

Risks Appraisal of Information and Communication Technology Project phases By Shannon Entropy Method With improvement approaches

Maryam Teimoori rad¹, MohammadAli Soukhakian², Alireza Azizi³, Meisam Ahmadi⁴

¹. M.S. Shiraz Payam-e-noor University, ². PhD faculty member of Shiraz University, ³. M.S. Shiraz Payam-e-noor University, ⁴. M.S. Shiraz Payam-e-noor University. teimoori.rad@gmail.com

Abstract: the risk management comes into existence for improving the quality of decisions, systematizing the project, and considering the each phases of the project more important. Each project has 4phase which the manager encounters with risks in different phases. In this research for the first time using a specialized risk assessment in each of the phases of the project to be specified in each phase of the project is a further risk. Managers in each of the phases should decide to encounter or prevented the risks. Accordingly, at first, it is necessary to specify project achievement, identification and management of the risks and the methods that follow up them. In this research, some risks which threat information and communication technology projects have been identified and introduced by means of risk management techniques. After that for quantifying and prioritizing identified risks, Multi criteria decision making model, according to Shannon Entropy method is used. Shannon Entropy model help us to categorize the risks. After identifying and evaluating the risks According to the amount of the effectiveness, these above mentioned factors are effectively used to make ideal decision. Finally, approaches to improve the risks which have the most effects on information and communication technology projects are presented.

[Maryam Teimoori rad, MohammadAli Soukhakian, Alireza Azizi, Meisam Ahmadi. **Risks Appraisal of Information and Communication Technology Project phases By Shannon Entropy Method With improvement approaches.** *J Am Sci* 2012;8(11):120-127]. (ISSN: 1545-1003). <http://www.jofamericanscience.org>. 17

Key words: project; phase; Risk identification; Risk evaluation; Multi Applied Decision Making Methods (MADM); Shannon Entropy.

1. Introduction

To assemble teamwork, it would be included Communication, Conflict resolving, and leadership. Ironically, those are not considered in team building in the organizations. Actually, this is the time to manage the knowledge of project according to scientific methods (Ali and Hasani, 2006). Because of unpredicted risks, fulfillment of projects encounters to the plenty of delays which declines the influential time period of project and make them detrimental. Sometimes, changes stem from time suspension and restarting of the projects. As though, the nature of activities is the same. But, in most cases, the project faces to time delay, besides, the nature of activities subject to changes. The risk factors are being identified and diminished their impacts by risk management (Malekzadeh and Sakhtianchi, 2006). An enterprise would be able to attain to competitive advantage by dint of its opportunities exploitation. The cardinal factor in changing is decision making process, which should be according to the exhaustive information with a high level of outputs certainty. However, in the real world, decision making process builds on deficient information with a low level of outputs certainty that results in the risk and precariousness (Hue and Boading, 2007). Therefore, risk is the inherent part of

project management (Malekzadeh and Sakhtianchi, 2006).

There are some methods to control the risks which developed by researchers. In recent decades, Chapman and the other scholars, Stephan and Kerzner (1983), have presented a systematic approach to design, schedule, project control, and risk analysis. The risks of any project depend on some exclusive factors such as project realm, activities field, users, internalities, and externalities which are different from other projects (Hargraves, 2005). Accordingly, wielding of Risk Management Information System (RMIS) would be helpful to the risks identification (Ameli et al., 2005). As Zwikael and Sadeh (2006) said: The optimization of the schemes of the project can conduct the projects [with a high level of risks] forward to more achievement. Consequently, they suggest some terms to discover the amount of high level of risk impact on planning quality. In this view, projects with greater schemes should have four dimensions, included: Comprehensive planning, Total costs, Technical performance, and Costumer's satisfaction which make the projects improved (Zwikae and Sadeh, 2006).

