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## Evaluating the Risk of Projects Implementation in Various Situations using Generalized TOPSIS Model and Business Plan

Gholamreza Jandaghi and Mahbube Hosseini  
University of Tehran, Farabi College, Iran

*Corresponding Author: Gholamreza Jandaghi, University of Tehran, Farabi College, Iran*

### ABSTRACT

Due to the growing acceptance of project management, the application of appropriate knowledge, processes, skills, tools and updated and new techniques can affect the success of project. Risk of project implementation has always been discussed in prosperity or not reaching the desired goal and due to complex world, the updated techniques and tools must be used for measuring of this kind of risk. So the purpose of this study is to evaluate this risk in various situations with the new models that the name is generalized TOPSIS and also used BP that it is one of the important tools before the implementation of the project. In this method the new concept is used; as peril, hazard and risk. A case study of the proposed model will be introduced in the MATLAB that the end method is modeled in it. The sensitivity analysis of the proposed method are discussed in the next and will be measured by using the Microsoft Excel.

**Key words:** Peril, hazard, risk, TOPSIS, sensitivity analysis

### INTRODUCTION

Innovation is the origin and driving force of economic growth in the post-industrial era. The competitiveness of the national economy is stably provided only by new products and improving existing products. In today's dynamic world innovation is accelerating and goods quickly are copied (Lyneis and Ford, 2007). But should we act hastily? Business executives in years ago have tried using techniques such as total quality management to restrain implications of changes in their business processes. Approach such as total quality management allows administrators to minimize the risk of changes with the scientific methods and run their business management step-by-step. But developments in the economies that are take place recently, need the new requirements in its business scope. In the new economic situation, different firms and organizations need more agility and flexibility to accept the changes that have been inevitable (Turner, 2009). Therefore many managers want to know how they can get greatest change in the business process in the shortest time and at the same time minimize the risk of changes. Sometimes the change is necessary because without it business is highly declined and cannot compete with other actors in the economy. However, if changes are not made intelligently, the risks will be created for the business that they may undermine the philosophy of all actions and efforts (Cleland and Ireland, 2008).

Managers always look for a reliable technique to overcome limitations of finance and time. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is widely used to solve Multi-Criteria Decision Making (MADM) problems. This technique assigns the best alternative among a pool of feasible alternatives (Fouladgar *et al.*, 2012).

In recent years, Build-Operate-Transfer (BOT) approach has provided an increasingly popular project financing to move toward infrastructure development in Asian countries such as Iran. There are many complexities in projects because of the variety of factors in project's trend and also the

dependence of project on mainly national factors. Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) and Fuzzy Linear Programming Technique for Multidimensional Analysis of Preference (FLINMAP) methods are presented in order to rank high risks in BOT projects (Ebrahimnejad *et al.*, 2010). Chin *et al.* (2009) used Bayesian network to model risk factors into a Bayesian network to facilitate the assessing of the risk involved in a New Product Development (NPD) process (Raftery, 1994). Abdelgawad and Fayek (2010) extended the application of FMEA to risk management in the construction industry. Fuzzy logic and fuzzy Analytical Hierarchy Process (AHP) are used to address the limitations of traditional FMEA. Their results confirmed the capability of fuzzy FMEA and fuzzy AHP to address several drawbacks of the traditional FMEA application. The use of this approach can support the project management team to establish corrective actions in a timely manner (Abdelgawad and Fayek, 2010). Chang *et al.* (2015) evaluated the risk level for both intra-organizational cultures and for different industries in implementing an Enterprise Resource Planning (ERP) system. Their study adopts the Fuzzy Analytic Network Process (FANP) method to assess ERP implementation risks, which were categorized into four dimensions: Management and execution, software system, users and technology planning. Our research results demonstrated that "Lack of management support and assistance" is vital risk for a successful ERP implementation. Top management support and involvement are crucial and essential factors to the success of a firm's ERP implementation (Chang *et al.*, 2015).

The main objective of this study is to propose a TOPSIS based method to evaluate the risk of projects implementation in various situations.

### **WHAT IS BUSINESS PLAN?**

Davenport and Short (1990) in an article define the idea of designing business plan in this way: "Analysis and design of cycles and new business processes". Design of business processes means analyzed delicately business and designed the existing processes to achieve significant improvements in business efficiency. In the TQM improvement process and more modifications are based on statistical control of the business situation, while the process of innovation and change in the design of business processes is based more on the role of information technology. So from this point to discuss IT is come in the change management and business process. In the methodology of designing business process the issue is to make rapid changes that the tools of these changes are IT. Sometimes these changes are to create environmental sustainability that beget IT-based tools and systems and sometimes IT is used to implement changes in business processes (Turner, 2009).

