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A Model for Prioritizing the Risks Associated with Road Construction Projects Based on Generalized Secondary Goal

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Abstract

This paper aims at providing a new model based on Data Envelopment Analysis (DEA) to prioritize project risks. It is clear that the large amounts of involved capitals, the long term of infrastructure projects' implementation, and the project management problems in on-time completion of projects indicate the necessity of paying particular attention to this issue and conducting applied research in this field. One of the important issues related to risk management is to identify the most appropriate project risks for the aim of adopting an appropriate strategy to manage them. The use of the secondary goal method in cross-sectional AHP/DEA was introduced as a more efficient model to prioritize road construction projects' risks.

***Keywords**:* Risk, efficiency, secondary goal, data envelopment analysis.

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1. Introduction

In the vast country of Iran, due to the dispersion and distribution of population settlement areas, road construction and development, as one of the most important infrastructures, is of particular importance. Therefore, a large amount of capitals are allocated to these projects annually. The most important indicator for the success of these projects, in addition to achieving the intended objectives and cost-effectiveness, is their completion at the expected time.

Risks and uncertainty associated with the projects cause reduced accuracy in the proper estimation of the projects' objectives thereby reducing their efficiency. Hence, identifying project risks is essential. Identification and classification of risks is the most difficult and important part of the risk management process because, in case of not recognizing the risk, it is omitted from subsequent analyses and no appropriate planning could be done to respond to it. Risk identification process is a continuous activity, the sustainability of which depends on the risks level and project conditions. Getting the experts' viewpoints is considered as the most important step in identifying the risks. However, it is possible to manage the risks effectively to reduce the impact of risks in achieving project objectives. Thus, identification, analysis, and prioritization of risks can be very important to the success of a project. In the initial stages of the project, the possibility of risk is at the maximum level, but information about the risks of the project is at the least possible amount. This situation does not mean that because we have little information the project should not be continued. However, there are different approaches in dealing with risks. The better understanding of the conditions, the more realistic the project plan and the expectations from the project results [PMI, 2008].

After identifying the risks, it is necessary to determine the importance of each risk in order to prioritize the individual risks for future measures, identify the overall project risks and determine the appropriate responses. Risk assessment can be conducted using qualitative methods such as data accuracy categorization, and evaluation of the measures of risk probability for and impact on the assessment of individual risks, or quantitative methods such as interview techniques to quantify the possibility and risks outcomes for the project objectives, sensitivity analysis, and decision tree analysis, or a combination of both of these methods [PMI, 2009].

Each of these two approaches requires different data. However, in cases where both methods are used, a coordinated approach should be applied. Qualitative methods are used through considering a set of attributes such as the probability of occurrence, the impact on project objectives, relationship with other risks, reasons or the impact of sharing, etc. for providing a better understanding of the causes or effects of the individual risks. Quantitative methods provide an insight into the combined effects of identified risks for the project output. In these methods, the likelihood and risk impact information at the project level such as the correlation between risks, dependencies, and feedback cycles are considered and thus, the overall risk of the project is shown. Since the project risk assessment is the most important component of risk management, providing a model to identify important risks may assist project managers in reducing their negative effects. The research conducted in this area provided models for the prioritization of risks. But, as time goes on, the problems of each of them were identified, and it was replaced with another alternative. Among the important issues about the presented patterns is ignoring the parameters and the existence of multiple optimal answers. While identifying the risks affecting road construction projects in mountainous areas, the cross-efficiency method was applied using secondary goal function in order to prioritize the risks. Then, the interval matrix obtained from the previous stage was converted to a paired matrix using a mapping and the project risks were prioritized using paired matrix prioritization methods.

The research literature, including methods of DEA, paired matrix, and project risk was first examined and the risks breakdown structure was presented according to the causes. In the process of doing the research, the techniques used to analyze the data were described and the results of field work on the construction project risks were presented according to the model.

2. Basic definitions

Data Envelopment Analysis (DEA)

The basic idea in the formation of DEA was to provide a technique to be used for identifying units (Decision Making Units or DMUs) that have the best performance among a set of similar DMUs, (efficient/extreme units) and also measuring the performance of other DMUs (inefficient/non-extreme DMUs). Since this technique evaluates and compares the performance of observations through creating a cover/envelope (efficiency extreme) on them, it is called DEA. In issues related to decision making, efficiency is to work well.

