

# Effects of ISO 9001 Standard on Critical Factors of Project Management in Construction Industry

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# Effects of ISO 9001 Standard on Critical Factors of Project Management in Construction Industry

Behnam Neyestani, & Joseph Berlin P. Juanzon

***Abstract*—This paper provides a significant contribution to the knowledge by identifying the impact of ISO 9001 implementation on the most vital factors of project management within large scale (AAA) construction firms in Metro Manila, Philippines. Thus, the study was accomplished an extensive literature review for identifying the main factors of project management, ISO 9001 standard, and other concepts, for developing an appropriate survey instrument. Then the questionnaires were distributed randomly among selected ISO 9001:2008-certified projects of large-scale (AAA) construction firms. For data analysis, the study adopted the descriptive and inferential statistics analysis, in order to find the results and conclusions. Lastly, the findings indicated that ISO 9001 certification can statistically affect the two main factors of project management, except time length of projects in Metro Manila, Philippines.**

***Keywords*—Cost of Project, Critical Factors, ISO 9001, and Project Management.**

## I. Introduction

The globalization and competitive pressure are the most important reasons that have forced the construction firms to change and promote their management systems for achieving their objectives successfully. Some studies investigated and found the main objectives in construction projects are tightly related to the most vital elements of projects management, which are very essential in success, or failure of construction project management. Accordingly, the management of construction firms should consider and emphasize on theses factors that called critical success factors (CSFs) of project management. [7] asserted the most critical factors of project management can be defined as having achieved the project objectives, such as the accomplishment of project on time, within cost, and accepted quality.

Dramatically, over the past three decades, numerous government and business organizations reported that construction industry in many parts of the world suffers from several problems, especially for low quality [1]. "Great amount of time, money and resources, both human and material, are wasted each year in the construction industry for inefficiency, or lack of quality management procedure" [11, p. 1115]. Quality is the most significant factor in the success, or failure of construction projects, which can affect cost and time length of projects' completion [1]. There are several methodologies, and tools that the construction firms can adopt to maintain quality at project level for reducing the cost and time length of projects. The most important technique in this field is ISO 9001 standard. The first edition of ISO 9001 as a quality assurance standard was officially introduced in 1987 by the International Organization for Standardization (ISO), in order to improve quality and customers' satisfaction within manufacturing sectors first. Later ISO 9001 standard was accepted by the construction community as the quality policy all over the world in the end of 1990s [9]. From the last two decade ISO 9001 standard has been widely accepted in construction industry at the international level. "Many benefits are gathered throughout the globe by its effective implementation" [8, P. 203], especially since 2000, when it became as a quality management standard.

Interestingly, numerous case studies revealed that ISO 9001 standard can improve project quality performance, avoid costly errors and delay in construction projects [3]. While some argued that the level of the effects of ISO 9001 on the most important elements of construction projects management are still ambiguous [1]. Also, literature survey indicated a few studies conducted concerning this topic by scholars in manufacturing and service sectors only, whereas no study was sufficiently found related to this problem in construction area. Consequently, it is necessary to determine the importance of ISO 9001 standard on the main elements of project management in construction industry. So, the general purpose of this research was to evaluate the impact of ISO 9001 standard on critical elements of construction project management, such as construction performance quality, time length of project, and cost of project within ISO 9001:2008 certified projects of large-scale (AAA) construction firms in Metro Manila, Philippines.

## II. Literature Review and Hypotheses Development

As in any other business, the main aim of the construction projects is to achieve their goals successfully [12]. Thus, it is vital to identify the critical factors cause success, or failure in the projects. Several studies found and suggested different elements as critical factors of project management [13]. However, the authors and experts have not determined similar factors as project management vital elements, but all of them are agreed that criteria of iron triangle are related to the main objectives in the construction projects [4],[15]. For a successful project

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management, critical issues are to minimize the cost and time of the project, while the project quality should be maximized [13]. Accordingly, these three factors are "predominant" in the management of usual construction projects [12]. Thus, Iron triangle traditionally has a key role to evaluate the construction project management (meeting deadlines, budget limit, and the level of expected quality) in construction industry [4],[15].

Without doubt, ISO 9001 provides a proper "environment" that helps construction projects in achieving these critical elements of project management [10]. This quality management standard can maintain and improve quality performance continuously at construction project level [3]. This standard was first introduced by technical committee of ISO/ TC-176 of ISO (International Organization for Standardization) in 1987 [8]. ISO 9001 standard is a set of the requirements for a quality management system (QMS). The requirements of ISO 9001:2008 has eight clauses, the first three clauses do not provide background information regarding QMS, and clauses 4 to 8 constitute the main body of ISO 9001 standard to comply into the organization. However, the main aims of the process approach in QMS are to increase an organization's effectiveness and efficiency, in order to satisfy customers by "identifying" and "eliminating" the root causes of the production problems [6].