**Why do you need BP:** According to the definition business plan is a plan that determines the future and develops a business and often takes a period of several years (Karlsson and Honig, 2009). Indeed it is a document that expresses company actions in a specified period and typically includes a detailed list of the risks and uncertainty and analyzes them. Consequently, it is a tool for predicting and managing better of existing businesses or new ones. These works can be accomplished through focus on priorities, monitoring and evaluating progress and contributing to achieve the predetermined objectives. Such a plan would enable individuals to gain necessary preparation for promotion programs in various stages of businesses (Honig and Karlsson, 2004). In fact, the plan is to respond such question as; why? What thing? How to? Who? What time? How much? And One of the stages of preparation of it is the assessment of the business risk.

**Risk and its management:** Risk in general is probability of incurring losses and project risk is an uncertain and plausible event and if it occurs, it affects on the positive impact of the project

results and objectives (opportunities) or negative impact (threats) (Galway, 2004). Consequently, it is essential in today's world; the risks should be identified and also controlled. So discussion of risk management is important too. Risk management is the systematic process that develops and implements to increase the positive risks (opportunities) and reduce the negative risks (threats) (PMI., 2004). For management policy the Risk Management is one of the good tools in any organization that he can reduce them by checking and evaluating of existing risks in the system. This tool is widely used in investment, project management, etc. (Hopkin, 2014).

**Position of risk management in project management:** Project management is a process that plans, organizes, directs and controls the context of project implementation by the possible ways to achieve the desired objectives. In other words, it is a process that coordinates all components of a project (Meredith and Mantel, 2011). The risk management process is continuously carried out in the project life cycle (FAA., 2000).

In Fig. 1 the project management has been modeling and the position of RM is showed in it (Dey, 2001).

**Main steps in the implementation of risk management:** There are some steps in implementing of risk management. Figure 2 shows the main steps that should be followed in implementation of risk management (Crouhy *et al.*, 2006).

**Benefit of RM in the project:** Risk management (RM) has produced criteria and procedures that persons, financial institutions (commercial and industrial) and non-profit organizations and governments can use it in evaluating prospective of job and controlling and also financing hazard. Accordingly risk management manage the risks by systematic approach. Therefore always in working it is important to respond to two basic questions about probable future events: The first question is "What will happen?" The second one is that "What should we do?" Risk management planes to deal with possible future events (Stoneburner *et al.*, 2002). Also it provides the ability for project manager to reduce the risk of failing in achieving the specified benefits by creating the efficient rating system in the process of project implementation, resourcing allocation and activities implementation and phases of project (Mobey and Parker, 2002).