The efficiency of each DMU is the result of comparing the indices of that unit with the standards. The best decision making units are located on an extreme which is called production function in microeconomics and provides the maximum output possible from the combination of the inputs. The production function is needed to calculate efficiency. A nonparametric method was first introduced by Farrell in 1957. He fitted the production function on a set of outputs and inputs using the outputs and inputs of DMUs in a manner that the result was a piecewise linear function. In the nonparametric methods, no functional form is considered for the production function and it is determined by the units (Hosseinzadeh Lotfi et al., 2011).

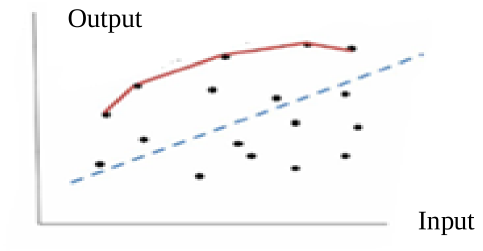

Figure 1: Regression method

Based on previous studies, Charnes, Cooper, and Rhodes introduced CCR for calculating the efficiency of DMUs (Charnes et al., 1978). A DMU is a unit that receives an input vector such as $X=(x_1,...,x_m)$ (m inputs), and produces an output vector such as $Y=(y_1,...,y_s)$ (s output). In the assessment of units, they should be heterogeneous DMUs, i.e. units with the same function produce the same outputs by receiving the same inputs. Now, efforts are made to evaluate the performance of DMU_o, where $o \in \{1,\dots,n\}$. For this reason, if no unit dominating (X_o,Y_o) is found, then DMU_o is called relatively efficient. Otherwise, it is inefficient. Now, the following model which is the input-oriented CCR model is considered:

$$\begin{aligned}
\min \quad & \theta \\
s.t. \quad & \sum_{j=1}^{n} \lambda_j X_j \le \theta X_o \qquad (1) \\
& \sum_{j=1}^{n} \lambda_j Y_j \ge Y_o \\
& \lambda_j \ge 0, \qquad j=1,\dots,n
\end{aligned}$$

where the envelope form is called input-oriented CCR Model. It can be easily proved that in the optimal solution of model (1), if $\theta^*=1$, then DMU_o will be efficient. This model is always possible, where $0<\theta^*\le 1$. Therefore, if for the optimal solution, $\theta^*<1$, then, DMU_o is inefficient. Dual model (1) is the multiplier form of input-oriented CCR model which is as follows:

$$\begin{aligned}
\max \quad & U^t Y_o \\
s.t. \quad & V^t X_o = 1 \qquad (2) \\
& U^t Y_j - V^t X_j \le 0 \qquad j=1,\dots,n \\
& U \ge 0,\ V \ge 0
\end{aligned}$$

where, $U=(u_1,\dots,u_s)$ is the dual variables vector corresponding to output constraints and $V=(v_1,\dots,v_m)$ is the vector of dual variables corresponding to input constraints. Model (2) is always feasible and DMU_o is efficient when the optimal solution exists, then $V^* X_o = 1$ and $(U^*,V^*)>0$

Paired matrix

Almost all calculations of AHP are conducted based on the initial judgment of the decision maker which appears in the form of paired comparisons matrix, and any errors or inconsistencies in the comparison and evaluation of the importance of options and parameters distorts the final result obtained from the calculations. Inconsistency ratio is a tool that specifies consistency and indicates the extent to which the priorities derived from comparisons can be trusted. Maybe it is a simple matter to compare the two options, but when the number of comparisons increases, confidence in the consistency of the comparisons is not easily possible; therefore, consistency ratio should be applied to achieve the necessary confidence. Experience has shown that if the inconsistency ratio is less than 0.10, the comparisons' consistency will be acceptable; otherwise, the comparisons must be revised.

Project Risk

Project risk is an uncertain event or condition that, in case of happening, adversely affects project goals. In connection with the project, risk is the chance of an adverse event and all its unpleasant consequences. Project risks cause delay in the implementation of projects or make them stop. They also affect the quality and cost of the project (PMI, 2013).

Risks are divided into two main categories of risks external to the project or risks internal to the project based on their condition, i.e. the private sector has the ability to control them or they are uncontrollable and should be managed by the government. In fact, this classification is done based on the source and cause of the risk.

External risks: The underlying cause of these risks is beyond the scope of the project and they are caused by several factors. Some of these risks are associated with macro indicators of the country. The private sector should examine the likelihood of these risks before deciding to launch the project and make decision about the selection of the related project after assessing the impact of each on the fate of the project, because little or no control can be exercised on them. They are divided into five categories of political, economic, legal, cultural, and social impact and force majeure risks based on the scope of the risks.