From literature, numerous case studies reported that ISO 9001 is an effective quality management tool in improving construction quality performance, avoiding costly errors and delay, and satisfying customers into construction projects [3]. For example, the empirical study of [8] indicated that the "errors from the start", "delay", and "quality cost" within ISO 9001-certified construction projects are significantly less than the Pakistani construction projects without ISO 9001 certificates in contrast, because ISO 9001-certified construction projects emphasize and practice more on "customer focus", "process management" and "continuous improvement" [14]. Similarly, the results of [1] from Malaysian construction companies showed that "functionality" (conformance to specifications: construction quality) was scored by the respondents as most impact of ISO 9001 certification on construction projects. Also, [10] discovered that ISO 9001 standard can significantly affect the critical factors of project management (cost, quality, time), which can promote customer's satisfaction into Indian construction projects. Therefore, based on the above discussions, the hypotheses have been formulated and presented, in order to determine the impact of ISO standard on critical factors of construction projects management, as follows:

H1: ISO 9001 standard improves quality performance in construction projects.
H2: ISO 9001 standard has a significant effectiveness in completion of the construction projects on time.
H3: ISO 9001 can minimize the expenses of projects.

## III. Research Methodology

### A. Research Design

For this research, a quantitative method based on survey was employed. To collect data, a set of the questions relate to the study was designed and distributed randomly to selected ISO 9001:2008-certified construction projects in Metro Manila, Philippines. Finally, the quantitative statistics analysis carried out to get results of the current study based on data obtained.

### B. Sampling method and Sample Size

The simple random sampling technique adopted in this study. Thus, the questionnaires were randomly distributed to the selected respondents. Furthermore, the population of this study is from managers working within ISO 9001:2008-certified projects of large-scale (AAA) construction firms in Metro Manila, Philippines. These AAA construction firms selected from the list of Philippine Contractors Accreditation Board (PCAB). However, a total of eighty questionnaires that sent to the construction projects, just 84% (67) of them were returned and used in the statistical analysis of this study.

### C. Research Instrument

A survey questionnaire was designed based on previous studies, in order to collect data. The questionnaire can let the researcher collect data faster and cheaper than other methods. In this study, the survey questionnaire was included 39 items, which divided into two parts. Part I is related to the requirements, or clauses of ISO 9001:2008 (24 items). Part II has three sections, and each section is concerned the impact of ISO 9001:2008 standard on one of the most important project management, such as quality, time, and cost. As suggested by [2], closed questions with a "five-point Likert-style scale" (e.g. a scale from 1 to 5, strongly disagreement= 1, to Strongly agreement= 5) employed to indicate the respondent's opinion concerning the objectives of this study. Meanwhile, the reliability and validity of items of the research instrument tested carefully before descriptive and inferential analysis.

### D. Data Analysis

Data from the survey questionnaires analyzed using Statistical Package for Social Sciences (SPSS) 17 in this study. This statistical software (SPSS) has been employed for measuring the reliability of the instrument first. Then the descriptive and inferential statistics employed to examine the impact of ISO 9001:2008 on most critical factors of construction project management. In addition, the mean score, standard deviation, skewness, and kurtosis were used for descriptive statistics. For hypotheses testing, the simple regression analysis was used to test hypotheses at the significance level of 0.05 and 1-tailed.

## IV. Results

### A. Reliability and validity of the research instrument

Before data analysis, the validity and reliability of measurement questions tested by statistical and judgmental methods. As stated and explained by [2],[5], the statistical techniques (eg. exploratory factor and confirmatory factor analysis) for validity of scale items could not be applicable in this study , because the sample size is very small (67 less than 100). Therefore, the study was only carried out content validity for evaluating the validity of the research questionnaire. The content validity is not a statistical procedure. So, a pilot study (pre-test) performed, and the questionnaires sent to four quality management experts, who reviewed and evaluated qualitatively/subjectively scale items, in order to determine that each measurement item is related to the content domain of the study, clear, and answerable for the respondents. Based on the recommendations of the experts, the mistaken questions were revised and corrected.

Likewise, a reliability analysis was accomplished on the items of the questionnaire after data collection. Reliability is related to "internal consistency" involves the correlation of the responses to each item with other items in the instrument. For this study, Cronbach's alpha was employed as most frequently used reliability test method by researchers . In this technique, the scale questions with reliability coefficient of 0.70 or more are reliable [2]. As presented in Table I, the alpha coefficient of ISO 9001 standard is 0.914, which showed very high reliability of scales, while three items of ISO 9001 were unreliable, and dropped before data analysis. Regarding the items of dependent variables, reliability analysis indicated that coefficient of Cronbach's alpha for three main critical factors of construction project management, such as, quality, time, and cost were respectively 0.796, 0.848, 0.861. Meanwhile, 1 question related the cost of construction project identified and removed as an unreliable item.