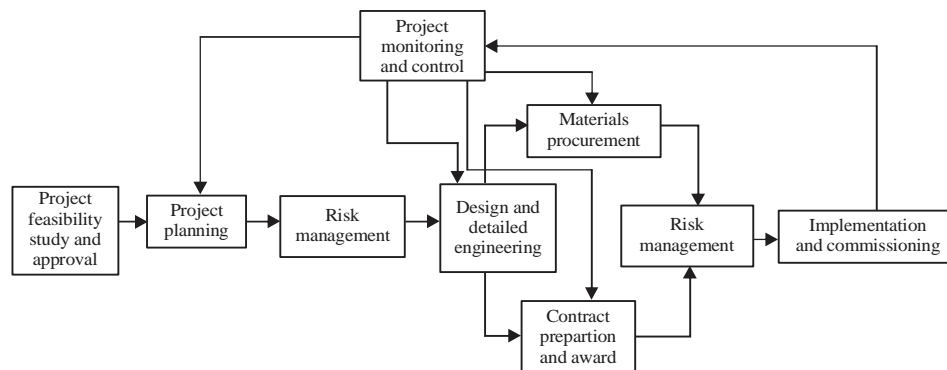


Fig. 1: Project management model

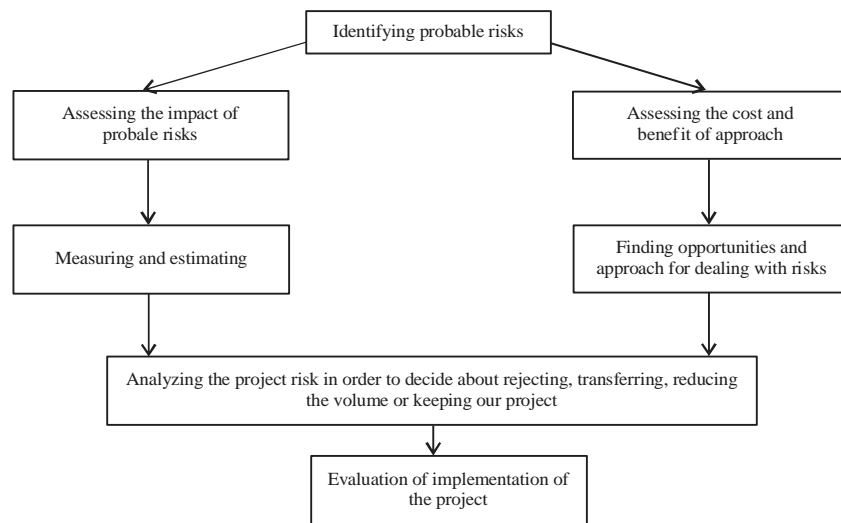


Fig. 2: Implementation of risk management

**The relationship between risk management and business plan:** By definition that has been presented can see that the risk management and business plan are closely related. To be able to face the peril before it individuals must be prepared to deal with it. As a result, the business plan can be identified risks.

But it should be noted that the business plan is based on a number of assumptions stated. Regardless of whether you have considered assumptions carefully. The probability that everything goes exactly according to your plan is too low. So if you plan for probable outcome, you're ready to run. It is very important that to know areas of your business plan as fragile and vulnerable (Raftery, 1994).

Due to follow the business plan can be used to manage and control project risks:

- It can help manager or entrepreneur to specify, focus and examine the aspects and development of their project
- Creates logical and accepted framework in which a work can be developed and measures related to the profession will follow in the next few years
- Offers criteria for the assessing the situation of a real business to what it should be (Karlsson and Honig, 2009)

**Research issue:** The purpose of this study is to measure the risk of project implementation in different situations. In following mathematical model offers for reaching to the aim.

Some assumption in this model must be considered:

- **Assumption 1:** The main objective of the model is to optimize the locating of project and measure the risk of project implementation in different places
- **Assumption 2:** It is assumed that by changing the location of the project the ratio of cost and income is constant (Anbari, 2003)

$$\frac{C_1}{I_1} = \frac{C_2}{I_2} = \dots \quad (1)$$

$C_i$  = The cost made by project in the i-th location  
 $I_i$  = Income of project in the i-th location

- **Assumption 3:** In this model risk is created only as a threat and do not consider the positive aspects of it. Indeed, for example, the rate is 0.9 implies that if the probable or unlikely event occurs, probability of threat in that location is equal to 0.9. And it does not mean that 90% can be converted to an opportunity or a threat (Kahkonen, 2001).

**METHODOLOGY**

- **Step 1:** Obtain an indicator that during the project create risk if the amount of them changes
- **Step 2:** Rank the locations of project with the TOPSIS model. This method is based on  $CL_i$  criterion and projects will be ranked by this criterion.  $CL_i$  of alternative that is higher than ones is in priority (Jahanshahloo *et al.*, 2006). But then you will see that what is important to choose the project is probability of peril  
 Before continuing some definition need to determine:

- **Peril:** It is a situation that can lead to an accident or incident
- **Risk:** It is a chance of peril detonating to an accident or incident
- **Hazard:** Personal injury arising out of an accident, direct or indirect financial loss caused by incident or accident is known hazard
- **Consequences:** It is a condition that occurs as a result of actual peril

Peril = Financial hazard×Risk (FAA., 2000)

Probability (peril) = probability (financial hazard)×probability (risk)

Probability of peril = probability of financial hazard causing×probability of risk

$$P_{pi} = P_{hi} \times P_{ri} \tag{2}$$

So for choosing project not only the risk is important, but also financial hazard is important, too. In fact, what it is important to choose the project is probability of peril.

- **Step 3:** Calculate the probability of the risk

$$1 - CL_i = P_{ri} \tag{3}$$

$CL_i$  = Index ranking of TOPSIS method

$P_{ri}$  = Risk probability in i-th location

- **Step 4:** Calculate the probability of financial hazard

For calculating this parameter at first it is required to calculate the financial hazard for each of the locations in each of the indicators.

- **Step 4-1:** Method of calculating the financial hazard for each of the indicators

Financial hazard for any indicator per unit loss should be estimated for each location.

$$fh_{ij} = p_{ij}(\text{create loss}) \times COI \quad (4)$$

$$i = 1, 2, \dots, n$$

$$j = 1, 2, \dots, m$$

$fh_{ij}$  = Financial hazard for  $i$  location in the  $j$  indicator

$COI_j$  (cost or income) = For  $j$  indicator when threat is created in the project the amount of cost become high or the amount of income become low

- **Step 4-1-1:** Calculate  $COI_j$

Cost On Income (COI) amount depends on the type of index that any of its damage to which part of the plan. It may be changed the cost or income. Cost may increase or income may decrease. Depending on the nature of index by the business plan the amount of costs or incomes that the index are influences them consider as amount of COI for that index. For example, consider the supply of raw materials indicator for the construction of the sugar production factory. If the cost of material become high, it's influence the cost. So the cost change. As a result, this index COI is equal to the amount of cost.

