

Assessment of most critical success factors for mega construction projects in Pakistan

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Abstract: The construction process is dynamic in nature due to many uncertainties in technology, budgets, weather, and development techniques. A comprehensive study of critical success factors (CSFs) can improve the effectiveness of project. This research work explains the impacts of success factors on mega construction developments in Pakistan. A proper questionnaire was developed to collect information from practitioners (Clients, Consultants and Contractors). At the same time general community was also consulted to get an idea about the impacts of mega construction projects on public. Data obtained from the questionnaires were analyzed through statistical analysis. By using rank method, top five success factors i.e., planning effort and scheduling (PES), adequacy of funding (AOF), project manager authority to take decision (PMD), adequacy of planning and specification (APS) and timely decision by client (TDC) were thoroughly investigated. Relationships between these success factors were elaborated using frequency analysis. It was found that, if AOF is certain throughout the project then other planning efforts should always support to achieve desire milestones within scheduled time of project. Also timely completion of mega construction projects may significantly support the economy of a country.

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1. Introduction

Construction sector throughout the world is considered one of the primary industry on which the development of any country depends. Construction industry may also be viewed as a barometer of country's economic health. To a great extent, the growth of a country and its development status is generally determined by the quality of its construction companies and their capability. Unluckily the inherent complexity, uncertainty and dynamic nature of the most construction developments create serious problems for authorities to manage the project successfully.

A comparison of the previous practices shows that during the recent decade mega infrastructure developments in Pakistan are progressing. At present, many mega projects are under progress and many more are under planning. These mega construction developments have serious prospective to lead and hence revive the local industry. New developments may improve the status and international gratitude of the nation. Due to rapid trend of mega construction projects, the challenges and management problems in the construction industry are also increasing with it. The "boom cycle" and corresponding shortage of labor trades has increased the need for industry participants to adopt and apply project management philosophy tools and techniques. These practices and management techniques may precede construction industry in a sustainable long term mode.

A lot of projects in Pakistan are facing a delay because of improper planning, corruption and inflation of material prices. Some of the recent examples are:

- The initial cost of Zero point Interchange Islamabad Project was about 2 billion rupees. But because of the huge variation in prices and lack of funding, this project has now been moved to 4 billion rupees.
- Underpass project at Wah/Taxila was delayed due to delay in payments to the contractors.
- Benazir Bhutto Shaheed Airport Islamabad is also facing lots of problems due to several reasons related to project management.

2. Research Objectives

The objectives of this research are:

- To prepare a strategic model for the in-time completion of projects by considering actual problems.
- To make a quantitative study and analysis of success factors by surveying different Pakistani construction industries.
- To make a framework for the standardization of construction industry practices for achieving improved performance improving cost and time management, safety, and quality in an effective way.

3. Literature Review

The accomplishment of a project depends on the degree to which the goals are achieved. A booming project indicates that it is completed within allocated time and budget, and which performs its technical responsibilities efficiently. Sanvido et al. stated that achievement for a mega project can be related to the degree to which project goals and prospects are met. Sanvido added that these goals and expectations may include professional, educational, technical, social and financial aspects. A mega project success means that certain required prospects are achieved properly by client, consultant and contractor. There are two main distinct components of project success. Product success primarily refers to the benefits released by using the project deliverable and ultimately to the strategic objectives. Project management success primarily refers to delivering the project within time, cost, quality and stakeholder's satisfaction.

Rockart initially used critical success factors (CSF) in the perspective of information systems and project management. A number of researches have contributed in this field too. Rowlinson (1999) and Thomsen (2008) state that CSFs are those elementary concerns intrinsic in the project activities, that must be conserved in proper order for efficient and effective results. CSFs require proper attention during all phases of the projects to achieve desired results.

Project success can be measured in terms of technical and management requirements. Qiping Shen et al. (2003) also identified critical success factors related to management issues. Two important factors that had not been properly discussed by previous researchers i.e.(i) co-ordination among management team (ii) joint efforts by client, consultant and contractors, were discussed in detail during their investigation. Jing Yang et al. (2010) explored the critical success factors for managerial skills of stakeholders. It was found that some factors related to the social responsibilities are also important. Therefore, the working precedence of project managers to deal with the stakeholders is context specific, depending on the nature of client, project and their organizational and management setup. These findings could be more helpful for project managers to become more aware of their responsibilities.

