Impacts of Engineering Work Quality on Project Success

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Abstract

The project success has always one of the most significant concerns of project managers. The main purpose of this study is determination of factors’ influence, on project success criteria in Iranian oil and gas industry. In the previous research that was conducted by the authors (Amini et al., 2012) for Iran’s oil and gas industry, twenty six factors which had influence on quality of engineering work, were identified. In the present study we try to find out which of those factors will contribute to project success. Questionnaire and statistical analysis has been conducted in this research to realize the most affecting factors. The survey results of 123 professionals who involved in different project based organizations (Client, Engineering, and Contractor); indicate that change orders is among top three influential factors in project success.

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1. Introduction

Over the years researches and practical experience have proven that engineering and detailed design is the key phase during the project life cycle (Carr, 2000). It is believed that detailed design and engineering process influence the overall project success. Engineering can be done in a way that the whole project be worthwhile and on time or to be late and bear cost overrun. The review of past papers show that there is no study conducted on engineering quality, mainly focused on Iranian oil and gas projects and its effects on project success. So, this study utilizes some points in interviews with projects specialists and previous

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papers and questionnaire to provide its own hypothesis. The main Objective of this paper is to recognize the engineering quality factors that have impact on oil and gas project success. Considering these factors, will introduce the useful possibilities and strategies to be employed by project parties in order to improve interaction between them as well as ensuring satisfaction and project success.

2. Literature review

In our previous study through wide literature review and face to face interviews with professionals in Iranian oil and gas industry, twenty six factors which had influence on engineering performance quality were defined as: Engineer’s relevant technical knowledge, clear WBS, new plan based on lesson learned, giving empowerment to employees, proper procedure, up to date standards, proper documentation system, high level of work force turnover, project manager leadership style, coordination, employees’ clear roles, employees' performance evaluating system, work force training, employees’ dissatisfaction, client’s estimation of total project duration, change orders, proper work schedule for document delivery, timely payment, functional experience of client team members, client interference in design procedure, commitment and responsibility of client team members, clear goals and scope, top management support, clients' regular communication and participation. In this research we inspect past studies to find out the correlation between these factors and project success criteria.

2.1. Project Success Criteria

In a literature review on project success various authors have identified a number of factors and criteria, either from experience or research. However, it does not seem to be any agreement over the meaning of success in project management study (Shenhar & Wideman, 2010).

One way to see if the project is successful is to determine the degree to which the project goals have been accomplished. Project success is usually defined as meeting time, cost and quality objectives (golden triangle) however, if ones consider all the stakeholders in a project, it is obvious that there are more objectives than just time, cost and quality such as, functionality and contractor, client satisfaction (Baker et al., 1988), Morris and Baker, have the same ideas but, they considered commercial success and termination efficiency as other criteria for success assessment (Baker et al., 1988; Morris, 1988). Atkinson and Baccarini have identified following items as determination for project success: stakeholder satisfaction, product success, organization benefit, and team development (Atkinson, 1999; Baccarini, 1999). Xiaojin and Jing view project success by evaluation of the project’s cost, time, and quality performance, and the relationships among the key stakeholders (Xiaojin & Jing, 2006).

According to our findings many projects especially in oil and gas industry cost a lot and were not finished on schedule however, considered being successful. The reason is the volatile price of oil that can make profit if increases and vice versa. So, we need to have a definition of successful project for oil and gas projects in our study. For our purpose success is viewed “in terms of delivery on time, completion to budget, satisfaction of client's overall expectations and being to the technical specification.” Because these four measurements had been shown to be valid and reliable in an alternative research setting, they were used in the present study as an assessment for project success.

3. Research Methodology

Besides our literature review, twenty three face to face interviews with experienced project managers and senior engineering administrator in oil and gas industry from different organizations were conducted to define four criteria of assessing a project success.
3.1. Validity of Questioner

One of the significant concerns of researchers is Validity of study. Factors that are irrelevant to the concerns of the research can invalidate the findings (Seliger & Shohamy, 1989). Validity indicates whether tools of measurement are precise and if they are really measuring what they are supposed to measure. In other words, does the research tool help to accomplish the objects of the study? Researchers generally determine validity by asking a series of questions (Joppe, 2000).

Interview with number of expert in this area has been used to validate the research’s questioner. In this area, interview by four professional experts has been conducted to validate questioner in order to reach the study’s purpose.

3.2. Data Collection

Through the method described in 2.3 Research Methodology, four project success criteria were identified. Moreover, twenty six potential factors affecting engineering quality performance were considered. So, a questionnaire was devised. The questionnaire consisted of two parts: in the first part respondents are asked to fill their personal characteristics. The demographic characteristics of the respondent are reported in Table 1 and Figure 1, 2. In the second part participants were asked to answer which of the quality factors contribute to successful implementation of the project in terms of delivery on time, completion to budget, satisfaction of client's, and meet technical requirements. 201 Iranian professionals in different organizations such as client, contractor, and engineering that are spread out through the whole oil and gas field in southern of Iran were asked to participate in the study. Of these, 178 returned questionnaires, of them only 123 questionnaires were complete and usable. The independent test for demographic characteristics of respondents for all 26 question in the questionnaire in terms of project success criteria’s (Time, Cost, Technical specification, satisfy client needs) was tested by Chi Square test. In sex and age groups the independency of variables was approved by significant factor which is greater than 0.05. The independency of responses in some of the questions for years of experiences and organizations (as far as the respondents are involved) was not accomplished. By using statistical analyses the groups of years of experiences and organization are stratified. Then the independent test for all groups is confirmed by Chi Square test. Finally, statistical analysis has been conducted to determine the most influential factors.