- **Step 4-1-2:** Method of calculating the  $P_{ij}$  (create loss)

Depending of the type of index that is quantitative or qualitative, calculating the probability of losses is different.

- **Step 4-1-2-1:** Probability of losses by the qualitative index

Weighted index for the  $j$ -th criterion ( $w_j$ ) in the TOPSIS model indicates that this criterion affects the project with the amount of  $w_j\%$ . As a result, when the level of criterion become low probability of the creating loss for the project is  $w_j$ .

$$P_{ij}(\text{create loss}) = w_j \quad (5)$$

- **Step 4-1-2-2:** Probability of losses by the quantitative index

$$P_{ij}(\text{create loss per unit reduction}) = \binom{x_{ij}}{1} w_i (1 - w_i)^{(x_{ij}-1)} \quad (6)$$

If the probability of creating failure or loss is  $w_j$ , the probability that  $x_{ij}$  (amount of  $j$ -th index for the  $i$ -th location in the TOPSIS model) reduces per unit, defines by the binomial distribution with  $(x_{ij}, w_j)$  parameters.

**Exception:** Positive and negative indicators that are at their lowest levels they will not cause harm for the project. Therefore, the probability of loss for these index will be zero.

- **Step 4-2:** Calculate the probability of financial hazard to the entire project

To calculate the peril probability it should be considered that all the parameters are not gone up or down at the same time to cause harm for the project.

$$P_i(\text{hazard from the } i\text{-th project}) = \frac{fh_i}{fh_T} \quad (7)$$

$$fh_i = \sum_{j=1}^n fh_{ij} \quad (8)$$

$$fh_T = \sum_{i=1}^n fh_i \quad (9)$$

$Fh_i$  = Financial hazard for the  $i$ -th location  
 $FH_{ij}$  = Financial hazard for  $i$  location in the  $j$  indicator  
 $FH_T$  = All project financial hazard for total locations

It must estimate the probability that at least one of the  $m$  index create financial hazard to the project. This probability is equal to:

$$P_{fh_i} = \sum_{j=1}^m \binom{m}{j} p_i^j (1-p_i)^{m-j} \quad (10)$$

$P_{fh_i}$  = Probability of financial hazard creation  
 $m$  = Amount of indicators  
 $p_i$  = Probability of  $fh$  from the  $i$ -th location

- **Step 4-3:** Calculate the peril probability

$$P_{p_i} = P_{fh_i} * P_{r_i} \quad (11)$$

$P_{p_i}$  = Peril probability of  $i$ -th location  
 $P_{fh_i}$  = Probability of financial hazard creation  
 $P_{r_i}$  = Risk probability in  $i$ -th location

$P_{p_i}$  represents the parameter that in this article known as risk of the project implementation in different situations. The more peril probability ( $P_{p_i}$ ) is less, the more project is ideal.

**Case study 1:** Appropriate location for Municipal solid waste landfills using Geographic Information System (GIS) and Analytical Hierarchy Process (AHP) (Case study of Iran (city: Ilam)).

In this study we introduce 12 indexes that their weights of each index were determined according to the AHP method. Based on geographic information systems and indicators top priority (location 1) have been selected from 3 locations.

Some assumptions are considered for comparison:

- Impact indicators and weights of them is intended according to the thesis



- Decision matrix according to the definitions in the thesis, is prepared by an expert
- The COI matrix is expressed with respect to the business plan of the project

**Decision matrix and indicators weights:** Decision matrix and Indicators weight are shown in Table 1.

**Calculate the relative proximity index and risk probability:** Relative proximity index and risk probability are show in Table 2.

**COI matrix:** The COI matrix are shown in Table 3.

**Calculate the probability of financial hazard:** Probability of financial hazard are shown in Table 4.

**Measuring risk of the project implementations:** Risk of the project implementations are shown in Table 5.

Table 1: Decision matrix and indicators weights

Indicators	Type of indicators	Weights	Location 1	Location 2	Location 3
Far from city	Quantitative	0.212	6	7	4
Far from airport	Qualitative	0.167	6	7	6
Stay away from the blue zone	Qualitative	0.13	8	6	8
Stay away from the main roads	Quantitative	0.104	6	4	8
Slope	Quantitative	0.09	8	6	4
Stay away from protected areas	Qualitative	0.068	7	7	7
Geology	Quantitative	0.06	5	8	7
Land use	Qualitative	0.048	8	6	8
Stay away from the village	Qualitative	0.041	7	7	7
Fault	Qualitative	0.033	7	7	7
Height	Quantitative	0.026	8	6	4
Precipitation	Qualitative	0.021	6	6	6