Chua et al.,(1999) and Edmond. W. Lam et al. (2008) find out critical success factors in terms of cost, time and quality. To measure the success of mega project, Chua et al proposed a hierarchical model which confers the four major project issues namely contractual arrangements, project characteristics, project participants and interactive process while Edmond et al. prepared a project

success index for design and build projects which is assessed by the key project performance indicators: i.e. time, cost, quality, and functionality. Edmond et. al. model mainly focuses on cost but if hierarchical model of Chua et. al., is followed then cost, time and quality could be properly managed.

Weisheng Lu et al., (2008) described the critical success factors related to contractors. All issues related to the contractors were discussed but the relationship among contractor, sub-contractor and client were not properly discussed. Sung Ho Park (2009) found out that the relationship between client and contractor must be stronger than contractor and sub-contractor. Per Erik Eriksson (2008) described the client-contractor relationship in term of cooperation and competition. This research emphasizes how client's procurement procedure affects the balance between cooperation and competition in client-contractor relationship. Client's earlier experience of certain procedure heavily affects the procurement choices. This approach can increase client's awareness of dealing with contractor, thereby serving a basis for more unbiased and systematic procurement decisions, facilitating cooperation-based competition.

William Ibbs et al. (2011) discusses the concurrent delays from general contractor along with subcontractor perspective. When there is a concurrent delay by multiple subcontractors, or between the government contractor and other subcontractors, there will not be a uniform approach as to how the liquidated damages are apportioned. Previous researches seem to ignore this issue. This specifies that practitioners should specify that which apportionment practice will be used and under what circumstances it will be applied to the subcontractors.

Cooke Davies, T. (2002) revealed that factors related to project planning and control, project personnel, and involvement of client were perceived to be critical for the success of large-scale construction projects. Muhammad Saqib et al. (2007) added that decision making effectiveness, project manager's experience, contractor's cash flow, contractor experience, timely decision by client, site management, supervision, prior project management experience and client's ability to make decision were found most important. This study is helpful for project managers to evaluate their current project in term of project success. Project managers can use this study to evaluate their current project, and compare the perceived and real success factors for knowledge management exercises.

Xueqing Zhang's (2005) found out the success factors of public-private partnerships (PPPs) in China. A questionnaire provided five main CSFs (fair bidding process, political and social

environment, equality of rights, and organizational setup ratio and decision authority to government) were found out to overcome the increasing load on the government due to increasing population in China. The literature presented in this research covers all the aspects of construction management i.e. critical success factors related to client, consultant, contractor and subcontractor in the countries where technical knowledge of project management is not superior. The more complicated issue is that the developing world is not learning from their past mistakes for future projects.

4. Research Methodology

The first stage of this research activity involved studying and understanding of the topic area, and to identify scope and objective of research. This study has employed the survey method by using questionnaires. In order to evaluate and analyze the project success factors in construction projects, a large range of professionals involved in the construction industry of Pakistan was targeted. These professionals were randomly selected from Pakistan Engineering Council (PEC) website. Feedbacks and interviews were conducted with a number of those persons. General public was also involved in the survey to know the view point of a common man.

A questionnaire containing twenty six factors was prepared from preliminary investigations carried out on construction projects. A web based questionnaire page was developed and emailed to the contractor and consultant firms. It was arranged in the order of priority scale from least significant (1) to most significant factor (4). The questionnaire was forwarded to four groups (a) Consulting officers, (b) Contractors working in construction industry, (c) Clients/Owner's representatives, (d) General public residing in or around those projects. The questionnaires were distributed to each of consultants and contractors and a few of them were filled by public, making a sum of one hundred and forty.

The results of the questionnaires were analyzed using SPSS Version 12 (Statistical Package for the Social Sciences) software. SPSS provides a broad range of capabilities for the entire analytical process. All data and information from the questionnaires were entered into SPSS program for statistical analysis in order to obtain mean and rank of variables. Descriptive analysis was conducted to describe and to interpret data. The frequency analysis was used as a tool for descriptive analysis, to examine the respondents' demographic factor, mean and rank. Based on frequency test, the rank of factors affecting success of construction projects and the recommendation for the problems solution were obtained, which led to the conclusion of the study.