2. Risk & Importance of the project risk management

The expressive changes, in the commerce and the routine life, named **Risk**. The risk describes any situation that is not adapted to its normal criterion. An event beyond control which may lead to an inevitable, and undesirable consequences, is called the risk of a project. Such a project causes the following consequences:

- 1- The costs of project will be increased above the budget.
- 2- The completion of project will be longer than expected.
- 3- The project may not be completed as expected, (cost, quality, etc).
- 4- The process project completion may not fit the standards.
- 5- Loss of credibility and good will of customs for further reference (Hargraves, 2005).

There are some definitions for the risks of project. One of them is the amount of facing to unpredicted events and its backwashes which can damage the aims of the project (Ali and Hasani, 2006). The risks and uncertainties are two important factors which would be harmful to any section of the project during implementation. As a whole, a kind of risk can amplify the other kind of risks' effect. The risk management is an intransitive requirement to realize the goals of project (Mohtashami et al., 2010).

3. Risk management of the project

Searching for the uncertainties and preventing them, is one of the main ideas in the risk management. The premier section [that creativity is the basic element in it] is the risk identification. The effective design and the development of the risk response need a new idea. Although, the risk identification is not sufficient solely, and if an adequate response is not shown, the depth of the risk would be stayed unchangeable. "Doing something repetitive and deferent outcome expectancy is madness" Einstein said (Hilson, 2005). How to plan for project risk management:

- 1- Determine the level of risk assessment for your project.
- 2- Incorporate risk management activities into the project schedule.
- 3- Make risk management agenda item for regularly scheduled project meetings.
- 4- Communicate the importance of risk management to the entire project team.
- 5- Establish the expectation that risk will be managed, documented and reported (Washington state department of transportation, 2010).

The risk assessment process named risk analysis. But using risk analysis in order to make a strategic decision for decreasing the risk or risk reformation, named risk management (Galway,

2004). Firelli held a seven phase's view in the risk management:

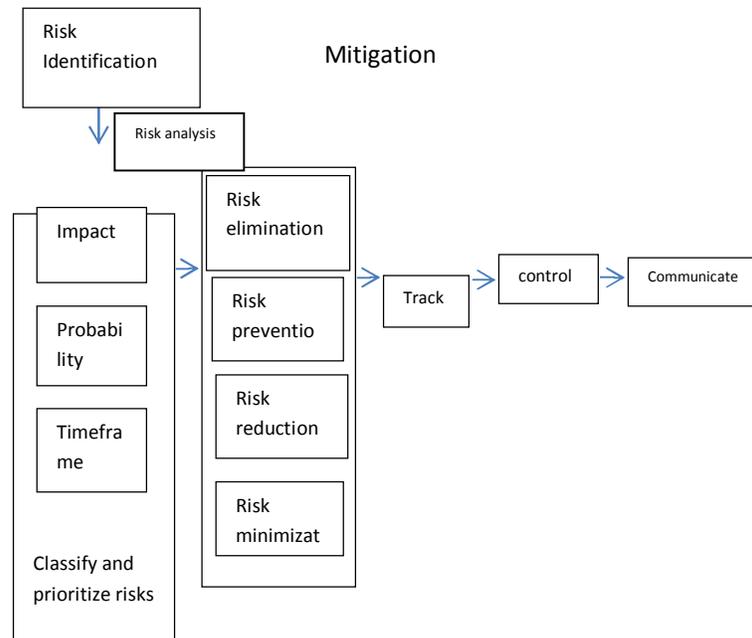
- 1- Risk factors identification.
- 2- The probability estimation of the risk occurrence and the amount of its effect.
- 3- Suggesting solutions to modify the identification risks.
- 4- Regulating on the risk factors.
- 5- Offering a probability plan.
- 6- Managing the crisis.
- 7- Rehabilitation of the organization after crisis (Project management group, 2010).

4. The primary process of the risk management project

The risk management included a process with several phases like the rate of vulnerability to formulize the risk decreasing plan as follows:

- 1- Risk management planning
- 2- Risk identification
- 3- Qualitative risk analysis
- 4- Quantitative risk analysis
- 5- Risk response planning
- 6- Risk monitoring and control (Pezzullo and De Filippo, 2009).

Diagram 1: Risk management process (Lawrence, 2000).



