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Crisis management of embankment dam in terms of construction delay reduction

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ABSTRACT
Delay is considered as a main problem in civil projects of Iran. Ending the construction of dam in determined time is of high importance in terms of huge capitals invested in dam building projects. The present study has attempted to manage crisis of embankment dams in terms of construction delay reduction. To this end, a questionnaire has been distributed among 50 employers, consultants and contractors of embankment dams' construction projects. The obtain data has been processed in SPSS software. As the research findings reveals, accelerating the trend of privatizing embankment dams' construction projects, prioritizing technical and financial capabilities compared to the prices suggested by contractors and supplying required credit to pay lands losses lead to the decrease of construction delay of embankment dams.

Introduction

The term of "crisis" has been emerged in Latin language for almost five centuries. During the two last centuries, "crisis" has been widely used in English and French languages. The phrase of "crisis management" in its currently used form was proposed by Robert McFarow for the first time when the possibility of missile war between America and Cuba was discussed. He stated that "there is nothing as strategy and crisis management should be acted on". Thus, major activities were manifested regarding crisis management from the last of the 1970s (Savadkouhi, 2007). Generally, the objectives of crisis management entail removing the crisis and emergency conditions in project, returning the project to the early status, decreasing the effects of crisis in the project, coping with it through spending the lowest cost, preparing to cope with the crisis, decreasing the damages due to the crisis in the project, and reconstructing critical regions (Salahshour & Farouji, 2011). Considering the fact that delay in construction leads to national capital losses and additional costs for executive institutions, recognizing delay is of importance as a factor preventing from similar problems in the next projects (Aghabi Dibaii, 2005). Generally, the importance of discussing embankment dams can be explained as follow:

- Due to the vital importance of water resources, recognizing delays causes to use this natural capital optimally and avoid its waste.
- Dam building projects are the main and infrastructural projects in Iran, so accurate recognition of delay and proper planning to remove and decrease them can solve main problems of timely exploitation of projects.
- In some highly important projects, delays prolongation in dam building projects decreases their efficiency (Sabze Pour, 2006).
- In Iran, large dams are the main elements of supplying the needed electricity power so that they supply 30% of required electricity power currently. With respect to the advantages of using hydroelectricity relative to thermal power plants, most of countries seek to develop hydroelectricity.

The Research Hypotheses

1)Accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects decrease construction delay.
2)Prioritizing technical and financial capabilities compared to the prices suggested by contractors decrease the construction time of embankment dams.
3)Supplying required credit to pay losses leads to the decrease of construction delay of embankment dams on the behalf of management and planning organization.

Generally, researchers have categorized the causes of delay into two classes of justified and non-justified. Justified factors are mostly natural factors with less predictability while non-justified factors are usually due to executive and management weaknesses. In this case, the previous studies report that delay factors are of non-justified type in developed countries while in developing countries, delays are generally due to justified factors. For instance, Al-Momani (2000) investigating civil projects in Jordan found that weak design, negligence of employer, changes of design, increase of quantity, and lack of proper planning can be mentioned as main causes of delay. Frimpong et al (2003) also considered design problems, financial problems, structure and principles, lack of human force, materials and equipments as main delay factors in the projects of Ghana. In the study conducted in Nigeria by Sounaga et al (2002), principle problems, inflation, design problems, financial problems, and weakness of project manager were regarded as the main delay factors. In Saudi Arabia, Odeh et al (2002) introduced delay parameters of a project as design mistakes and changes, delay in the payments of contractors, financial problems of contractors, structural problems, and bureaucracy in employer`s organization.

Assaf and Al-Hejji (2006) studied delay factors of large construction projects. They investigated the performance of various construction projects in Saudi Arabia in terms of time variable. They attempted to examine and determine delay causes and their importance based on individuals participated in a

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project including 15employers, 19 consultants, and 23contractors. 73 delay causes were identified during the research. Seventy six percent of contractors and fifty six percent of consultants referred that the mean of extra time was between 10 to 30 percent of the main time duration. The most common and main delay cause confirmed by all three groups was changes of the design. The findings revealed that 70 percent of the projects had extra time, and 45 projects out of 76 projects had delay (Assaf and Al-Hejji, 2006).

Ultimately, all the conducted studies indicate that no delay factor in civil projects can affect total trend of delay by itself. Delay factors interact with each other actively. Additionally, each of these factors is the direct or indirect result of other factors which may be taken into less consideration in other works. On the other hand, previous works have only investigated and prioritized delay factors and finally presented the suggestion of decreasing delay but no practical strategy has been proposed in this regards. Undoubtedly, delay reduction will be possible only by presenting applied and practical patterns and models; therefore, the present study has attempted to present some practical strategies in this regards in addition to investigate delay causes in embankment dam construction projects.