Table 2: Relative proximity index and risk probability

	Location 1	Location 2	Location 3
CL	0.633	0.592	0.381
P <sub>r</sub>	0.367	0.408	0.619

Table 3: Cost on income index

Indicators	COI (\$ t <sup>-1</sup> )
Far from city	0.51
Far from airport	0.51
Stay away from the blue zone	0.51
Stay away from the main roads	0.51
Slope	93.75
Stay away from protected areas	0.51
Geology	93.75
Land use	93.75
Stay away from the village	0.51
Fault	973.75
Height	973.75
Precipitation	973.75

Table 4: Probability of financial hazard

Parameters	Location 1	Location 2	Location 3
P <sub>f</sub>	0.99998997436	0.999997555	0.9999980368

Table 5: Risk of the project implementation

Parameters	Location 1	Location 2	Location 3
P <sub>p</sub>	0.366561994	0.407779	0.6194821

Location 1 with the lowest risk (36.66%) is selected as the preferred location. Risk of the project implementation in location 2 is 40.78% and in location 3 is 61.94%. This ranking is consistent with the end priorities of the thesis. But this method shows risk and also ranking.

**Case study 2:** An example of Turkish domestic airline industry (Torlak *et al.*, 2011).

We use the method in the Turkish domestic airline industry. The implementation of fuzzy TOPSIS method in the Turkish domestic airline industry reveals the ranking of major air carriers in light of key success variables in the sector. The study also provides an evaluation of empirical findings of fuzzy TOPSIS method from a managerial perspective.

There are 9 indicators in this study for analyzing the Turkish domestic airline industry between 4 ones.

**Decision matrix and indicators weights:** Decision matrix and indicators weights are shown in Table 6. The weight that typed in the table is the average of three weight that used in the based article.

**Calculate the relative proximity index and risk probability:** Relative proximity index and risk probability are shown in Table 7.

**COI matrix:** Cost On Income (CIO) is based on the minimum passengers in each day that any company can have (Jahanshahloo *et al.*, 2006) plus the weight of each indicators plus the minimum price of the all flying. Min passengers is 50164, Min price is 11 EUR (Table 8).

Table 6: Decision matrix and indicators weights

Indicators	Weight <sup>1</sup>	Turkish airline	Onur air	Atlas jet	Pegasus
Advertising	0.0559	5	2	3	3
Product quality	0.1531	5	2	3	3
Price competitiveness	0.1862	3	4	5	4
Customer loyalty	0.1558	4	2	3	2
Market share	0.0565	5	3	4	3
Customer service	0.2372	5	1	3	2
E-commerce	0.0433	5	3	4	3
Management experience	0.0453	5	2	4	2
Branding	0.0667	5	1	3	1

Weight that typed in the table is the average of three weight that used in the based study

Table 7: Relative proximity index and risk probability

Parameters	Turkish airline	Onur air	Atlas jet	Pegasus
CL	0.80045	0.11008	0.50688	0.25594
P <sub>r</sub>	0.19955	0.88992	0.49312	0.74406

Table 8: Cost on income index

Indicators	COI
Advertising	30845.8
Product quality	84481.2
Price competitiveness	102746
Customer loyalty	85971.1
Market share	31176.9
Customer service	130888
E-commerce	23893.1
Management experience	24996.7
Branding	36805.3

Table 9: Probability of financial hazard

Parameter	Turkish airline	Onur air	Atlas jet	Pegasus
$P_h$	0.9224	0.92442	0.9283	0.92442

Table 10: Risk of the project implementation (in this case study the project implementation means decision of selecting one company for flying)

Parameters	Turkish airline	Onur air	Atlas jet	Pegasus
$P_p$	0.184069414	0.82266	0.45776	0.68783

**Calculate the probability of financial hazard:** Except the "Price competitiveness" and "Market price" all indicators are qualitative index (Table 9).

**Measuring risk of the project implementations:** Risk of the project implementation are shown in Table 10. Turkish airline with the lowest risk (18.41%) is selected as the preferred company.

In any decision method, risk has not been investigated and also the values obtained from the models are used to rank the options. For this reason, this method is distinct from other methods. Furthermore in the next section another distinctive feature of this method will be specified.

In any decision method risk has not been investigated and values obtained from the models are used to rank the options. For this reason, this method is distinct from other methods. Furthermore in the next section another distinctive feature of this method will be specified.