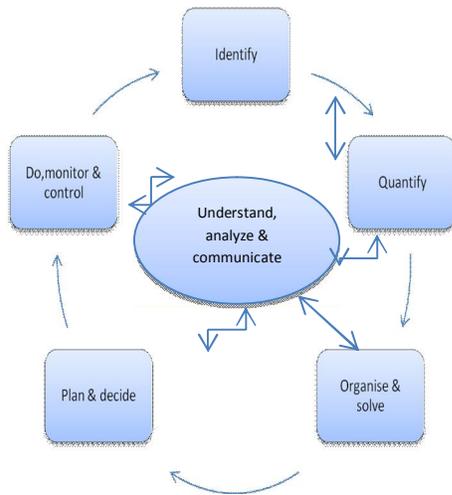
5. Risk identification process

Risk identification process contains the determination and regulation of the risks which have effect on the project and documentation of their characteristics. The participants in the risk identification are the team of project, board members, some experts from the other departments of the

executive organization related to the project subject, risk management team, shareholders, customers, the ultimate consumers, other project managers and external experts (Harrop, 2005). Risk identification methods are:

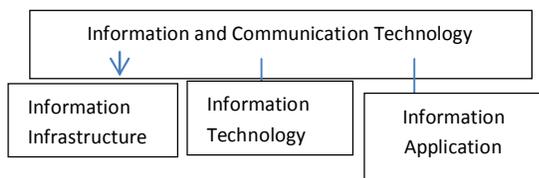
- 1- Revising of documentaries.
- 2- Gathering information techniques such as brain storming, Delphi, interview and SWOT1 techniques.
- 3- Checklists based on previous information and experiences from the other projects and the other information resources.
- 4- Hypotheses analysis.
- 5- Graphic techniques (Ahmadpor and Agharezaiee, 2005).

Diagram 2: The cycle of risk management project (Harrop, 2005).



6. Information and communication Technology projects

Information and communication Technology are categorized in three essential parts as follows: Information Infrastructure², Information Technology³ and Information Application⁴ (Soltanzadeh, 2010). Diagram 3: Infrastructure of Information and Communication Technology



¹ - SWOT: Strong, Weakness, Opportunity, Threat
² - Information Infrastructure:II
³ - Information Technology:IT
⁴ - Information Application:IA

7. Research materials and methods

One of the most popular techniques is interview and gathering information from the experts. First step in quantitative calculation of the risk is to carry out some interviews with shareholders and the specialists related to the project subject. The type of information depends on the type of likelihood distribution that will be used in the future. The participants in this research included managing director, board members and all of the senior managers and experts who are specialists in the field of ICT projects. All of respondents were 70 persons that 55 persons were male and 15 persons were female and their average educations were bachelor and the other specifications of them have been recorded in the following chart:

Table1: the average of age, education and servant's age

Gender	Respondents	The average Age	The average education	The average servant's age
Male	55	42	Bachelor	2
Female	15	28	Bachelor	8

Finally more than 140 risks were identified and because of some items similarities, merging concluded 33 final ICT project risks as follows:

1. Lack of correct project time estimation
2. Lack of a motivating system for finishing projects
3. Chronic qualitative problem in systematic project management
4. Devastating and lack of needed equipments
5. Lack of transaction and coordination of service organizations
6. Public preventing and damaging acts (cable, fiber optic, and Stealing)
7. Lack of project control software use at the time of project implementation
8. International prohibitions
9. Prolonging tender phase
10. Project accomplishment with inappropriate quality
11. Wrong Consultants, contractors and executive team selection
12. Powerless project managing system and its weak performance
13. Lack of attention to respective project technological changes speed
14. Lack of environmental analysis
15. Arising natural unexpected events
16. Lack of project information security
17. Arising effective, unpredicted and unknown project errors
18. Wrong personnel management and allotting