Methodology

The present study is a descriptive survey research. The data has been gathered using field (through using questionnaire distributed among 50 employers, consultants and contractors of dam building construction projects) library (through reviewing other works and specialist magazines to collect information about the related internal and foreign works) methods. In the present study, questionnaire is the main data gathering tool with respect to the type of the research methodology.

Discussion and results

The data gathered from the opinions of 50 employers, consultants and contractors of embankment dam construction projects has been analyzed using referential statistics (Pearson correlation coefficient, Spearman correlation coefficient, variance analysis …) in SPSS software version 17.

Normality and fitness test

To evaluate the normal distribution of variables (construction delay reduction, privatization trend, technical and financial capabilities, good price proposed by contractors, and credit supply for damages), S-K test has been used. In single sample case, S-K test compares observed accumulative distribution function with expected accumulative distribution function in a variable at ordinal scale measurement. In other words, distribution of an attribute in a sample can be compared with the given distribution of the population. In results` interpretation, observed distribution and theoretical distribution will be same and there will be no difference between them if the value of observed error level is greater than 0/05; that is, obtained distribution is a normal distribution. While there will be a difference between observed distribution and expected distribution if the significance value is less than 0/05; i.e. the distribution is not normal.

As shown in table 1, the absolute, positive and negative differences for variable have been estimated. The absolute difference indicates the greatest difference between observed accumulated distribution and expected accumulated distribution; the positive difference indicates the value of the point in which observed accumulated distribution function is greater than expected accumulated distribution function while the negative difference shows the value of the point in which observed accumulated distribution function is less than expected accumulated distribution function. According to table 1, with respect to the obtained value of K-S test and the observed error level, it can be concluded that there is no significance difference between expected distribution and observed distribution for variables of construction delay reduction, privatization trend, technical and financial capabilities, and good price proposed by contractors; thus, the distribution of variables is normal but the distribution of credit supply for damages is not normal and the difference is significant.

Testing the research hypotheses

1)The first hypothesis: "Accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects decrease construction delay".

H_0 : Accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects does not decrease construction delay.

H_1 : Accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects decrease construction delay.

In this hypothesis, Pearson correlation coefficient is used to investigate the relation between privatization trend acceleration and the increase of competition principle in embankment dam construction delay reduction. Then, the results are interpreted.

According to table 2, considering the value of Pearson statistic (0/729) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects decrease construction delay.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, privatization trend acceleration and the increase of competition principle decrease embankment dam construction delay up to 73% and vice versa. Figure 1 depicts construction delay reduction based on privatization.

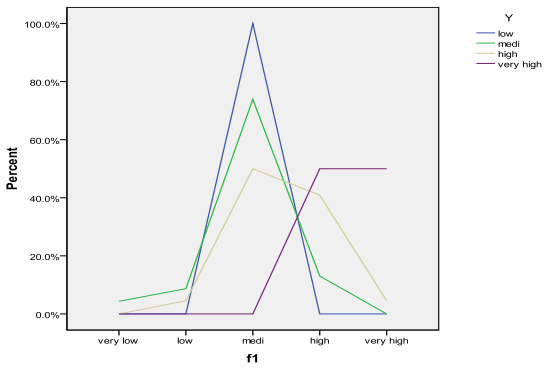

Figure 1. Construction Delay Reduction based on Privatization

2)The second hypothesis: "Prioritizing technical and financial capabilities compared to the prices suggested by contractors decrease the construction time of embankment dams".

H_0 : Prioritizing technical and financial capabilities compared to the prices suggested by contractors does not decrease the construction time of embankment dams.

H_1 : Prioritizing technical and financial capabilities compared to the prices suggested by contractors decrease the construction time of embankment dams.

In this hypothesis, to compare embankment dam construction delay reduction in terms of prioritizing technical-financial capabilities and suggested prices by contractors, one way variance analysis (F-test) is used. To use F-test, the variances should be equal, thus:

As it is observed, the variances are equal, so variance analysis test can be conducted.

Considering the value of F statistic and the observed error level (P-Value < 0/05), it can be concluded that there is a significant difference between construction delay reduction in terms of technical-financial capabilities and suggested prices by contractors. Therefore, the alternative hypothesis is confirmed.

But to compare the effectiveness of them, descriptive statistic and their mean values should be taken into consideration. Thus:

Considering the mean value of technical-financial capabilities relative to suggested prices by contractors to decrease construction delay, it is concluded that prioritizing technical-financial capabilities relative to suggested prices by contractors decrease the construction delay.