**Sensitivity analysis of the proposed method (as used in this case) using a stability index:**

Sensitivity Analysis (SA) is the study of how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input. The SA is hence considered by some as a prerequisite for model building in any setting, be it diagnostic or prognostic and in any field where models are used. Kolb (quoted in Rabitz, 1989) noted that theoretical methods are sufficiently advanced, so that it is intellectually dishonest to perform modeling without SA (Saltelli, 2002).

In fact, it checks the relationship between input and output of information and discuss the modifications that affect the output of the model (Saisana *et al.*, 2005). There are different ways for sensitivity analysis that Campolongo *et al.* (2005) and Saltelli *et al.* (2000) fully reviewed these methods.

One of these methods is changing the index weights. But it should be noted that the output of this proposed model are two different things:

- Ranking the project locations
- Calculating the risk of project implementation in the site chosen

Therefore, it is necessary to do sensitivity analysis on both output per changing the index weights. To change the weights of indicators it is used an index that called instability index and its sensitive will be discussed in those two output (Del Cano and de la Cruz, 2002).

**Sensitivity analysis of first section:** This part is focused on changing of the final ranking of project per changing of the indicator weights.

Since the thesis is used AHP method and paired comparisons for weighting the indicators, for analyzing the sensitivity the instability index (L') will be used. This index indicates that in which

extent decision maker judging can be such that the final ranking does not change. Therefore in the AHP matrix elements above the main diagonal should be multiplied on  $L'$  and the elements below the main diagonal should be divided on  $L'$  ( $0 < L' < 1$ ). The  $L'$  gradually reduced from the unit until the final ranking does not change. As soon as ranking changing causes, the decreasing of  $L'$  must be stopped and the instability index is obtained. Stability index ( $L$ ) is defined as followed:

$$L = \frac{1}{L'} \tag{12}$$

The lower the instability index is, the less sensitive model is to changes in weights (Chang *et al.*, 2007).

Figure 1 shows the trend of changes in the instability index and the final result for the case study. According to the entries expressed first part of curves that intersect will be presented as an instability indicator.

Decreasing  $L'$  has continued until  $10^{-7}$  but as the Fig. 3 shows none of the graphs intersect. So we can say that the final ranking model is not sensitive of weights changing or it's almost zero. This case seems reasonable. Because the ultimate goal of the model is measuring the locations risk and final ranking should not be changed by changing the weights. For accurate investigation, this claim will be examined in future research.

**Sensitivity analysis for second section:** The previous section outlined that model ranking sensitivity is very few by changing in the weights. In this part the sensitivity analysis will be done based on the risk of implementing the project in location 1 in case study by changing the weights of indicators.

In this section we will use the instability index, too. But the difference is that amount of  $L'$  will decrease until the amount of deviation in risk has arrived to 5%. Figure 4 shows decreasing of  $L'$  and percentage of changing in the amount of risk (Chang *et al.*, 2007).

According to the Fig. 1 when the  $L' = 0.2$ , Percentage of risk changing for location 1 is equal to 5%. As a result  $L = 5$ . Since the instability index is low, so the amount of risk is less sensitive to changes in weight.

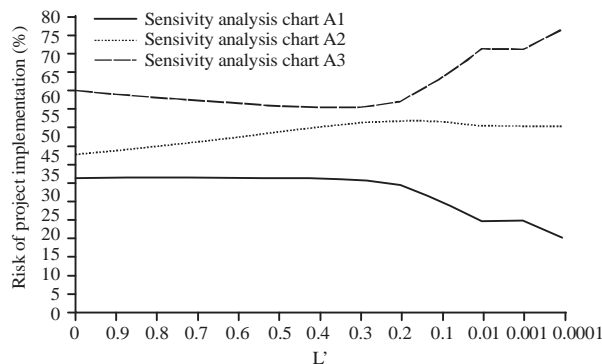


Fig. 3: Sensitivity analysis based on the instability index for the first section