19. Need to professional and formal consultant in risk management context
20. Lose of key personnel in serious project points
21. Inaccuracy in method and environmental analysis validity
22. Inaccurate hypotheses in technique type and planning and programming
23. Financiers' request changes and their economic justification priority
24. Having no attention to needed substructure before planning
25. Weak performance and lack of managers support
26. Lack of adequate time observance between project planning and implementing
27. Lack of exact control and supervision on personnel performance
28. Individually and not technically tastes and styles
29. Imperfect explanation of project goal and quality
30. Lack of risk management teams and having incomplete sight to the changes
31. Project plan changing because of mistakes
32. Shortage of experts and adequate information on systems and equipments
33. Lack of project cost estimation

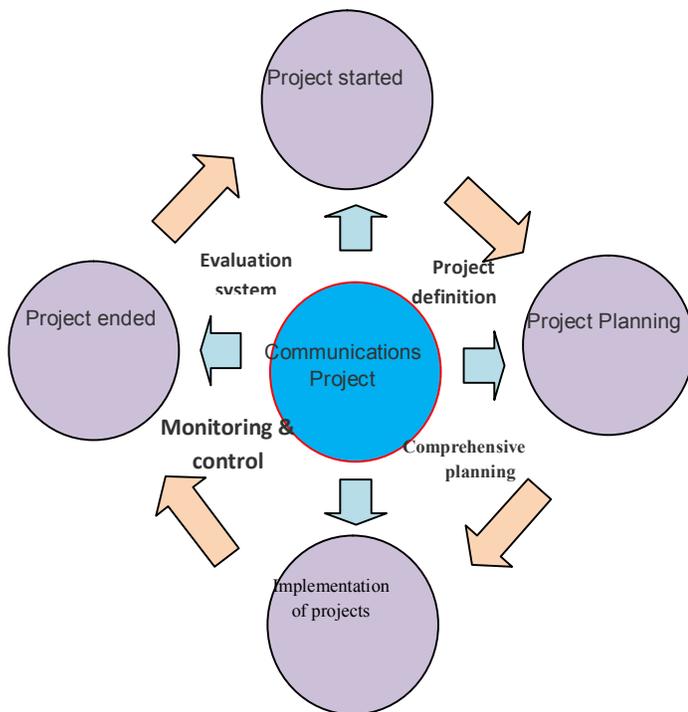


Diagram 4: project life cycle (Momeni, 2010).

8. Project Life Cycle

Each project has 4 phases that encounter with different and important risks. Each project has 4 phases which the manager encounters with risks in different phases. In this research for the first time using a specialized risk assessment in each of the phases of the project to be specified in each phase of the project is a further risk. Managers in each of the phases should decide to encounter or prevented the risks. Surface structure of the project has a higher probability of error, and damages, distractions in comparison with the deep structure of the project. So, the risk management comes into existence for improving the quality of decisions, systematizing the project, and considering the each phases of the project more important. A successful manager must use all of the facilities and tools for improving the project, and controlling the program and the cost. Increasing of efficiency and efficacy, cause the managers of organizations pay attention to the establishment and use of ICT rapidly. Inattentiveness to the managerial qualifications in implementation of ICT projects, not only strikes predicted profits down, but also, probably frustrates the projects.

9. ICT risks case study

After risk identifying and evaluating, 15 risks among these 33 which were the most effective and obvious ones were studied with Shannon Entropy method (one of the multi criterion decision making methods) in digital center of Shiraz Sadra town to see which one happens more in each of the center 4 phases. 15 project managers were participated in this case study to answer to the questionnaire in all of the 4 phases. The most effective risks were as follows:

- A: Lack of correct project time estimation
- B: Having no attention to needed substructure before planning
- C: Devastating and lack of needed equipments
- D: Lack of transaction and coordination of service organizations
- E: Public preventing and damaging acts (cable, fiber optic, and Stealing)
- F: Lack of project control software use at the time of project implementation
- G: International prohibitions
- H: Lack of risk management teams and having incomplete sight to the changes
- I: Powerless project managing system and its weak performance
- J: Chronic qualitative problem in systematic project management
- K: Lack of adequate time observance between project planning and implementing
- L: Wrong personnel management and allotting
- M: Shortage of experts and adequate information on systems and equipments