Political risks: These risks are associated with domestic and international political conditions and government stability. They also illustrate the capabilities or request of government to attract private investments to the infrastructure projects. Failure to properly manage these risks excludes each type of investment. **Economic risks:** They are uncertainties in the macroeconomic indicators of the country which are related to the project costs and revenues and are associated with the cases such as inflation rate. Inaccuracy in predicting these risks will lead to failure in financing the project, or at least, increase in the costs. **Legal risks:** They deal with the potential problems arising from contractual arrangements and legal frameworks in which the project is performed. The presence of multiple factors and different contracts between them is associated with many implications causing the blockage of the project due to any ambiguity in the rules.

Cultural-social influences risks: These risks are mainly due to social and cultural issues of the project implementation environment such as ethnic and regional restrictions, the absence of a collective satisfaction, working conditions of local contractors, etc. Since the route of road construction projects in mountainous regions passes mainly from rural and urban areas, attention should be paid to this issue. **Force majeure risks:** Due to the fact that the country is highly risk-prone, most projects are at the risk of natural disasters. Of course, the weather conditions specific to mountainous regions slow down the trend of project implementation in some parts, and, in some cases, have led to project termination. The unexpected events, which are beyond the control of the project, are also among this type of risks.

Internal risks of the projects: In addition to the preparation of the project environment before project implementation, there are risks in the project which refer to the technical issues of the project. These risks are project-specific, and unlike the external risks, they are controlled by the private sector. Internal risks of the project include developmental risks (project preparation) according to the project cycle, financial risks, design risks, construction and completion risks, and the risks involving organizational and project management.

Developmental risks (project preparation): Following the government decision to undertake the project, the first phase is project preparation. Land acquisition for project implementation is very critical and one of the risks that the project will face is the risk of failure to resolve the conflicts. **Financial risks:** Risks that threaten the project financing and costs fall into this category. Anything that endangers the anticipated revenue makes the project financing more difficult or increases the costs.

Design risks: Project design in high capacity with its specific complexities could be followed by design problems such as uncertain conditions, lack of experience in the field of designing road construction projects and changes in the design.

Risks of construction and completion of the project: They are related to the probability of the failure to complete the project or leave it half-finished.

Organizational and project management risks: Given the extent of the financial and administrative aspects of project construction, project management in these types of projects are more complex than regular projects. Therefore, due attention should be paid to this issue.

3. Research model

The research model is described as below:

Some of the most important risks affecting these projects were identified using the Delphi method and interviews with relevant experts and they were made available to the road experts. Road construction experts were provided with the risks identified by the questionnaires prepared based on the FMEA research model and the approach based on the

3 factors of risk probability, the severity of risk, and risk discovery potential. Tables (1), (2), and (3) show the verbal expressions and their corresponding numbers used in this study to evaluate the risk factors (Wang et al., 2009).

Table 1: Numbers of the probability of the risk occurrence

Degree	Probability of Occurrence	Number
Very high	Almost Certainly	9,10
High	Recurrence risks	8,7
Average	Implicit risks	6,5
Low	Comparatively low risks	3,4
Very low	Improbable risks	1,2

Table 2: Numbers of the severity of risk

Degree	Severity of Impact
High-risk without warning	10
High-	9
Very high	8
High	7
Average	6
Low	5
Very low	4
Negligible	3
Very minimal	2
NA	1

Table 3: Numbers of risk detection capabilities

Degree	Detection probability	Number
Quite impossible	No chance	10
Very unlikely	Very unlikely chance	9
Unlikely	Unlikely chance	8
Very low	Very low chance	7
Low	Low chance	6
Medium	Average chance	5
Relatively high	Relatively high chance	4
High	High chance	3
Very high	Very high chance	2
Quit possible	Quite possible chance	1

Each risk is considered as a single DMU and a uniform input is considered for all of them as well. Outputs are the probability of occurrence, severity of impact, and risk detection capability. Input-oriented CCR model (Model 1) is calculated using multiplier form. Then, various methods that have been introduced so far can be used to rank those risks that are efficient under Model (1). Here, generalized secondary goal model is used. In this method, two models (2, 3) are applied for efficient risks. In fact, risk P is measured by the weights that have made the kth risk efficient. Therefore, the result of this measurement is an interval.