3)The first hypothesis: "Supplying required credit to pay losses leads to the decrease of construction delay of embankment dams on the behalf of management and planning organization".

H_0 : Supplying required credit to pay losses does not lead to the decrease of construction delay of embankment dams on the behalf of management and planning organization.

H_1 : Supplying required credit to pay losses leads to the decrease of construction delay of embankment dams on the behalf of management and planning organization.

In this hypothesis, Spearman correlation coefficient is used to investigate the relation between supplying credit to pay losses and decrease construction delay. Then, the results are interpreted.

According to table 6, considering the value of Spearman statistic (0/711) and the observed error level (P-Value < 0/05), it can be concluded that the relation between variables is significant at the confidence level of 0/99. In other words, the alternative hypothesis is confirmed indicating that there is a significant relation between supplying credit to pay losses and decrease construction delay of embankment dams.

Also, the obtained correlation coefficient indicates that the relation is strong, positive and direct. In other words, supplying credit to pay losses decreases embankment dam construction delay up to 71% and vice versa. Figure 2 depicts construction delay reduction based on privatization.

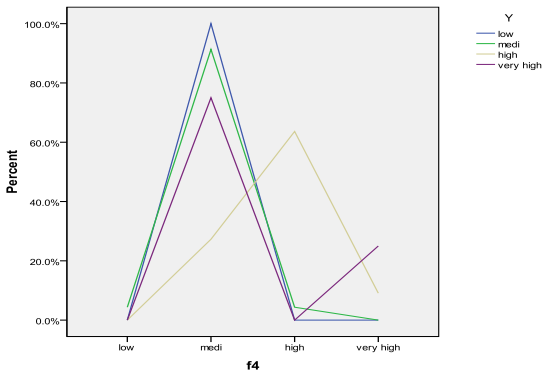

Figure 2. Construction Delay Reduction based on Privatization

Regression Analysis

Multi-variable regression is a statistical analysis method determined variations of one or more dependent variables(s) relative to one or more independent variables(s). In other words, it is a strong statistical technique investigating the effects of one or more independent variables(s) in one or more dependent variables(s). In this method, net effect of dependent variable (construction delay reduction of embankment dams) in independent variables (privatization acceleration, suggested prices by contractors, technical-financial capabilities, supplying credit to pay losses) is determined.

According to table 7, all the variables under investigation have been entered into the model without any specific order to be analyzed.

Table 8 indicates the relation between the independent variables (privatization acceleration, suggested prices by contractors, technical-financial capabilities, supplying credit to pay losses) and dependent variable (construction delay reduction of embankment dams). According to the table, the multiple correlation coefficients of the independent variables with the variable of civil project improvement equals with 0/93. The determination coefficient (effect and predication) of the independent variables equals with 0/86 and the balanced determination coefficient based on the degree of freedom of the variables equals with 0/85. In other words, the amount of the variations of construction delay reduction of embankment dams based on the above mentioned variables` effects equals with 0/86 which is 0/85 with precise computation of degree of freedom (this value is the strong coefficient indicating the efficiency of the model). Therefore 85% of the variations of the variations of construction delay reduction of embankment dams is predicted and determined by the above mentioned variables.

According to table 9 and considering the value of F statistic as well as the observed level of error (P-Value< 0/05), it can be concluded that there is a correlation at the confidence level of 99%. In other words, there is a significant relation between the independent variables (privatization acceleration, suggested prices by contractors, technical-financial capabilities, supplying credit to pay losses) and construction delay reduction of embankment dams. Therefore, the null hypothesis is rejected and the alternative hypothesis is confirmed.

According to table 10, the value of the weight coefficients of each independent variable on the standardized and non standardized dependent variable (Beta), t test value and the observed error level of each variable with the dependent variable have been considered. Accordingly, the value of the standardized weight effects as well as t value, all factors are significantly related with the independent variable (construction delay reduction of embankment dams); among them, privatization trend acceleration has the greatest effect in the in construction delay reduction of embankment dams . Therefore, considering these coefficients, firstly the regression equation of construction delay reduction of embankment dams can be stated based on the independent variables and the value of constant coefficient; and then the amount of the effect of each independent variable can be predicted for each variation unit in the dependent variable.

