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Strategic Management of Project Cost Control to Improve Green Project Management

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Abstract

Green management is a model used to make the best decision regarding a project implementation so that the least environmental damages are resulted. All the management processes are affected by the green notion. It is needed to mention that the green management does not only mean to reduce the impact of activities on environment but means to consider the environment while making decisions. The present paper focuses on strategic management of project cost control to improve project management which has been conducted as a case study in Iran. To achieve the research objectives, the managers' and project experts' opinions have been collected via the field method. Therefore, in order to follow the research purposes, the managers' and project experts' opinions are used. Also, their opinions are studied in order to determine the research variables. In this research, the statistical population consists of contractors, engineers, and managers of the construction managers who use the green project management in their project. As the findings reveal, applying strategic management affects the index of principles of green project cost control.

Keywords: Project, strategic management, cost control, green project management.

Introduction

Development is derived from human activities and human activities affect the environment aligned with development. 4% - 8% of GDP (Gross Domestic Product) in countries is allocated to the cost of environment destruction[1]. Development especially in industry domain has many environmental results[2]. On the other hand, it is not possible to stop the development since it is needed for human survival. In fact, according to the present and future needs, it is necessary to try to be more developed[3]. The development dynamic process can be continued in any country but environmental protective programs must be considered in development programs[4]. The researchers of many countries have studied the impact of development on the environment. They applied scientific methods and tools[5]. The results of their studies have been used effectively for controlling the negative impacts of development on the environment[6]. Some of the scientific methods used to control the development effects on the environment are as follows[7]:

Assessing the environmental effects of developmental plans and projects using the project management and control framework, Embedding the principles of environmental protection in organizations strategic planning and assessing the strategies environmentally, The EFQM excellence model including the cleaner production EFQM excellence model and green management model, Therefore, after identifying the position of each organization, it is needed to plan so that the organizations always maintain their growth since an incorrect planning causes the organization to become out of date and finally to be lost[8].

The research hypotheses: Each research is initiated by a problem. The problem arouses some questions in the researcher's mind and the researcher provides the hypotheses according to the questions[9]. Therefore, the researcher main task is to answer the research questions, conclude based on the collected data and finally, reject or confirm the hypotheses according to the findings. It is obvious that the primary collected information is raw data. In order to convert the raw data in to usable information, they must be analyzed. The analyzed data are applied to decision making process. The research hypotheses are as follows:

Main hypothesis: The green project cost controlling is affected by the strategic management.

Secondary hypotheses: Strategic management affects the index of the green project implementation. Strategic management affects the index of the green project design philosophy. Strategic management affects the index of the green project cost control principles.

Scientific studies regarding the project management is not an old issue and the first serious research dates back to less than half a century, it has significantly developed during this short time. Some researches which have done regarding the project management are as follows:

Cheung et al. developed a monitoring and controlling system regarding the performance of construction projects based on web and considering the factors related to manpower, cost,

quality, time, security, environment, and beneficiaries' satisfaction. Their system included developing performance criteria and providing practical approaches to measure above mentioned factors[10]. Lauras et al. also developed an approach to facilitate the control and monitoring of project performance. Their approach considers the factors and indices related to time, cost, domain, quality, and risk to control and monitor the performance. Doloi studied "understanding stakeholders' perspective of cost estimation in project management". Despite the previous methods (which concentrated on the factors which were directly and indirectly related to the project environment), Doloi's goal was to develop a conceptual model to define the most important issues in a project life cycle[11]. In the study, a structural interview with some selected organizations was conducted and the data were collected according to the interviews. The research used a method based on software system to convert the images into conceptual models and extract a scientific framework. The results showed that the political and legal factors significantly affect the business development at the beginning of the project. Legal compliance and environmental factors are the most effective factors on regarding project cost[12].

Pajares and Lopez Paredes investigated "an extension of the EVM analysis for project monitoring: the cost control index and schedule control index". Their study provided two new criteria regarding the project control. In fact, their criteria used the features EVM and PRM. Their method compares time variances and EVM cost with the deviations of project in predicted risk conditions[13]. These two indices let the managers analyze if the project error is in expected mutable boundaries or it is a systematic and structural change which shifts the project life cycle. The cost and time controlling indices were presented as new indices in their research[14].

Locatelli et al. examined "project controlling in mega events: the expo 2015 case". They defined that international exhibitions play a great role in development of host cities. However, such projects organizers have to face many problems regarding the cost increases and delays. Time is the most important issue in such projects. Therefore, time controlling is a determining factor in performance estimation of such projects. Although the great projects are usually planned very well, the execution of their instructions must be so that they can evoke a great event. Their research studied the strategic elements without considering the executive methods to control the implementation stage. The research included a case study: the expo 2015 in Milan. In the case study, they provide a supervision to prevent unexpected problems and control the project according to its structure[15].