$$\begin{aligned} \theta^l_{pk} = \min \quad & U^tY_p \\ s.t. \quad & U^tY_j - V^tX_j \le 0 \qquad j=1,\dots,n \\ & U^tY_k - V^tX_k = 0 \qquad (3) \\ & V^tX_p = 1 \\ & U \ge 0,\ V \ge 0 \end{aligned}$$

$$\begin{aligned} \theta^u_{pk} = \max \quad & U^tY_p \\ s.t. \quad & U^tY_j - V^tX_j \le 0 \qquad j=1,\dots,n \\ & U^tY_k - V^tX_k = 0 \qquad (4) \\ & V^tX_p = 1 \\ & U \ge 0,\ V \ge 0 \end{aligned}$$

Thus, measurements are obtained as $[\theta^l_{pk}, \theta^u_{pk}]$ interval, where θ^l_{pk} and θ^u_{pk} are lower bound and upper bound of DMU_p, respectively, in terms of the optimal weights of DMU_k.

Then interval matrix is converted to a t-matrix using the following interval metric mapping:

$$Index([a,b]) = \sqrt{(a^2 + b^2 + ab)/3} \quad (5)$$

In the next step, t-matrix is converted to a paired matrix using the following mapping: Of course, this matrix is not expected to be a consistent one.

$$P_{i,j} = \exp(\frac{Index_{ij}}{Index_{ij} + Index_{ij}^{\ t}} - 0.5) \quad (6)$$

Therefore, if the inconsistency ratio is low, the eigenvalues method can be used to calculate the final weights.

4. Case study

In order to prepare an initial list of potential risks affecting construction projects in the mountainous areas of the country, the results of previous research in the field of construction project risks were first collected, and then the collected list consisting 50 risks in the road construction projects capable of affecting the objectives of road construction projects was reviewed in terms of comprehensiveness, relevance, and influence using the Delphi method and through obtaining the viewpoints of 9 experts including the employer – Consultant Engineers of Construction Projects Contracting and Investment Companies.

Some items were omitted and some other suggested items that were missing were added to the list. For the final identification of risks, in a meeting attended by 7 directors and authorities of construction projects, a list consisting 24 risks was finally identified. The breakdown structure of the identified risks is shown in Table 5.

The questionnaires used in this study in accordance with the FMEA research model and approach were based on the 3 factors of the probability of risk occurrence, severity of risk impact, and risk detection capabilities. In this regard, 19 individuals from among project managers, workshop supervisors, and technical-executive authorities of the construction projects were selected for data collection and they provided acceptable responses. Cronbach's alpha test for reliability was 0.7. After collecting the data, the 3 items of the probability of risk occurrence, severity of risk impact, and the risks detection capabilities were first calculated. Given the fact that the project conditions were equal for the occurrence of all of the risks, the input for all risks was considered to be one and the probability of risk occurrence, severity of risk impact, and the risks detection capabilities were considered to be outputs for each of the risk factors. A matrix of rank 1x24 was considered as the inputs matrix and a matrix of rank 3x24 was defined as the outputs matrix. Then, the CCR model was executed on the data, the results of which are shown in the table below:

Table 4: Breakdown structure of the construction projects risks in mountainous areas

Risk scope	Types of risk	Risk items
Risks that are external to the project	Economic risks	Inflation and rising prices
	Political risks	International sanctions
	Legal risks	Ambiguity in agreements and contracts
	Risks of cultural and social impact	Geographical, cultural, and, religious situation of the region
	Force Majeure	Unfavorable climatic conditions
		Geotechnical problems
		Abnormal events
Risks that are internal to the project	Developmental risks	Failure to resolve the conflicts at the appropriate time
	Design risk	Delay or shortfall in delivering the executive plans
		Lack of adequate expertise in the design team
		Ambiguities and errors in the executive plans
	Financial risk	Failure to supply adequate funding to implement the plan in a timely manner and delaying payments to contractors
	Construction and completion risks	Technical weaknesses of the employer in monitoring the operations of contractors
		Weaknesses of employer in resolving the problem of delay in the presentation of experimental results
		Mismatch between the technical, financial and administrative capabilities of the selected contractor
		Failure to issue orders to perform the tasks by the employer
		Improper executive procedures and reworks
		Error in the timing and sequencing of project activities
		Machineries' malfunction and their poor management
	Organizational risk and project management	Misallocation of human resources, equipment and machinery
		Improper management of supply chain
		Lack of strategy in the implementation of research projects and immediate decision making to execute them
		Excessive bureaucracy in organizations associated with the project
		Inaccurate estimation of the time, costs and resources in compliance with WBS