Furthermore, the scatter plot of the dependent variable based on the standardized value of the predictive variables will be as follow:

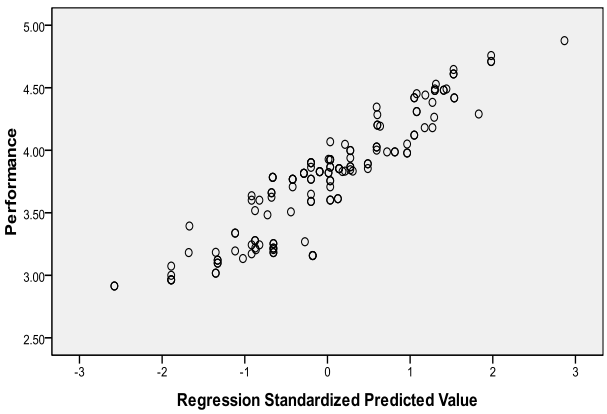

Figure 3. Regression Standardized Predicted Value

Table 1. Normality and Fitness Test

	Absolute difference	Positive difference	Negative difference	K-S	P-Value
Construction delay reduction	0/075	0/075	- 0/063	0/906	0/385
Privatization acceleration	0/101	0/101	- 0/088	1/209	0/108
Technical and financial capabilities	0/083	0/083	-0/076	1/099	0/297
Good price	0/073	0/073	-0/060	0/883	0/415
Credit for damages	0/374	0/374	-0/246	2/647	0/000

Table 2. Pearson Coefficient Statistic

Row	Variable	Pearson coefficient value	P-Value	Total
1	Privatization trend and dam construction delay reduction	0/729	0/000	50

Table 3. Leven`s Test (equal variances assumed)

Row	Leven`s Test Value	The First Degree of Freedom	The Second Degree of Freedom	P-Value
1	1/395	2	46	0/258

Table 4. Variance Analysis

Resources Changes	Sum of Squares	Degree of Freedom	Mean of Squares	F Statistic	P-Value
Inter-group	8/547	3	2/849	7/785	0/000
Intra-group	16/833	46	0/366		
Total	25/380	49			

Table 5. Mean and Standard Deviation

	Mean	Standard Deviation
Technical-Financial Capabilities	3/89	0/603
Suggested Prices by Contractors	3/63	0/680

Table 6. Spearman Coefficient Statistic

Row	Variable	Spearman coefficient value	P-Value	Total
1	Supplying credit to compensate damages and decrease construction delay	0/711	0/000	50

Table 7. The Entered and Remover Variables

Model	Entered Variables	Removed Variables	Regression Method
First	Above independent variables	-	ENTER

Table 8- Estimation of Regression Model Summary

Row	Model	Multiple Correlation Coefficients	Determination Coefficient	Balanced Determination Coefficient
1	**Above variables**	**0/927**	**0/859**	**0/852**

Table 9- ANOVA analysis and determining the significance level of the model

Model	Squares sum	Degree of freedom	Mean squares	F statistic	Sig
Determined (regression)	10/550	4	2/637	10/205	0/000
Residual	11/630	45	0/258		
Total	22/180	49			

Table 10. Regression Weight Coefficients

Model factors	Non-standard B	Standard B	t value	Sig
Constant Coefficient	0/167	0/280	2/866	0.005
Privatization Acceleration	0/296	0/385	10/374	0.000
Suggested Prices by Contractors	0/143	0/184	3/063	0.003
Technical-Financial Capabilities	0/103	0/129	2/246	0/026
Supplying Credit to Pay Losses	0/200	0/333	9/305	0/000

Conclusion

1)Considering the results obtained from studies and the complexity of each urban civil project, the possibility of increasing the time of implementation can be expected with respect to executive limitations. The purpose of identifying the causes of time prolongation is to remove or decrease the effects of prolongation factors so that project can be accomplished with the minimum changes relative to primary scheduling. Moreover, it is clear that project managers cannot be ready to various crises. However, the possibility of crisis occurrence in projects will be minimized if managers believe in crisis management as an integral part of their strategic management task. In this regards, crisis management and its relation with technical and operational planning is very important. Generally, previous studies report that weak principles and rules, lack of proper credit supply, problem of lands ownership, delay in contractors` payment, lack of enough experience in some contractors, weak management, lack of efficient and professional human forces, economic status, and increasing prices can be mentioned as the most significant delay causes in embankment dam construction projects. Further, testing the research hypotheses revealed that accelerating the trend of privatizing and increasing the principle of competition in embankment dam construction projects can decrease construction delay. Also, prioritizing technical and financial capabilities compared to the prices suggested by contractors can be effective to decrease the construction time of embankment dams. Finally, supplying required credit to pay lands losses leads to the decrease of construction delay of embankment dams on the behalf of management and planning organization.

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