Methodology

In this research, the statistical population consists of contractors, engineers, and managers of the construction managers who use the green project management in their project. To collect the data regarding the process and progress of the project, the questionnaires have been distributed to them randomly. The questionnaire questions are related to factors of project cost control as well as factors of green project management provided with regard to the green project senior managers' opinion. The validity and reliability of questionnaires have been evaluated and confirmed by experts[16]. Descriptive statistical methods are used to analyze the collected data. In fact, descriptive statistics are used to quantify the collected data and apply it for the statistical population. The purpose of descriptive statistics is to calculate population parameters with the help of census of all the population elements. After collecting the data, the obtained data has been scored in the form of numerical data and entered the Excel software. Then, the data was analyzed by SPSS software. Also, all the relevant figures and tables were depicted by SPSS software[17].

Results and Discussion

The inferential statistics: Variables test of normality via Kolmogorov- Smirnov test: In order to study the normality of variables distribution, Kolmogorov- Smirnov test is used. Based on a single- sample state, the test concentrates on a comparison between observed cumulative distribution function and expected cumulative distribution function in a variable at sequential assessment level. In other words, in this test, the distribution of a trait in a sample is compared with the distribution assumed for that population[18].

For interpreting the results of the test, if the observed level of error is more than 0.05, the observed distribution will equal the theoretical distribution, and there will be no difference between these two values. It means that the obtained distribution is a normal distribution. If the level of significance is less than 0.05, the observed distribution will be different from the expected distribution, as a result, the above distribution will not be normal.

According to table-1, the value of the absolute difference, positive difference, and negative difference for the above variables have been presented. The absolute difference indicates the maximum difference between the observed and the expected cumulative distribution. The positive difference indicates the point where the value of the observed cumulative distribution function is more than the value of expected one, while the negative difference indicates the point where the observed cumulative distribution function is less than the value of the expected one. In this table, with regard to the observed value of Kolmogorov- Smirnov statistic and also the value of the observed error, it could be inferred that there is not a significant difference between the observed distribution and the expected distribution; therefore, the distribution of all variable is normal[19].

Factor analysis: Factor analysis is one of the multivariate statistical methods that make a specific relation among the variable sets as a hypothesized model. The method is based on this hypothesis that the observed variables are linear combinations of the more infrastructural hypothetical- variables (factors). It means that the presence of a factor or a set of infrastructural factors and a set of the observed variables are assumed. In fact, there is a specific relation between the two sets and the factor analysis method applies the relation to obtain an inference regarding the factors. One of the applications of the factor analysis related to the test of the assumption of deliberate combination of several variables refers to the measuring of a hypothesized construct; such a factor analysis is called confirmatory factor analysis (CFA). In fact, the objective of CFA is to test the theory and assess the validity of indices. In other words, the researcher determines components of a complicated concept via the previous experimental research studies and/or the relevant theories, and then he determines validity of the indices of the considered construct via CFA technique. The strategic management is the basic construct of the research consisting of hypothesized combination of several indices. With regard to the relevant theories, the strategic management has been made up of five components of environmental review, strategy determination, strategy implementation, assessment, and strategy control. The factor analysis technique should be used to determine validity of each of the indices as follows[20]:

The construct of strategic management: As it was mentioned, the construct of strategic management consists of five hypothesized components. The first step to determine validity of the construct in the factor analysis technique is to determine correlation coefficient tables associated with the components and also to determine matrix determinant and K.M.O coefficient estimation.

Totally, the more the correlation coefficients of the construct indicators are in relation with one another, the more is the power of indicators in forming the construct. The value of correlation coefficients varies between 1 and -1. Therefore, when the values are close to 1, the correlation is stronger; however, when the value is close to 0, the correlation is weaker. According to the above table, except from the correlation between the environmental review with other components, the rest of them show a correlation coefficient higher than 0.8. This value indicates a very strong correlation among the indicators. Also, the main diameter of the matrix equals 1 and this number indicates the correlation of each component with itself and it shows the value of perfect correlation. The value of correlation matrix determinant equals 0.002 and this value indicates validity of data and variables correlation matrix. The more the determinant is close to 0, the more is the competence of data for entering the factor analysis[21].