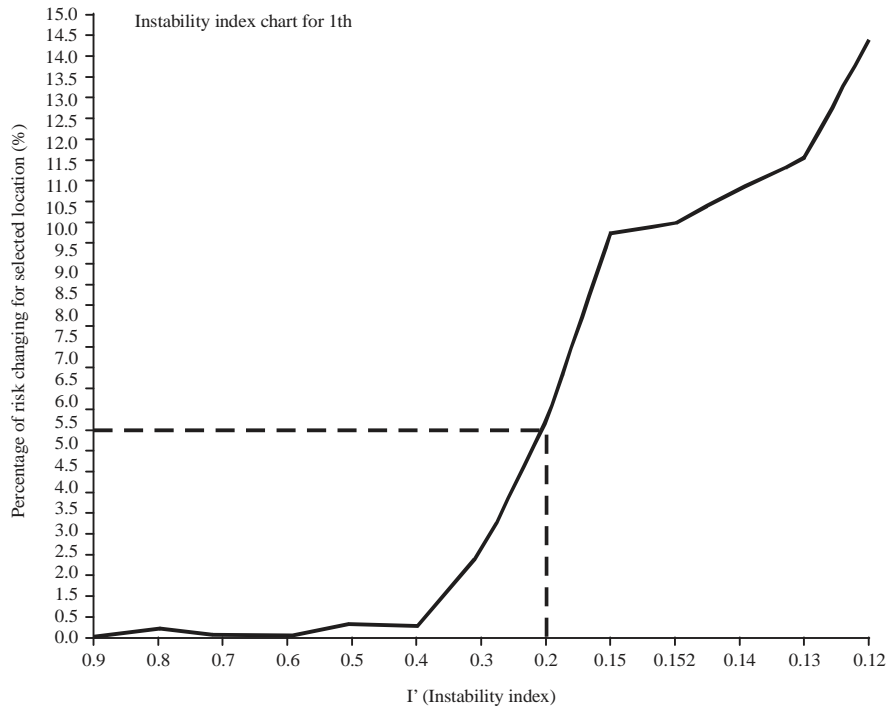


Fig. 4: Sensitivity analysis based on the instability index for the second section

**DISCUSSION**

At the management level, a clear vision that is created by the use of risk management system is to facilitate and improve the quality of decision making in the project. To create a clear vision should always combine qualitative and quantitative approaches to decide better (Haimes, 1998). In this study, new model called generalized TOPSIS method has been presented by integrating the business plan as a basis for the start of a project and TOPSIS method as a quantitative method for ranking decision problems. In this method three elements have defined: peril, financial hazard and risk and with these elements risk of project implementation measures and the best options is selected in the terms of the lowest risk. This model can be similar in some aspect with (Fouladgar *et al.*, 2012). One of the attributes of this model that differentiate it from other forms of multi-criteria decision making is that in addition to ranking options this model measures the peril probability and Final numbers obtained will be not applications only for ranking which is different from the approach of (Mobey and Parker, 2002; Abdelgawad and Fayek, 2010).

Sensitivity analysis is also examined in this study in a particular case and has been identified that final ranking of the model is not sensitive relative to the weights changing and the method for analyzing the sensitivity is stability index and model sensitivity from this index is 5 relative to the 5% changing in the amount of the project implementation risk in the best location. Since the stability index for the peril probability of the project implementation is very high, the model has very low sensitivity.

The study, suggest that, to develop more and better the model the fallowing items will be studied in future research, included:

- According to the first assumption in this model risk is considered as its negative aspect. In the future research this one can be developed and the positive aspect of it can be considered, too. One the way that can remove this problem is that after measuring the risk of project implementation this factor can again come to the model as a indicator and with the one of the multi-criteria decision making model such as TOPSIS resolved the issue. The name of this indicator can be "Unforeseen options"
- One of the factors influencing the decision-making model and also this model is to explain the impact indicators. On the other hand the PMBOK standard is a complete guide for Project Management. So with Combining this standard by business plan and fuzzy expert system can explain effective indicators on these issues and define the scientific basis for the indicators (Kahkonen, 2001)
- About the sensitivity analysis in future article can speak better and more. Also one can analyze sensitivity of the model with the others one

## **REFERENCES**

- Abdelgawad, M. and A.R. Fayek, 2010. Risk management in the construction industry using combined fuzzy FMEA and fuzzy AHP. *J. Constr. Eng. Manage.*, 136: 1028-1036.
- Anbari, F.T., 2003. Earned value project management method and extensions. *Project Manage. J.*, 34: 12-23.
- Campolongo, F., J. Cariboni, A. Saltelli and W. Schoutens, 2005. Enhancing the Morris method. *Proceedings of the 4th International Conference on Sensitivity Analysis of Model Output, (SAMO'04), Santa Fe, USA.*, pp: 369-379.
- Chang, B., C. Kuo, C.H. Wu and G.H. Tzeng, 2015. Using fuzzy analytic network process to assess the risks in enterprise resource planning system implementation. *Applied Soft Comput.*, 28: 196-207.
- Chang, C.W., C.R. Wu, C.T. Lin and H.C. Chen, 2007. An application of AHP and sensitivity analysis for selecting the best slicing machine. *Comput. Ind. Eng.*, 52: 296-307.
- Chin, K.S., D.W. Tang, J.B. Yang, S.Y. Wong and H.W. Wang, 2009. Assessing new product development project risk by Bayesian network with a systematic probability generation methodology. *Expert Syst. Applic.*, 36: 9879-9890.
- Cleland, D.I. and L.R. Ireland, 2008. *Project Manager's Handbook: Applying Best Practices Across Global Industries*. 1st Edn., McGraw-Hill Professional, New York, ISBN-13: 978-0071484428, Pages: 547.
- Crouhy, M., D. Galai and R. Mark, 2006. *The Essentials of Risk Management: The Definitive Guide for the Non-Risk Professional*. McGraw-Hill Professional, New York, USA., ISBN-13: 9780071483322, Pages: 416.
- Davenport, T.H. and J.E. Short, 1990. The new industrial engineering: Information technology and business process redesign. *Sloan Manage. Rev.*, 31: 11-27.
- Del Cano, A. and M.P. de la Cruz, 2002. Integrated methodology for project risk management. *J. Constr. Eng. Manage.*, 128: 473-485.
- Dey, P.K., 2001. Decision support system for risk management: A case study. *Manage. Decis.*, 39: 634-649.
- Ebrahimnejad, S., S.M. Mousavi and H. Seyrafipour, 2010. Risk identification and assessment for build-operate-transfer projects: A fuzzy multi attribute decision making model. *Expert Syst. Applic.*, 37: 575-586.