Table 1. Demographic characteristics of the respondents

| Item             | Frequency | Percentage (%) |
|------------------|-----------|----------------|
| Gender           |           |                |
| Male             | 84        | 68.2           |
| Female           | 39        | 31.7           |
| Age (In years)   |           |                |
| 20-30            | 54        | 43.9           |
| 31-40            | 49        | 39.8           |
| 41-50            | 12        | 9.8            |
| >51              | 8         | 6.5            |
| Organization they work | |                |
| Client           | 37        | 30.1           |
| Engineering      | 76        | 61.8           |
| Contractor       | 10        | 8.1            |
According correlation test, Pearson Analysis, it is concluded that the research is independent from Gender, Age, Experience and Education of interviewers, and also from organization type of respondents.

3.3. Statistical Analysis

Respondents were asked to identify which of the 26 factors discussed in the literature review have influence on project success criteria. Data from the survey was imported from Microsoft Excel to SPSS statistical software for analysis. The ranking was done according to the frequency of responses.

3.4. Reliability of Data Gathering

The quality of research is the main concept of reliability (Stenbacka, 2001). Reliability process is done to ensure that respondents allocate the same degree of concentration to answer all questions. The method used in this research is the Cronbach’s Alpha test. Table 2 shows the results for Cronbach’s Alpha coefficients related to each category of questions. Cronbach’s Alpha value which is more than 0.7 is considered reliable in this study.
Table 2. Result of Cronbach’s Alpha Coefficients

| Category of Question                          | Cronbach’s Alpha | Number of Items (Questions) |
|----------------------------------------------|------------------|----------------------------|
| Meet Project Time                            | .761             | 26                         |
| Meet project Cost                            | .878             | 26                         |
| Meet Project Technical Specification         | .877             | 26                         |
| Meet Client Satisfaction                     | .889             | 26                         |
| All Categories Together                       | .903             | 104                        |

4. Findings and Discussion

The 26 questions which had been (I suggest you name some of these questions!!) identified in the authors’ previous paper (Amini et al., 2012) are used to recognize if they have any impact on project success criteria (time, cost, technical specification, and client satisfaction) or not. In case of item’s impact on the project success criteria, respondent was asked to mark the blank box for “yes” answers, and for ineffective items, they should leave the blanks, empty.

4.1. Impact of factors on meeting project time schedule

Figure 3 shows the 10 most affecting factors on time which are: regular client communication and involvement during the project and timely document approval, Engineers experience, change order, client regular interfering, and good team work and coordination between engineer’s departments.

Fig. 3. Ranking order of identified affecting factors on meeting project time schedule
4.2. Impact of factors on project cost

Figure 4 presents the factors ranked in respect to their impacts on total cost of the project. It indicates change order, engineers experience, employees’ dissatisfaction, clear work definition and WBS, and client regular interfering are most important factors which change the project cost.

![Fig. 4. Ranking order of identified affecting factors on meeting project cost](image)

4.3. Impact of factors on meeting project technical specification

In Figure 5 factors have impact on meeting project technical requirement are ranked. It shows that the first five affecting factors are engineers experience, change order, client experience, clear work definition and WBS, and client’s clear goal and scope respectively.
4.4. Impact of factors on client satisfaction

Figure 6 demonstrates that after client regular participation, project manager leadership style and competence, client operational work experience, engineer technical knowledge and relevant experience, and change order are most effective factors to satisfy the client expectations.
5. Conclusion and recommendation

This paper points to the absence of empirical research about recognizing variables which have impact on project success. Regular client communication and involvement during the project and timely document approval are the most important factors that respondent chose them as the influential factors on meeting project’s time. On the other hand, It has indicated that change order, engineers experience, employees’ dissatisfaction are the most noteworthy items, which can influence meeting project cost. To meet project technical requirements, project manager should care about engineers experience, change order, client experience, clear work definition and WBS. In this case, client regular participation, project manager leadership style and competence, client operational work experience, and engineer technical knowledge are the factors that for client satisfaction should be considered.

Results of this study demonstrate the importance of engineer’s and clients’ functional and relevant experience on the quality level of engineer’s output as well as on meeting the final project technical specifications. In addition, next to change order, the major contributor for implementing the project on budget, is the technical experience of the engineer. Accordingly results of this paper shows that change order lays in the top three contributors for meeting the project time, cost and technical specifications. It is recommended by some experts (who are they!!!!???) to regularly do the following to manage change orders:

- Report all changes as soon as possible
- Identify consequences of change to project schedule and budget
- Review approving changes in a technical points of view
- Specify person who is authorized to request and approve change orders
- Change order handling procedures must be agreed upon by client
- Document change order
- Prepare change order handling procedure that client agrees on
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