication and coordination problems are common

and affect project performance and productivity [1]. Many studies have compared the advantages and disadvantages of design-build (DB) with the traditional design bid-build (DBB) delivery system. DB project delivery method brings various design disciplines and construction together, and this is supposed to minimize incidents of re-works that result in cost and time savings for the owner [2].

Increasing globalization of projects and project management adds to a diverse mix, creating intercultural challenges for project managers, [3] There is growing recognition that different types of projects require different approaches to their management, requiring management procedures tailored to the needs of the project, [3,4] and project managers selected with appropriate competencies, [3] Therefore, the identification of appropriate success criteria is important for project owners and managers, who need a specific and measurable framework for tracking key project outcomes [2]

This paper aims to determine primary factors which support the successful application of D&B method. The study attempts to distinguish these factors based on their degree of importance in relation to success of project in question.

2. Literature Review

Construction industry plays a vital role in the national economy. However, the success of most construction projects is much affected by physical, political and social environment, cultural traditions, and especially human-related factors which are usually different from country to country.

2.1 Design-Build Literature Review

The term “Design and Build” refers to the project delivery system that entails the contractor carrying out the work; the design works as well as the construction and

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completion of the work. It is a form of project delivery whereby the contractor will design and construct the project. A Design and Build contract is one in which a single entity, usually a contractor assumes responsibility for the design in whole or in part and for the construction and completion of a construction project.

In D&B, the client will enter into a single contract with D&B contractor to perform the full service of designing and constructing). The contractor and client are in a close contact throughout the project phases (i.e., design, procurement, construction and completion). Nevertheless, some clients are still claimed that the D&B procurement method are subjected to poor quality of project services [5]. A survey conducted by Ling and Chong concluded that service performance is still lacking in D&B project. They recommended that in order to succeed, the D&B contractor should be capable to tackle the practical aspects of design and construction; build up the design management expertise and project management capability; achieve a high level of cooperation; share common project goals; and develop an ability to resolve conflicts among project team. Contractor is supplying the procurement option of “buying” a finished building [6].

2.2 Critical Success Factors

Critical Success Factors is known as a tool for measuring performance in an organization to achieve their mission [8]. In building maintenance, CSF is becoming very important as it could identify the cause of failure as well as improving the system. The success of maintenance management initiatives depends on many factors. The authors categorized critical success factors into five primary categories: leadership, culture, structure, roles and responsibilities, system infrastructure, measurement. These five categories were based on the objective of the organization. According to the researchers, it is also essential to identify the constraint of the critical success factors. In understanding the constraints, critical success factors defense measures can be derived. Knowing the constraints will eliminate predicted work which can bring about greater risks to the company's success. Knowing critical success factors in the operation of the business can strengthen management strategy.[2] Risk management process can be more focused and many issues will be corrected and probability of failure is greatly reduced. Every single activity within the organization will be directed towards achieving the overall success of the company [8].

A construction project is commonly acknowledged as successful when it is completed on time, within budget, satisfaction [9]. Thus, project success is usually defined as meeting time, cost and quality objectives and satisfying project stakeholders [10]. Project success

could be refined into achieving product success, which meets quality output standards, and process success, which meets time and budget objectives [11].

2.3 Design-Build Critical Success Factors

Before explaining CSFs in D&B, it is necessary to talk more about project participants and their roles, as they are crucially involved in this method. Project participants play an important role determining the success or failure of a project [9]. Therefore, human-related factors should be well performed in order to achieve good project outcomes [5,12]. Project-related participants refer to related major parties in D&B projects including owners, contractors, design consultants, project management consultants and project managers or project team.