TABLE I: Reliability Analysis

| Variable | No. of items before reliability | No. of items after reliability | Cronbach's alpha |
|---|---|---|---|
| ISO 9001 | 24 | 21 | 0.914 |
| Quality | 5 | 5 | 0.796 |
| Time | 5 | 5 | 0.848 |
| Cost | 5 | 4 | 0.861 |

### B. Descriptive statistics analysis

As demonstrated in Table II, the findings of the descriptive statistics showed that the most important impact of ISO 9001:2008 on construction projects management is quality performance with the highest mean score that is 3.47, followed by cost with the mean scores of 3.35, while time had the lowest mean (3.21) in contrast. The standard deviations (SD) are between 0.5304 and 0.8835 that proved the homogeneous data and less spread out or dispersed. Moreover, the normality of the variables measured using skewness and kurtosis levels to determine normality, the acceptable values of skewness and kurtosis is between -2.00 and +2.00 [5]. In this study, the skewness and kurtosis levels were in satisfactory range (from -0.667 to 0.927). Consequently, there are no outliers, and extreme values that might jeopardize and violate the validity of the analysis, and data was suitably distributed.

TABLE II: Summary of the Descriptive Statistics of Variables

| Criterion | M | SD | Skewness | Kurtosis |
|---|---|---|---|---|
| Quality | 3.47 | 0.5304 | 0.293 | -0.496 |
| Cost | 3.35 | 0.6379 | -0.358 | -0.494 |
| Time | 3.21 | 0.8835 | 0.927 | -0.667 |

### C. Inferential statistics analysis

As recommended by [2], simple linear regression was adopted as most appropriate statistical technique to test hypothesized correlations between/among one independent variable (ISO 9001) and dependent variable/s (critical factors of construction project management: quality, time, and cost). Thus, this study developed three regression equations (Models), which examined the effects of ISO 9001 standard in predicting quality, time, and cost of the projects of large-scale (AAA) construction companies, at 5% significance level. These regression equations are as follows:

$$\text{Model I} = \beta0+\beta1*X+\varepsilon \quad (1)$$

$$\text{Model II} = \beta0+\beta2*X+\varepsilon \quad (2)$$

$$\text{Model III} = \beta0+\beta3*X+\varepsilon \quad (3)$$

*Where,*

Model I, Model II, and Model III = Impact of ISO 9001 on quality, time, and cost respectively.

$\beta0$ = Constant of proportionality;

X = ISO 9001 standard;

$\varepsilon$ = Error term

$\beta1$, $\beta2$, and $\beta3$ = Unstandardized regression coefficients of predictors viz, quality, time, and cost respectively.

As presented in Table III and IV, linear regression technique was accomplished in SPSS to investigate the causality between ISO 9001 and independent variables (project management elements). In the regression model I, Adjusted R square is 0.318 that indicates ISO 9001 standard accounted for 31.8% percent of the variance in the construction quality. Likewise, $\beta$ value ($\beta1$=0.573) and T-test result were significant ($p<0.05$). Thus, H1 was strongly supported.

TABLE III: Summary of the Models

| Model | R | R Square | Adjusted $R^2$ | Std. Error of the Estimate |
|---|---|---|---|---|
| I | 0.573[a] | 0.329 | 0.318 | 0.43795 |
| II | 0.205[b] | 0.042 | 0.027 | 0.69400 |
| III | 0.306[c] | 0.094 | 0.080 | 0.61187 |

Notes: Predictor: (Constant), ISO 9001; Dependent Variable: Quality[a], Time[b], Cost[c], $p<0.05$.

Also, regression analysis revealed ISO 9001 standard has not statistically affected time of construction project completion. The coefficient of adjusted R square from Table III, indicating ISO 9001 explained 2.7% of the variance in time length of projects. Likewise, standardized value $\beta$ ($\beta3$=0.205) and T (1.686) values proved that there is no

significant correlation between ISO 9001 and time at 5% level of significance ($p=0.097>0.05$). Therefore, H2 is rejected from the regression analysis. Lastly, ISO 9001 indicated to have a significant impact on the cost of the construction projects, this standard explained 8% of the variance in cost. The significant values of T (2.594) and standardized coefficient β (β3=0.306) were significant ($p<0.05$). It confirms H3.

TABLE IV: REGRESSION ANALYSIS

| Model | Unstandardized Coefficients | | Standardized Coefficients | T-test | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constant) | 0.657 | 0.414 | 0.573 | 1.590 | 0.117 |
| ISO 9001[a] | 0.631 | 0.112 | | 5.639 | 0.000 |
| (Constant) | 2.173 | 0.655 | 0.205 | 3.316 | 0.001 |
| ISO 9001[b] | 0.299 | 0.177 | | 1.686 | 0.097 |
| (Constant) | 2.171 | 0.578 | 0.306 | 3.756 | 0.000 |
| ISO 9001[c] | 0.405 | 0.156 | | 2.594 | 0.012 |

Notes: Predictor: (Constant), ISO 9001; Dependent Variable: Quality[a], Time[b], Cost[c], $p<0.05$.