According to table-3, K.M.O and Bartlett's test are two other measures represented to evaluate validity and adequacy of data. K.M.O equals 1 at maximum state and equals 0 at minimum state. Therefore, the more it is close to 1, it is a better measure, and the value of 0.6 is not acceptable. According to the above table, the value is more than 0.8 and it is called an appropriate value. Also, the value of Bartlett's test is significant at level of confidence equal to 99 percent. Therefore, these two measures confirm the presence of analysis factor.

Table-1
Variables test of normality via Kolmogorov- Smirnov test

Test	Implementation index	Design philosophy	Project control
Number of cases	200	200	200
Mean	3.33	3.37	3.68
Standard deviation	0.642	0.689	0.7
Absolute Difference	0.121	0.091	0.103
Positive Difference	0.121	0.059	0.062
Negative Difference	-0.059	-0.091	-0.103
K-S statistic value	0.891	0.668	0.753
P- value	0.405	0.764	0.622

Table-2
Correlation coefficient

Correlation coefficients	Environmental review	Strategy determination	Strategy implementation	Assessment	Control
Environmental review	1.000	0.573	0.579	0.573	0.555
Strategy determination	0.573	1.000	0.892	0.839	0.863
Strategy implementation	0.579	0.892	1.000	0.914	0.932
Assessment	0.573	0.839	0.914	1.000	0.896
Control	0.555	0.863	0.932	0.896	1.000
Value of coefficients determinant	0.002				

Table-3
K.M.O

Measure		Factors
K.M.O measurement or sampling adequacy measurement		0.895
Bartlett Test	Chi square value	1299.741
	Degree of freedom	10
	Significance	0.000

According to table-4, the amount of cooperation between each component and the factor has been calculated. The degree of variable cooperation indicates their variance determined by the factor. The more the cooperation indicates the more desirable method used by the determined factors. In the above table, the component of strategy implementation has the maximum share of cooperation in the strategic management. Also, all the components have a proper cooperation with the factor.

According to table-5, the eigenvalue and determined variance are obtained via each factor. In fact, all indicators have determined a very high percentage of the first factor; moreover, over 81 percent of the factor is determined by the indicators. Therefore, the next factors are not extracted as a result of very low value of the undetermined variance and no other factors are formed. It could certainly be mentioned that the indicators of

Environmental review, strategy determination, strategy implementation, assessment, and strategy control are very important for providing the factor of strategic management. Therefore, validity of the structure is confirmed.

Table-4
The estimation of cooperation between each component and the factor (strategic management) via the principal component analysis

Components	Cooperation before extraction	Degree of cooperation with the factor
Environmental review	1.000	0.590
Strategy determination	1.000	0.867
Strategy implementation	1.000	0.934
Assessment	1.000	0.892
Control	1.000	0.905

Table-5
The estimation of the eigenvalue and corresponding variance with the factor

Component	The calculated eigenvalue		
	Total	The determined variance	Cumulative percentage
1	4.089	81.780	81.780
2	0.581	11.615	93.395
3	0.167	3.345	96.740
4	0.102	2.042	98.781
5	0.061	1.219	100

Factor loading refers to the correlation of each of the observed variables with the factor. In fact, the factor loading indicates degree of correlation or sense of belonging between each of the observed variables and the factor. Mathematically, factor loading is a quantity whose square is a ratio of a certain variable variance which is considered by a specific factor. According to the above table, strategy implementation has the maximum correlation coefficient with the factor of strategic management. However, all the indicators have a very high factor coefficient[21].

Testing hypotheses: The main hypothesis: Applying strategic management influences green project cost control. H0: Applying strategic management does not influence green project cost control. H1: Applying strategic management influences green project cost control. The hypothesis uses one-way analysis of variance (F test) to determine the relation between applying strategic management and green project cost control. In order to apply the test, the condition of variances equality should be considered:

Table-6
Factor loading determination

Component	The ratio of factor loading to the first load
Environmental review	0.700
Strategy determination	0.931
Strategy implementation	0.967
Assessment	0.945
Control	0.951

According to the values of F statistic and also the observed level of error less than 0.05, it is concluded that there is a significant relation at confidence level of 0.99. In other words, there is a significant relation between applying strategic management and green project cost control. Therefore, null hypothesis is rejected and the researcher's hypothesis is confirmed. Moreover the figure of green project cost control based on applying strategic management is indicated as follows in figure-1.