Lehtiranta et al [13] explored a new dimension of the determinants for construction project success, i.e. the relationship between success and multi-firm project participants' satisfaction with each other. The results showed that correlations can be found between certain project participants' satisfaction with each other's performance and the owner's perception of project success. More specifically, satisfaction with performance factors within the relationships between the owner and any other participant (i.e. the contractor, designer or project consultant), within the relationship between project consultants and designers and within the relationship between project consultants and contractors were reflected in the owner's perception of project success [2]. In 1986 Ashley identified these seven factors as the success factors:

1. Construction activities programming,
2. Design planning,
3. Project manager commitment to the goals,
4. Project team motivation,
5. Project manager technical capabilities,
6. Control systems,
7. Definition of work and its field

He also identified following six as the success criteria: [14]

1. Budget performance,
2. Schedule performance,
3. Employer satisfaction,
4. Task-orientation,
5. Contractor satisfaction,
6. Project manager satisfaction [13].

Among other factors, good governance is identified by [15] government support by Zhang et al. (1998) [16]; A stable macro-economic environment by Dailami and Klein (1997)[2]; and suitable legal and administrative framework by Stein (1995)[17].

Westerveld (2003) also attempted to differentiate project success criteria and success factors as he argued that the former signify the result areas while the latter represent the organizational aspects. Ronald Daniel was among the first experts who offered the critical success factors as the business guidance for the first time in 1961. In his opinion there are three to six critical factors which

determine the success in all industries. Among the next experts, Rockart contributed in the field of introducing the critical success factors more than other researchers. [18] Tabish and Jha [19] studied success factors for public construction projects. Achieving success in public construction projects is difficult because it requires economy, efficiency, quality, fairness and transparency. Such projects are taken up on the requisition of owners/clients and almost always involve multiple entities and are also accountable to external financial audit and vigilance agencies. Identification of the success factors is considered the key to achieve success in these projects.

3. Research Procedure:

In order to identify critical factors of DB projects in urban projects of Karaj, a multi-dimensional qualitative approach was adopted. For such purpose, it was decided to conduct a combination of literature surveys and data gathering techniques through questionnaires.

Table 1: Job position and expertise of interview respondent

No.	Job position	Education	Experience (year)
1	Technical & Reconstructive Assistant to Development Branch of Municipality of Karaj	Master of Construction management and civil engineering	16
2	Acting Deputy to Technical & Reconstructive Assistant of Municipality of Karaj	Civil engineer	13
3	Supervision Office of parks & Urban Buildings	Master of civil engineering	20
4	Management Office of Technical & Intersections Inspections	Civil engineer	15
5	Head of Inspectorate in Technical & Reconstructive Assistant of Municipality of Karaj	Mechanical engineer	14
6	Project Manager of Multi-level Junctions in Municipality of Karaj	Master of Construction management and civil engineering	12

The questionnaire was designed based on sum of information gained in literature review and semi-structured interviews with 6 construction experts working on Karaj’s urban projects whose job position and expertise is shown in Table 1.

Analysis of data collected in literature surveys and interviews helped in making a list of factors influencing success of Karaj urban projects. As it was stated before and also based on the responses gathered from interviews, project participants play an important role in project success which made it necessary to design the questionnaire having multiple projects participants and their effect on success factors of projects in mind.

In the first part of questionnaire, respondents are required to indicate basic factors in project success and their contribution percentage in urban projects. These factors have been chosen based on the literature review and semi-structured interview in which respondents’ ideas were asked. Following factors are the most important indices for recognizing and measuring project’s success:

- Done within scheduled time
- Done within scheduled budget
- Done within expected quality
- Project Integration
- HSE Approval

These questions were asked for measuring the percentage of success in Karaj urban projects to give us a comprehensive insight on such projects’ general status. Second part of questionnaire is dedicated to critical success factors which affect Karaj urban projects. These factors had been classified in 7 following groups:

- Financing and procurement
- Communication
- External factors
- Legal factors
- Contactors
- Design team and Consultants
- Client

4. Discussion of Results:

Next, designed questionnaire was distributed amongst 50 people who were managers, contractors, consultants, and clients of Karaj urban Design- build Projects. Out of 50 people, only 41 of respondents replied to the questionnaire. Extracted data was explored by normalized means of Likert Rating Scale and then analyzed by SPSS 21.