Furthermore, the associations of ISO 9001 with critical factors of project management, such as quality, time and cost (in the horizontal axis) can be depicted by scatter-plot with the regression line, as demonstrated in Figure 1 to 3 respectively.

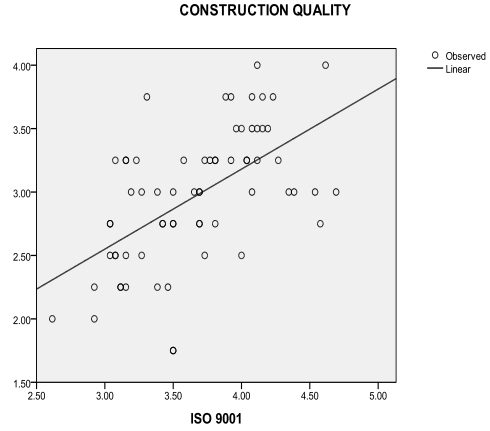


Fig. 1. Scatter-plot with the regression line between ISO 9001 and quality

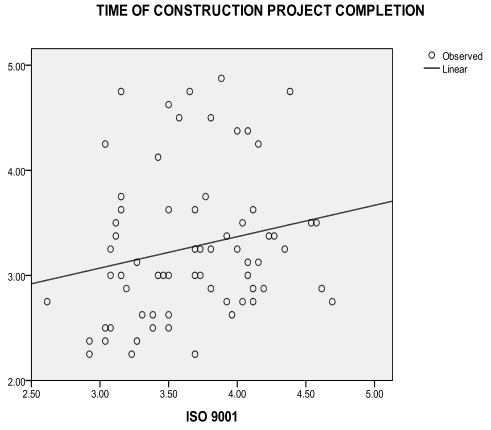


Fig. 2. Scatter-plot with the regression line between ISO 9001 and time

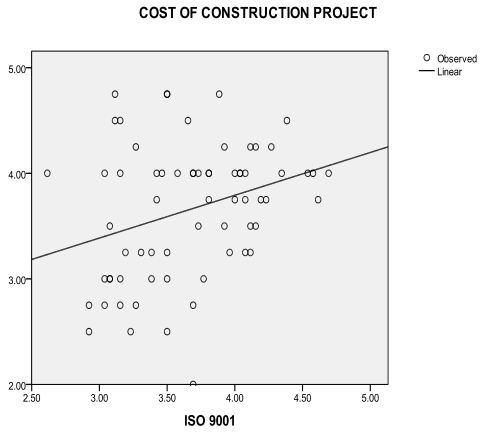


Fig. 3. Scatter-plot with the regression line between ISO 9001 and cost

## V. DISCUSSIONS AND CONCUSSIONS

This study employed both descriptive and inferential analysis, in order to investigate the impact of ISO 9001 standard on critical factors of construction project management (quality, time, cost) within large-scale (AAA) construction firms in Metro Manila, Philippines. The descriptive statistics analysis based on the responses of 67 managers revealed that the impact of ISO 9001 on quality had the highest overall mean score (3.47) in comparison with other critical factors of project management, construction cost (M=3.35) and time length of project (M=3.21) were respectively second and third mean scores, these findings were also consistent with the reported study by [1], who found cost and time occupying lowest ranking by the respondents in ISO 9001-certified construction contractors in Malaysia. In inferential analysis, the findings indicated the significant relationship of the ISO 9001 with construction quality and the cost at a 5% level of significance, whereas there was no significant correlation between ISO 9001 standard and time length of projects. This finding consists with the study of [1], who reported that the "complexity" and uncertainty of projects (weather, plan changes, etc.) can cause that ISO 9001 cannot assist the firms in completing the construction projects on time.

The study concluded that the construction projects can achieve the benefits of the adopting ISO 9001 standard for improving construction quality performance, and reducing the expenses of the projects only, while this standard is not able to assist construction firms to deliver the projects on time because of the nature of construction industry. Some project management scheduling, such as, PERT and CPM may help construction projects to accomplish their construction works with minimum of time. Also, this study is recommended to the construction companies in emphasizing and focusing more on quality aspects of ISO 9001 certification in project management, instead of achieving just an ISO 9001 certification as a marketing tool. Furthermore, it is essential to establish a suitable total quality management model at enterprise level, in order to

support and assure the success of implementing ISO 9001 standard in construction projects. So, it may cause that ISO 9001 affects more on construction project management and its critical elements.

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