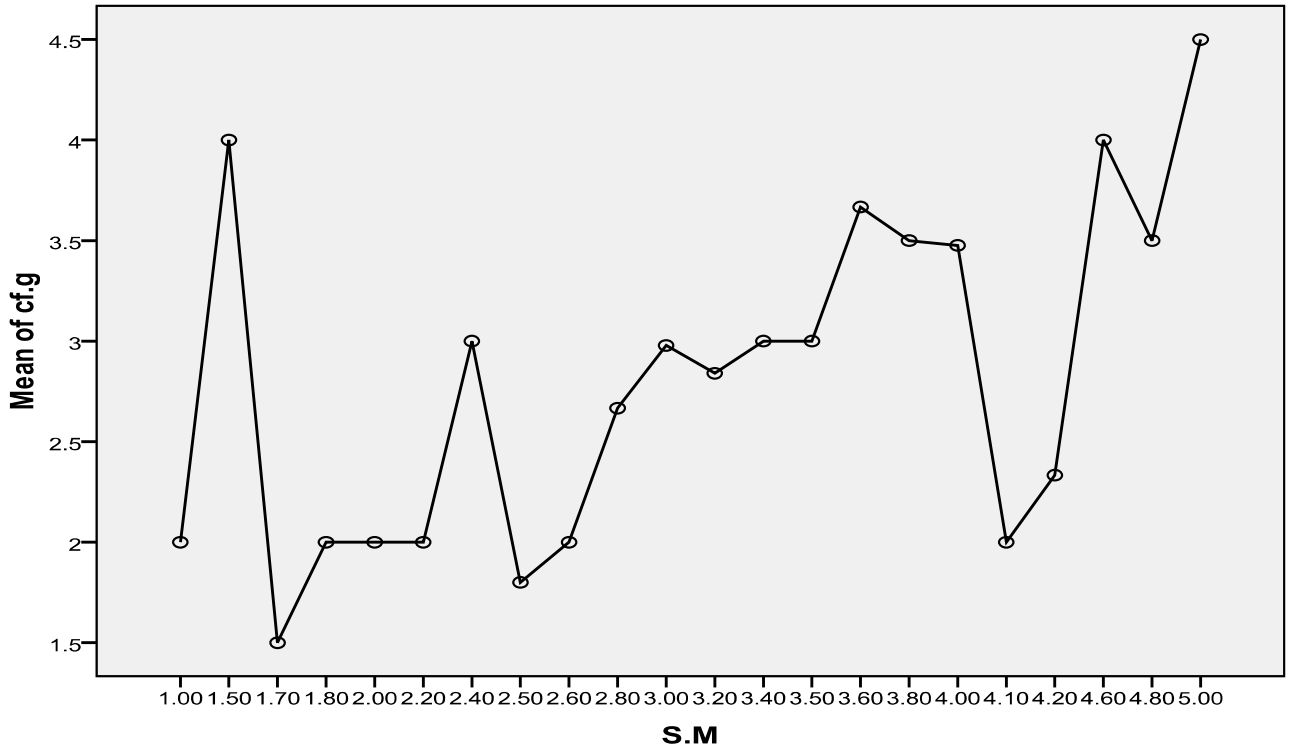

Figure-1
Green project cost control based on applying strategic management

Table-7
Levene's test

Row	Value of Levene's test	The first degree of freedom	The second degree of freedom	P-Value
1	1.755	15	178	0.044

Table-8
ANOVA

Changes resources	Sum of squares	Degree of freedom	Mean of squares	F statistic	P-Value
Among groups	77.232	21	3.678	7.238	0.000
Within group	90.448	178	0.508		
Total	167.680	199			

Pearson correlation coefficient is also used to estimate the impact of applying strategic management on green project cost control, therefore,

Table-9
Pearson correlation coefficient for applying strategic management on green project cost control

Row	Variable	Pearson statistic value	P-Value	Total
1	Strategic management and cost control	0.670	0.000	200

According to table-9, the relation between applying strategic management and green project cost control has been assessed by estimating 200 experts' opinions. According to the Pearson statistic value (0.670) and level of error less than 0.05, it could be mentioned that there is a significant relation between variables at 99 percent level of confidence. Also, Pearson correlation coefficient between two variables indicates that there is a fairly strong relation between the two mentioned variables whose direction is direct and positive. In other words, applying strategic management affects green project cost control up to 67 percent.

The secondary hypotheses: Applying the strategic management affects the index of green project implementation. H0: applying the strategic management does not affect the index of green project management. H1: applying the strategic management affects the index of green project management. In order to determine the relation and impact of applying strategic management on the index of green project implementation, T statistic of a comparative sample with a ratio or a fixed index is used. Further, the ratio of confidence interval is interpreted with regard to the observed level of error.