The result of first part of questionnaire on urban projects’ status, which was obtained based on principal indices for measuring project success, is shown in Figure 1.

As it is obvious in Figure 1, most of the indices have more or less a similar percentage. Although the least effective index amongst success factors of projects was the budget index, most of the project was done within the expected quality.

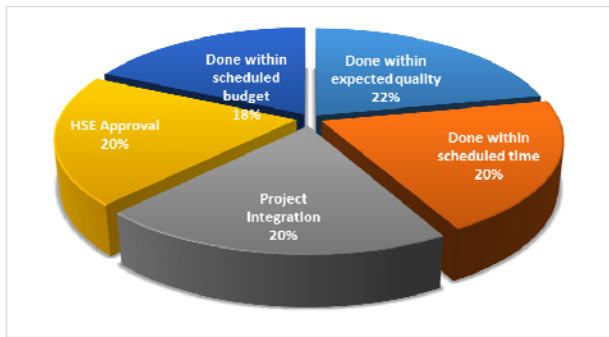


Figure 1: Percentage of Karaj urban projects' success based on different factors

Table 2 is showing the importance of different factors in success of Karaj urban Design-Build projects.

Table 1: Percentage of factors' appropriateness in success of project

Group	Factors	Mean Percentage
Procurement and Finance	On time Financing	3.97
	On time Procurement	3.83
	Effect of contract on financing and procurement	4.00
Communication Management	Management of client communication with consultants and contractors	4.25
	Management of consultants communication with contractors	4.58
	Management of Procurement team's communication with contractors	4.39
Legal factors	Management of legal Problem	3.70
	Public organizations' cooperation	4.03
External and Environmental factor	Managing project hindrances	3.23
	Environment and weather	3.89
Contractor	Employment of skillful forces	3.89
	Implementation of Innovative Techniques	3.23
	Experience and knowledge	3.95
	Financial power and prestige	3.86
		3.56
	Commitment to project	4.00
	Project manager 's success	3.67
	Effectiveness of power & experience of contractor in managing project hindrances	3.88
Consultants and Design team	Quality of team inter-communication	4.06

Client	Knowledge and experience	4.19
	Performance of project surveyors	4.33
	Managing the legal problems	4.47
	Knowledge	4.30
	Commitment to the project	4.47
	Percentage of employer's collaboration in managing project hindrances	4.24

4. Conclusions

As it was made clear by results of study, financial supply of projects is one of the main and most effective causes of success in urban projects of Karaj. Other critical factors of success in projects include: external agents (especially project hindrances), financial supply and contractors which in this particular case are classified as points of weakness and obstructive to success. Since data collected show that type of selected contract and its' legal clauses are influential in financial and provisional supply of project, we can claim that selecting the right contract form based on project needs and then, financial supply of design and build projects, plays a remarkable role in solving related problems .Also, regarding the fact that project manager's performance is recognized as one of the least effective CSFs in contractor's group, outsourcing related activities or selecting skillful and knowledgeable people could be considered as a way for more improvement in success of design –build projects. As it was shown in last section, by changing type of contracts into Design & Build, we can be hopeful to reduce problems resultant of design and stop waste of time and energy.

Management of hindrances is considered as another principal and contributory factor on success of projects, too. Analysis of data shows that in comparison to employer's performance, contractor has demonstrated weaker. Again due to weak performance of contractor in question in terms of risk management factors and employment of modern technologies, we can assume Design & Build contractors ' lack of a powerful administrative team as a problem which can be solved completely if selection of contractors is done according to a number of principal criteria and instrumental factors influential in success of projects. It should be mentioned that all of the aforementioned approaches need to be considered and approved by administrative and legal officials. Other such factors which could be researched further include selection of appropriate approach in Design & Build contracts in accordance with type, needs and necessities of construction projects.

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