N: Prolonging tender phase
 O: Lack of project cost estimation

Managers were informed that for answering to the questionnaire questions they should give a number among 1 to 5 to show what is shown below:

- 1 = 0% - 20%
- 2 = 20% - 40%
- 3 = 40% - 60%
- 4 = 60% - 80%
- 5 = 80% - 100%

10. Risk evaluation in digital center project

After questionnaire analyzing with Shannon Entropy method and reaching to an average of the participants view about each of the risks, Shannon

Entropy is a method for evaluating the prioritizing the criteria. It cans priorities the risks and the formula is this:

$$A_i = S(P_1, P_2, \dots, P_n) = -K \sum_{i=1}^n P_i \ln P_i \quad \langle i = 1, 2, \dots, m \rangle$$

(Azar and Rajabzadeh, 2009).

It gave us below calculation and results:

A→O: project risks $x_1 \rightarrow x_4$: project phases from 1 to 4

Basic formula:

$$A_i = S(P_1, P_2, \dots, P_n) = -K \sum_{i=1}^n P_i \ln P_i \quad \langle i = 1, 2, \dots, m \rangle$$

Table 2: evaluating the prioritizing the risks

Risk Phase	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
x ₁	4	3.8	2	4/1	1/6	3/1	1/8	1/9	3/1	4/1	1/2	1/8	1/1	2/9	4/2
x ₂	4	3.8	3.3	4/6	3/2	3/2	3/8	3/8	4/4	4/1	3/3	2/4	2/8	3/4	4/4
x ₃	2.6	2.6	4.1	4/6	4/4	2/4	4/6	3/5	3/6	4/2	3/6	2/5	3/4	3/3	2/9
x ₄	2.1	1.7	3	1/8	3/5	2/4	2/6	2	2/4	2/7	1/6	2/1	2/7	2/8	2/9
total	12.7	11.9	12.4	15/1	12/7	11/1	12/8	11/2	13/5	15/1	9/7	8/8	10	12/4	14/4

Risk Phase	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
x ₁	0.3150	0.3193	0.1613	0.2715	0.1260	0.2793	0.1406	0.1696	0.2296	0.2715	0.1237	0.2045	0.11	0.2339	0.2917
x ₂	0.3150	0.3193	0.2661	0.3046	0.2520	0.2883	0.2969	0.3393	0.3259	0.2715	0.3402	0.2727	0.28	0.2742	0.3056
x ₃	0.2047	0.2185	0.3306	0.3046	0.3464	0.2162	0.3594	0.3125	0.2667	0.2781	0.3711	0.2841	0.34	0.2661	0.2014
x ₄	0.1653	0.1428	0.2419	0.1192	0.2756	0.2162	0.2031	0.1786	0.1778	0.1788	0.1649	0.2386	0.27	0.2258	0.2014

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Ej	0.9737	0.9660	0.9779	0.9605	0.9599	0.9933	0.9578	0.9657	0.9829	0.9894	0.9308	0.9942	0.9518	0.9975	0.9861

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Dj	0.0263	0.034	0.0221	0.0395	0.0401	0.0067	0.0422	0.0343	0.0171	0.0106	0.0692	0.0058	0.0482	0.0025	0.0139

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
wj	0.0637	0.0824	0.0535	0.0957	0.0972	0.0162	0.1023	0.0831	0.414	0.0256	0.1677	0.0140	0.1168	0.0060	0.336

So, the most effective and current risks could be as follows according to the above results:

I > O > K > M > G > E > D > H > B > A > C > J > F > L > N

11. Risk evaluation in each phase

As the resulted numbers from Shannon Entropy tables are for all the 4 phases of the project, any project risk limitation can be calculated. In order for it, we should first introduce an amount as crisis number so that each number in any phase above it can be selected as an important risk in that phase. The resulted number as for scale number one that is from 1 to 5, get the number 3. So, below results are produced:

Arrangement of more current & important risks for phase 1 Sadra project: O > J > D > A > B > F > I