- FAA., 2000. System Safety Handbook. Federal Aviation Administration, Washington, DC., USA.
- Fouladgar, M.M., A. Yazdani-Chamzini and E.K. Zavadskas, 2012. Risk evaluation of tunneling projects. *Arch. Civil Mech. Eng.*, 12: 1-12.
- Galway, L., 2004. Quantitative risk analysis for project management: A critical review. Working Paper No. WR-112-RC, RAND Corporation, USA., February 2004.
- Haimes, Y.Y., 1998. Risk Modeling, Assessment and Management. John Wiley and Sons, New York, ISBN: 9780471240051, Pages: 744.
- Honig, B. and T. Karlsson, 2004. Institutional forces and the written business plan. *J. Manage.*, 30: 29-48.
- Hopkin, P., 2014. Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk Management. 3rd Edn., Kogan Page UK., ISBN-13: 978-0749472443. Pages: 448.
- Jahanshahloo, G.R., F.H. Lotfi and M. Izadikhah, 2006. An algorithmic method to extend TOPSIS for decision-making problems with interval data. *Applied Math. Comput.*, 175: 1375-1384.
- Kahkonen, K., 2001. Integration of risk and opportunity thinking in projects. Proceedings of the 4th European Project Management Conference, June 6-7, 2001, London, UK.
- Karlsson, T. and B. Honig, 2009. Judging a business by its cover: An institutional perspective on new ventures and the business plan. *J. Bus. Venturing*, 24: 27-45.
- Lyneis, J.M. and D.N. Ford, 2007. System dynamics applied to project management: A survey, assessment and directions for future research. *Syst. Dyn. Rev.*, 23: 157-189.
- Meredith, J.R. and J.S. Mantel Jr., 2011. Project Management: A Managerial Approach. John Wiley and Sons, London, UK., ISBN-13: 9780470533024, Pages: 600.
- Mobey, A. and D. Parker, 2002. Risk evaluation and its importance to project implementation. *Work Study*, 51: 202-208.
- PMI., 2004. A Guide to the Project Management Body of Knowledge. 3rd Edn., Project Management Institute, USA., ISBN-13: 978-1930699458, Pages: 390.
- Rabitz, H., 1989. Systems analysis at the molecular scale. *Science*, 246: 221-226.
- Raftery, J., 1994. Risk Analysis in Project Management. 2nd Edn., E & FN Spon Press, Padstow, UK., ISBN-13: 9780419184201, Pages: 143.
- Saisana, M., A. Saltelli and S. Tarantola, 2005. Uncertainty and sensitivity analysis techniques as tools for the quality assessment of composite indicators. *J. R. Stat. Soc.: Ser. A*, 168: 307-323.
- Saltelli, A., 2002. Sensitivity analysis for importance assessment. *Risk Anal.*, 22: 579-590.
- Saltelli, A., K. Chan and E.M. Scott, 2000. Sensitivity Analysis: Gauging the Worth of Scientific Models. Wiley, New York, ISBN: 9780471998921, Pages: 504.
- Stoneburner, G., A. Goguen and A. Feringa, 2002. Risk management guide for information technology systems. NIST Special Publication 800-30, National Institute of Standards and Technology, Gaithersburg, MD., USA., July 2002.
- Torlak, G., M. Sevkli, M. Sanal and S. Zaim, 2011. Analyzing business competition by using fuzzy TOPSIS method: An example of Turkish domestic airline industry. *Expert Syst. Applic.*, 38: 3396-3406.
- Turner, J.R., 2009. The Handbook of Project-based Management: Leading Strategic Change in Organizations. 3rd Edn., McGraw-Hill, London, UK., Pages: 452.