5. Analysis and Findings

5.1 Ranking of success Factors

Ranking of mega project success factors, in the questionnaire to the respondents, were technically asked to rate the degree of significance of 26 selected success factors extracted from literature. Additionally, the respondents were also requested to add other success factors that they may identify as being necessary. However, they did not make significant additions. Table 1 shows the rankings of 26 success factors by all the respondents and Table 2 shows the breakdown of responses from different parties. The five factors namely, planning effort and scheduling, timely decision by Client, PM authority to take decision, Adequacy of planning and specification and adequacy of funding were very highly ranked by all the respondent groups. The means of all the five factors are greater than all the other factors. Thus, they are considered to be CSFs for construction industry of Pakistan. Although it was spontaneously identified that there exists general agreements towards the rankings among different respondents' groups, the correlation tests are deemed necessary to confirm whether or not the agreements are significant. Through linear equations it was tried to find out the relation among the top five factors. R2 values were used to find out percentage of these factors compared to each other.

5.2 Use of SPSS and Frequency analysis

SPSS software is used in this study for data analysis and interpretation. SPSS is a computer based program used for survey analysis and deployment of data mining, text analytics, statistical analysis and collaboration. Descriptive analysis was used to describe and interpret data. The descriptive analysis used in this study was frequency analysis to examine the respondents' demographic factor, mean, mode and rank data.

Based on frequency test, all factors were analyzed by using descriptive analysis techniques. The rank of factors affecting success of construction projects and the recommendation for the problems solution were obtained whereby the conclusion for the study could then be made.

5.3 Mean value

Usually we are interested in statistics calculations of our sample to get information about the population. The mean value along with confidence intervals is an informative measure of the "central tendency" of the variable. The larger the sample size, the more reliable it's mean is. The mean can be calculated as,

$$\text{Mean} = (\sum x_i) / n$$

Where "n" is sample size.

5.4 Rank

The rank of a number in a list is the position at which the value would be placed if the variables list was sorted. The RANK function of SPSS was used, which assigns ranks in either ascending order or descending order. Descending order is the default for the RANK function. In descending order, the higher score is assigned a lower numeric rank.

6. Results of Frequency Analysis

The questionnaire results from different respondents groups are shown in the Table 2, showing average response rate. Two third of the respondents were engaged in public sector projects, while one third were working on private projects. Top five factors having highest rank were chosen and analyzed through different graphs using linear equations.

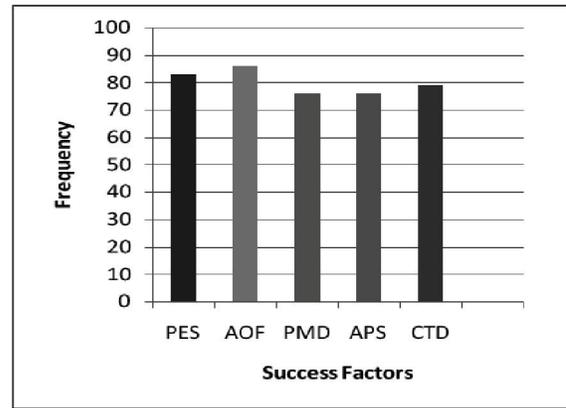


Fig 1: Comparison of top five success factors

Table1: Mean and ranks of selected factors

Sr. No	Factors	Symbols	Mean	Rank
1.	Planning effort and scheduling	PES	3.71	1
2.	Adequacy of funding	AOF	3.56	2
3.	Frequent progress meetings	FPM	3.06	14
4.	Decision making effectiveness	DME	3.27	7
5.	Communication and co-ordination system	CCS	3.05	15
6.	Co-ordination ability of PM	CAOMP	3.26	8
7.	PM commitment to meet time, cost and quality	PMCTCQ	3.01	18
8.	Leadership skills of PM	LSPM	3.13	12
9.	PM authority to take decision	PMD	3.50	3
10.	PM experience	PME	3.08	13
11.	Consultant's knowledge of available materials	CKM	3.00	19
12.	Design team contribution to economical design	DTED	3.05	15
13.	Adequacy of planning and specification	APS	3.48	4
14.	Design team experience	DTE	3.18	10
15.	Involvement of Client in the project	ICP	2.99	20
16.	Timely decision by Client	TDC	3.53	5
17.	Change of implementation schedule by Owner	COIS	2.76	23
18.	Initial cost effect on the project	ICE	3.04	17
19.	Contractor's desired profitability	CDP	2.85	22
20.	Technical capability of Contractor	TCC	3.16	11
21.	Shortage of skilled labor	SSL	2.90	21
22.	Availability of resources	AOR	3.19	9
23.	Fair bidding process	FBP	3.56	6
24.	Use of up-to-date machinery	UOUM	2.67	24
25.	Weather conditions	WC	2.62	25
26.	Political Influence	PI	2.28	26

Table 2: Questionnaire response

Description	Questionnaire distributed	Number of respondents	Response rate %
Consultants	45	26	57
Contractors	53	29	55
Client	34	18	53
General Public	16	10	62
Total	148	83	56

The graphs (Figure 2,3&4) shows the points of top five factors responsible for project success on x-axis and no. of respondents on y-axis. The factors having largest no. of respondents are ranked first. The figures depicts that AOF (Adequacy of funding)

is most important factor ranked by larger no. of respondents. PES (Planning effort and scheduling) has second highest peak and so on.