Table 5: The breakdown structure of the risks associated with road construction projects in mountainous areas

Code	Project risks	Probability of the occurrence	Severity of impact	Detection capability	Efficiency
Risk 1	Failure to supply adequate funding to implement the plan in a timely manner and delaying payments to contractors	8.17	7.67	6.00	1.0000
Risk 2	Unfavorable climatic conditions	7.92	7.05	4.04	0.9616
Risk 3	Excessive bureaucracy in organizations associated with the project	3.69	4.86	5.47	0.6905
Risk 4	Immediate decision making and lack of strategy in the implementation of research projects	3.51	9.04	7.05	1.0000
Risk 5	Error in the timing and sequencing of project activities	3.51	9.04	7.05	1.0000
Risk 6	Machineries' malfunction and their poor management	7.74	6.97	3.10	0.9414
Risk 7	Ambiguities and errors in the executive plans	7.28	6.05	2.37	0.8824
Risk 8	Geographical, cultural, and religious situation of the region	4.74	6.44	6.70	0.8769
Risk 9	Poor management of existing problems in line with the progress of the project	6.02	7.13	5.05	0.8836
Risk 10	Improper executive procedures and reworks	6.28	5.95	5.68	0.8300
Risk 11	International sanctions	5.76	6.08	7.02	0.9182
Risk 12	Inaccurate estimation of the time, costs and resources in compliance with WBS	5.87	6.12	4.98	0.7895
Risk 13	Geotechnical problems such as landfalls or landslides and reduction in the levels of groundwater	4.25	7.10	6.86	0.9078
Risk 14	Delay or shortfall in delivering the executive plans	4.86	6.67	8.44	1.0000
Risk 15	Mismatch between the technical, financial and administrative capabilities of the selected contractor	7.69	6.17	4.95	0.9321
Risk 16	Lack of adequate expertise in the design team	4.52	5.88	7.39	0.8889
Risk 17	Technical weaknesses of the employer in monitoring the operations of contractors	4.02	6.58	6.17	0.8319
Risk 18	Inflation and rising prices	7.83	7.12	6.77	1.0000
Risk 19	Weaknesses of employer in resolving the problem of delay in the presentation of experimental results	4.98	5.34	3.65	0.6755
Risk 20	Lack of coordination with relevant organizations	7.28	6.03	3.59	0.8824
Risk 21	Improper management of supply chain	6.90	3.87	4.67	0.8364
Risk 22	Misallocation of human resources, equipment and machinery	6.03	6.65	4.80	0.8363
Risk 23	Abnormal events (human)	4.56	6.86	7.16	0.9224
Risk 24	Failure to resolve the conflicts at the appropriate time	8.15	7.16	5.98	1.0000

Here, risks 1, 4, 13, 18, and 24 were considered as serious obstacles in carrying out specific projects. Now, the interval matrix is calculated for these 5 risks using the method mentioned in the previous section.

$$
\begin{array}{c} \\ R\,1 \\ R\,4 \\ R13 \\ R18 \\ R\,24 \end{array}
\begin{array}{c}
\begin{array}{ccccc} R1 & R2 & R13 & R18 & R\,24 \end{array} \\
\begin{bmatrix}
[1.000, 1.000] & [0.802, 1.000] & [0.949, 1.000] & [0.787, 1.000] & [0.935, 1.000] \\
[0.836, 1.000] & [1.000, 1.000] & [0.589, 0.864] & [0.787, 1.000] & [0.637, 0.979] \\
[0.959, 1.000] & [0.720, 0.975] & [1.000, 1.000] & [0.803, 0.983] & [0.961, 1.000] \\
[0.652, 1.000] & [0.807, 1.000] & [0.425, 0.762] & [1.000, 1.000] & [0.545, 1.000] \\
[0.948, 1.000] & [0.710, 0.989] & [0.989, 1.000] & [0.848, 1.000] & [1.000, 1.000]
\end{bmatrix}
\end{array}
$$

Then, the following paired matrix is calculated using the interval mapping.

$$
\begin{array}{c} \\ R\,1 \\ R\,4 \\ R13 \\ R18 \\ R\,24 \end{array}
\begin{array}{c}
\begin{array}{ccccc} R1 & R\,4 & R13 & R18 & R\,24 \end{array} \\
\begin{bmatrix}
1.0000 & 0.9955 & 0.9987 & 1.0185 & 0.9984 \\
1.0046 & 1.0000 & 0.9628 & 0.9907 & 0.9879 \\
1.0013 & 1.0386 & 1.0000 & 1.1028 & 0.9965 \\
0.9818 & 1.0094 & 0.9068 & 1.0000 & 0.9595 \\
1.0016 & 1.0122 & 1.0035 & 1.0422 & 1.0000
\end{bmatrix}
\end{array}
$$