Arrangement of more current & important risks for phase 2 Sadra project: D > I > O > J > A > B > H > G > N > K > C > E > F

Arrangement of more current & important risks for phase 3 Sadra project: D > G > E > J > C > I > K > H > M > N

Arrangement of more current & important risks for phase 4 Sadra project: E > C

12. Improvement paths presentation: Today, the most important task of any manager is decision-making and planning. Because of scarcity of resources, facilities, and internal and external effective factors, implementation conditions in order for denominated goals, changes continuously. Since because of scarcity of time and resources, there is not enough ability to resolve all of the risk-makers factors, it is essential to pay more attention to some main factors. We should try to concentrate our resources on some basic numeral risks on the basis of Pareto law. After risks identifying and prioritizing, by using checklists and surveys, it should be requested from top managers that present improvement paths for the most effective 15 first risks in ICT projects. These proposals are added in below table:

Table 3: Improvement paths presentation

Risk name	Lack of correct project time estimation
Suggested Solutions	Use of former experiences and obstacles
	Use of project management software
	Dividing the project into small ones for better time estimation
	Making an expert team for determining the project situation before its start
	More Project phases Scrutiny for better possible obstacle forecasting
	Project implementation in the best time(season)
Risk name	Having no attention to needed substructure before planning
Suggested Solutions	Noting to monolithic management and on the basis of ITU standards
	Noting to purported technologies and making common relation protocol between companies and related organizations
	Paying more attention to available network transaction with new ones and their coordination
	Making projects more applicable by having a wider view to projects
	Experience transition between Middle managers and other experts in project designing
	Removing obstacles before its start
	Making an update data base
Risk name	Devastating and lack of needed equipments
Suggested Solutions	Provision of proper and standard equipments according to weather conditions
	Revision in guarantee and warranty of equipments and facilities
	Spare equipment
	Sight improvement in designers, equipment buyers, and supervisors
	Supporting systems and measuring instruments calibration
	Making QC sections and having quality control capable systems
	Having more attention to supporting systems in contracts
	Cyclical maintenance for systems and equipments
	Personnel destruction removal training courses
Risk name	Lack of transaction and coordination of service organizations
Suggested Solutions	Eliminating redundant rules in organizations
	Making an applied relationship with equivalent projects
	Makin a concentrated urban management for more coordination
	Coordination procedures identification
	Transaction of region management with project involved organizations
	Direct negotiation with main decision-makers in engaged organizations
	Trying to make a service and public organizations consensus through mutual transaction
	Public preventing and damaging acts (cable, fiber optic, and Stealing)
Risk name	Establishing a cultural context for citizenry to protect from equipments
	Provision of a desired and confident system for the region

Suggested Solutions	Training and regional culture building after social pathology in the field of equipments robbery
	Making a confident physical protection
	Establishing public self-consciousness and protection and preservation spirit through propaganda
	More transaction with police force and other security organizations
	Using modern methods like relationship way monitoring
	Designing the project with the least possible accessibility for vulturine
	Fast and proper identification of owners and meeting their logical needs and prevention of their misuses
	Getting Inquiry from all of the neighbor organizations and lands
	Risk name
Suggested Solutions	No project phases acceptance from contractors in cases they do not use related software
	Buying, implementing, and obliging use of update software
	Comparison among managers who use or don't use software in their projects
	Designing and implementing executive operations from traditional perspective to modern ones
	Transaction between university and industry for software creation
	Personnel training and changing attitude of whom are responsible in implementing a design which is used in projects
Risk name	International prohibitions
Suggested Solutions	Noting to economic transactions among countries and their economic interdependency
	Project designing according to national facilities
	Transforming threats to opportunity by the use of SWOT
	Making and establishing crisis management and risk management in projects
	Noting to national productions and strengthening them to become independent
	Using outsourcing strategy and contracting out public activities to private enterprise
	Trying to transact between industry and university national production approach and industrial self-sufficiency
	Not use of the equipment which may cause lack of warrantee
	Encourage experts to face with prohibitions
	Tying to break prohibition in emergency external equipment use and make a context to montage it
Risk name	Prolonging tender phase
Suggested Solutions	Eliminating redundant phases and summarizing it
	Making a powerful team and have an approach consensus in tender phase
	Estimating tender phase time according to project conditions and restrictions
	Changing the structure of tender phase
	Justifying fiscal section for tender phase acceleration
	More control on tender phases and development