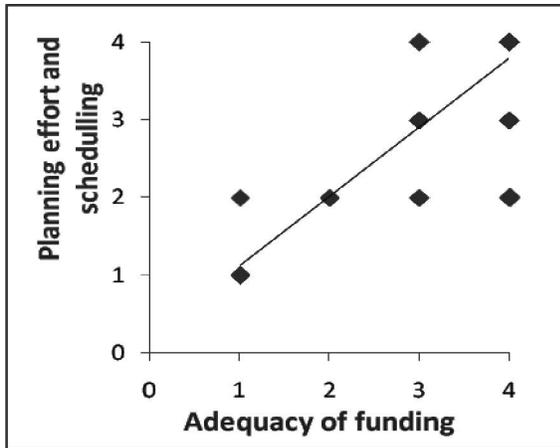


Fig 2: Comparison between AOF and PES

Adequacy of funding is one of most important factors for the success of project and continuous funding enables to complete the project within due time. If there is continuous funding throughout the project, the planning effort always goes to right direction enabling to achieve milestones within scheduled time of the project. The Figure 2 leads to the formation of linear relation ($y = 0.888x + 0.240$) between planning effort, and scheduling and adequacy of funding. Co-efficient of determination value ($R^2=0.7305$) shows that AOF and PES are 73% directly proportional to each other.

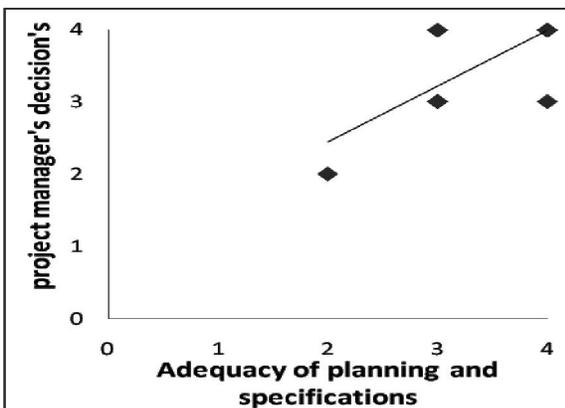


Fig 3: Comparison between APS and PMD

The figure 3 shows that project manager's decision will only be implemented in an efficient way when drawings prepared by the design team are practically implementable and all the specifications related to project are clearly described. This is mainly attributed to the fact that there is less need of correction of drawings during construction phase. A linear relation between these two factors is found by the equation as $y = 0.772x + 0.905$ and also $R^2 = 0.691$ shows that they are 69% proportional to each other.

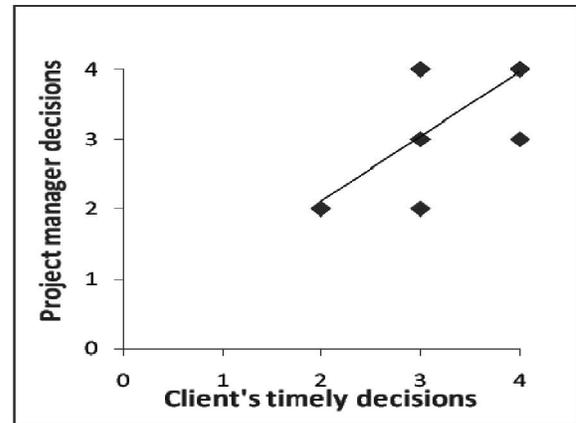


Fig 4: Comparison between CTD and PMD

The figure 4 shows that timely decisions made by client have a great impact on the project manager's decisions because the decisions made by project manager will be implemented according to client's requirements and intentions. Linear equation of this relation is $y = 0.933x + 0.245$ and $R^2 = 0.755$, which shows that both factors are very important. This figure also indicates that when these two factors i.e. client and project manager are competent then project will be more successful.