Table-10
Descriptive statistics

Variable	Number	Mean	Standard deviation
Strategic management and index of project implementation	200	3.33	1.018

Table-11
***S*ingle-sample t statistic**

A comparison with the intermediate level and fixed number of 3			
Variable	**T statistic**	**Degree of freedom**	**P-Value**
Strategic management and index of project implementation	4.584	199	0.000

Table-12
Descriptive statistics

Variable	Number	Mean	Standard deviation
Strategic management and the index of philosophy of design	200	3.37	1.004

Table-13
Single- sample t statistic

A comparison with the intermediate level and fixed number of 3			
Variable	**T statistic**	**Degree of freedom**	**P-Value**
Strategic management and index of philosophy of design	4.719	199	0.000

Table-14
Descriptive statistics

Variable	**Number**	**Mean**	**Standard deviation**
Strategic management and index of cost control principles	200	3.68	1.029

Table-15
Single- sample t statistic

A comparison with the intermediate level and fixed number of 3			
Variable	**T statistic**	**Degree of freedom**	**P-Value**
Strategic management and the index of principles of cost control	5.404	199	0.000

Mean values and standard deviation for the hypothesis variables have been estimated in table-18. Therefore, the men value of effect of strategic management on the index of project implementation (3.33) has been estimated.

According to the values of the single- t statistic and also the observed level of error less than 0.05, there is a significant relation at confidence level of 99 percent. In other words, applying strategic management affects the index of green project implementation. Therefore, null hypothesis is rejected and the researcher's hypothesis is confirmed[22].

Applying strategic management affects the index of philosophy of green project design. H0: applying strategic management does not affect the index of philosophy of green project design. H1: applying strategic management affects the index of philosophy of green project management. In order to determine the relation and impact of applying strategic management on the index of philosophy of green project management, T statistic of a comparative sample with a ratio or a fixed index is used. Also, the ratio of confidence interval is interpreted with regard to the observed level of error.

In table-12, the values of mean and standard deviation have been estimated. Therefore, mean of impact of strategic management on the index of philosophy of project design (3.37) has been estimated.

According to the values of the single- t statistic and also the observed level of error less than 0.05, there is a significant relation at confidence level of 99 percent. In other words, applying strategic management affects the index of philosophy of project design. Therefore, null hypothesis is rejected and the researcher's hypothesis is confirmed[23].

Applying strategic management affects the index of principles of green project cost control. H0: applying strategic management does not affect the index of principles of green project cost control. H1: applying strategic management affects the index of principles of green project cost control. In order to determine the relation and impact of applying strategic management on the index of principles of green project cost control, T statistic of a comparative sample with a ratio or a fixed index is used. Also, the ratio of confidence interval is interpreted with regard to the observed level of error.

In table 14, the mean values and standard deviation have been estimated for the hypothesis variables. Therefore, mean of impact of strategic management on the index of principles of green project cost control (3.68) has been estimated.

According to the values of the single- t statistic and also the observed level of error less than 0.05, there is a significant relation at confidence level of 99 percent. In other words, applying strategic management affects the index of principles of green project cost control. Therefore, null hypothesis is rejected and the researcher's hypothesis is confirmed[24].

Conclusion

Today, civil projects are important element in economic and politic of states due to the volume of consumed credit and social

sensitivities; especially in the recent decades in which civil projects have found specific importance. However, in spite of specific considerations in the frame of specialist principles and instructions, little projects are ended with favorable cost and quality in the determined time. It can be due to the fact that many actual disturbances of the project in the environment are not considered and also requirements of the owners are changed due to unreasonable measurements leading to inconsistent consequences. But these are the known phenomena in industry world applied in the category of primary dissatisfaction of owners. They are classified in the function quality development of a product and also many techniques have been developed to achieve objectives and customers` and owners` needs. Each of these techniques emphasizes on key points f industries management including productivity, quality and function improvement as well as processes results` value. Meanwhile it seems that some of these attitudes and corresponding techniques such as value engineering can be considered as effective tools to improve civil projects. However, apparently, above mentioned techniques should be applied in a more integrative way to solve the defects of projects. It should be noted that two problems should be solved to adjust these tools with civil projects. One is that these tools are mostly created for repeatable industrial productions while nature differences of two operational space types should be considered to adjust them with a civil project. Another is that their variation and the way of their interaction in civil projects are complex and difficult for users of operational level. Nevertheless, managers of this industry can be provided with the benefits through appropriate and intelligent integration of these techniques. Due to plenty of construction contracts, the hypothesis of the present study is focused on this type of projects. Notably, the present study discuss about planning civil projects in cultural and economic space of Iran`s state and approach to the issue where the project permission as a mission from management and planning organization of the country given to executive organization. The project`s organizational levels has also been considered from executive organization (employer) to operational level(specialist contractor).

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