For the above paired matrix, the consistency index, equal to 0.002, indicates very low inconsistency calculated using eigenvalues and final ranking methods:

Risk	R1	R4	R13	R18	R24
Weight	0.2004	0.1978	0.2054	0.1948	0.2023
Rank	Third	Fourth	First	Fifth	Second

Therefore, it can be said that the final ranking table is as follows:

Rank	1	2	3	4	5	6
Risk code	R13	R24	R1	R4	R18	R2
Rank	7	8	9	10	11	12
Risk code	R5	R14	R15	R23	R10	R12
Rank	13	14	15	16	17	18
Risk code	R16	R8	R20	R6	R7	R21
Rank	19	20	21	22	23	24
Risk code	R22	R17	R9	R11	R3	R19

It should be noted that the risk of inefficiency will be indicative of the position.

5. Conclusions

The major risks affecting road construction projects in the mountainous areas of the country were identified and rated using the research model. In prioritizing the risks based on the research model, risks of geotechnical problems and failure in resolving conflicts at the right time were identified as the main risks. The third risk (in terms of the importance) is the risk of failure to provide adequate funding to implement the plan in a timely manner and delaying payments to contractors. The risks of the lack of strategy and inflation are the next priorities.

Therefore, acknowledging that the secondary goal method in DEA has not been provided for prioritizing construction yet, it seems that this research is unique in its kind in terms of application. However, with conducting field studies and adding independent risks, better results can be achieved in future studies.

The advantages of using the model presented in this paper can be stated as follows:

1. This technique was able to evaluate several factors in a combined assessment, even if the factors have different units of measurement.
2. It performs a more realistic assessment, because inefficient DMUs have not been evaluated inefficient due to being compared with a predetermined specific standard or a specific function. However, their evaluation criteria were other units that have worked with them in relatively the same conditions. Finally, it is suggested that the executive style of conducing this study can be used as a model for similar research in construction projects and be a source of many benefits.

Reference

[1] Charnes A et al.(1978). Measuring the efficiency of decision making units، European Journal of Operations Research, 2, pp. 429–444.

[2] Jahanshahloo, G.R. and Hosseinzadeh Lotfi, F. and Jafari, Y. and Maddahi, R.(2011). Selecting symmetric weights as a secondary goal in DEA cross-efficiency evaluation. Applied Mathematical Modelling, 35. 544–549.

[3] Hosseinpour.S, Pour Mahmoud.J , Masrouri.N .(2013). Using Cross Efficiency with Symmetric Weights for the Method DEAHP. Journal of Educational and Management Studies ,vol.3(4) , pp. 384-389.

[4] Hosseinzadeh Lotfi.F , Jahanshahloo.G.R , Zamani.P .(2011). A new ranking method based on cross-efficiency in data envelopment analysis . African Journal of Business Management ,Vol. 5(19), pp. 7923-7930.

[5] Project management Institute Standard Committee.(2009). Practice Standard for project Risk management. Pennsylvania, USA: Newtown Square.

[6] Project management Institute Standard Committee.(2008). A guide to the project management body of knowledge. Pennsylvania, USA: Newtown Square.

[7] Project management Institute.(2013). A guide to the project management body of

knowledge. Pennsylvania, USA: Newtown Square..

[8] Sadeghi Gavgani.S, Zohrehbandian.M , Khorram.E.(2013).Secondary Goal in DEA Cross Efficiency Evaluation . Journal of Basic and Applied Scientific Research, vol. 3(7), pp.235-240.

[9] Sexton, T.R., Silkman, R.H., Hogan, A.J.(1986). Data Envelopment Analysis. Jossey-Bass, San Francisco .

[10] Tohidi.G ,Khodadadi. M,Rostamian.E. (2013).Improving the Selection Symmetric Weights as a Secondary Goalin DEA Cross-E_ciency Evaluation . International Journal of Mathematical Modelling & Computations ,Vol. 03, No. 02, PP.149 – 155.

[11] Wang.Y, Chin.K.S, Poon.G.K.K, Yang.Y.(2009). Risk evaluation in failure mode and effects analysis using fuzzy weighted geometric mean. Expert Systems with Applications, vol.36 , pp.1195–1207.