7. Discussion of Top Five Factors

7.1 Funding throughout the project

From survey of different contractor, consultants and clients, and subsequent analysis of the data obtained, it was found that continuous funding is the most important factor in project success and thus ranked as 1st in CSFs as shown in Table 1. Adequate funding is important in the project success because it effectively utilizes and makes all the project units busy for completing their tasks. It is also clear from Figure 3 that if continuous funding is available, the planning manager can easily plan and schedule activities of project in the specific ordered. This enables a fast processing of the activities of the project till the end. Pakistan is a developing country; the root cause of inadequacy in continuous availability of funding is related to corruption. Main problems which occur due to inadequacy in funding are wages, unavailability of material and construction progress. The previous discussion leads to the conclusion that continuous funding could be considered as one the most important success factors, which makes the project alive and complete on time. Lots of examples from the past show that projects were never completed on time due to funding difficulties e.g. the completion date of the zero point interchange, Islamabad project was August 2010, but due to lack of funding and addition of two new loops in design, it had to be delayed up to June 2011.

7.2 Planning effort and scheduling

Planning and scheduling is 2nd most important success factor as suggested by data from contractors and consultants. From literature, it was found that a project has a good chance to be completed successfully when the project plans and schedules are well organized and are updated regularly after each milestone. Moreover, in order to guarantee project success, the project planning should be kept uncomplicated, with the right level of details that can encourage a project to be reviewed and implemented easily [19]. Different consultants suggested various advance techniques to undertake scheduling functions in order to achieve success in project. In Pakistan, planning efforts are not given much importance at the project initiation stage that causes hurdles to the project activities at the later stages, resulting in delays of planned schedule.

7.3 Influence of Project managers decision

From the result of data analysis, out of top 26 success factors for a project, the factor "decision made by the project manager" also has a great influence on the project success. It was also ranked as 4th in Table 1. Figure 3 and 4 depicts that if there is a proper communication between client and project manager, and plans and specifications are clearly defined and followed, then project success entirely depends on PM decision. This further results in saving time, money and achieve a good quality. There are lots of ups and downs in the running projects and sometimes project manager has to take solid on spot decisions that can steer the project to success. Hence project can be executed successfully if Project manager's decisions are well-built and well planned. This is possible only if project manager is confident, experienced and is effective as a communicator, and thus able to convey technical solutions considering time, cost, and human factors.

7.4 Adequacy of planning and specification of design team

From survey and analysis it was found that to a great extent time and cost depends upon the feasibility of specifications and drawings prepared by the design team. It is evident from Figure 3 that if drawings are well defined and understandable, then project manager finds no trouble in giving quick decision without further delay in working of project activities. It was also found that for better plan and specifications, design team should have a good past experience. They should be well aware of right and suitable machinery practically suitable for the job and should have good materials knowledge and detail of drawings. In short, for the success of project, drawings and plan should be prepared in such a way that activities of project should be continued without producing hindrance in the subsequent activities.

There are lots of examples which show that projects were not completed on time due to errors in specifications e.g. Darya Khan-D.I. Khan Bridge scheme was revised several times due the lack of appropriate data provided by the design team.

7.5 Timely decisions by Owner

Figure 4 indicates that for the continuous progress of a project; project manager's decision making power is directly related to client's ability to make a decision for particular task. Project manager has to wait for the client's decisions before the implementation of work. If client makes quick decision for his requirements, project manager can plan a better working team for that task. Also late decisions by client provide lesser time which results in a less competent working team and hence quality of work is degraded. Main concerns for the owner are funding, changing in the project schedule and design, quality of work completed and fulfillment of market demand. One timely decision of owner can make a huge impact on project success. Concurrently, timely decisions are effective only when the owner has good communication with contractor and consultant.

7.6 Other factors

From the research conducted (Table 1), it was found that Owner's technical capability, design team, project managers past experience, project managers commitment to meet cost, time and quality and design team contribution to economical and feasible design are the major success factors. Hence a project will be successful only when client, consultant and contractor contribute to the project and utilize all of their resources necessary for the project success.

8. Conclusions

In this research 26 success factors were studied and rated against their importance from different contractors, consultants and clients according to their opinion. After analyzing survey data, a list of five factors named as critical success factors was obtained. These top five critical success factors are;

1. Adequate funding throughout the project
2. Planning effort and scheduling
3. Influence of Project managers decision
4. Adequacy of planning and specification of design team and
5. Timely decisions by Owner. Other success factors include

Design team experience, Weather conditions, Political Influence, Co-ordination ability of PM, Shortage of skilled labor etc. but have relatively a lesser impact on project success.

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