	declaration Strength points identification and presenting solution ways Establishing a separate tender committee for tender phase acceleration Using consultant in provision of tenders and contracts in contact with R&D team Tender phase elimination and project direct contracting to empowered companies
Risk name	Powerless project managing system and its weak performance
Suggested Solutions	Project manager training and appointing the best one as project manager Continues control and supervision on project management performance through superior managers Establishing assessment system for evaluating, selecting and promoting qualified managers to project manager Proper dividing and presenting job description in a fashion that make the most independency to project manager Task framing from the project start to its end and contracting each task to an empowered work team Using project control instrument and using former project records
Risk name	Wrong personnel management and allotting
Suggested Solutions	Establish empowered training work teams Making " human resource, organization main capital" the main belief of organization Protecting key personnel by participating them in organizational gains Planning for finding talents and use them in specialty status Establishing an expert team for personnel selection Selection of empowered personnel in all of the organization sections not aggregating them in a special point Establishing punishment and encouragement system for motivation Using expert, emotional, proficiency, and moral tests for better personnel identification
Risk name	Lack of adequate time observance between project planning and implementing
Suggested Solutions	Using control project software Establishing fiscal and technical context before project starting Prioritizing plan implementation on the basis of their importance in the project and in accordance with project region Emphasis on some techniques like CPM for better project time control Having a monolithic approach to the project Making personnel motivated as much as possible for project acceleration
Risk name	Chronic qualitative problem in systematic project management
Suggested Solutions	Using project management standards and evaluating project on the basis of standards Assigning the whole project from start to the end to an expert as a project manager and don't let inexpert ones to give any idea Continuous personnel training for their scientific

	promotion Acting in a process manner and maintaining quality in all project phases Restraining technical and experienced manager changes Designing, implementing, estimating, transacting, and supervising with caution and being update from the start to the end Investigating similar projects and using hypotheses analysis for preventing them from being repeated
Risk name	Shortage of experts and adequate information on systems and equipments
Suggested Solutions	Predicting personnel training before contracting and equipment procurement Establishing academic classes in constructor companies presenting their licenses Optimized use of warrantee services, catalogs, and constructor companies sites Using empirical ability of similar individuals and instructing models, theory and practical training Having displacement view and noting to expert persons decline Establishment of an internal powerful training center for continuous personnel training and promoting
Risk name	Lack of risk management teams and having incomplete sight to the changes
Suggested Solutions	Placing risk management position in organizational structure Proper risk management and enrichment training Establishing data bases monolithic management in order to identify risk factors and making project risk priority list Noting to technological changes speed and using replacement alternatives Establishing risk management committees in all the projects and identifying problems and threats and their confronting ways Noting to project progress flow and its crisis points in order to identify prevention ways and confronting them Using talented university persons besides organization old ones
Risk name	Lack of project cost estimation
Suggested Solutions	Establishing economic analysis groups and noting to inflation flow and social circumstances Precise evaluation of costs and capital return before project implementation Diminishing designing, trend, implementation and phase project management time gap Using cost estimation techniques and estimating a percentage above calculate rate Project updated progress control Project Documentation and acts and not occulting standards on the basis of project cost management techniques Instructions updating on the basis of project time and place qualifications Making a balance between project cost and time by using PERT, GERT, GANT, CPM, and... Having an economic team besides project management team

12. Conclusion and discussion

Risk management is an actuality and we need it to encounter risks which introduced in this article. For an important decision-making process, it needs to identify the internalities and externalities of the organizations and projects. This research is concentrated on the negative risk aspects in terms of its detrimental effects on the each phase of the project results. The most important section in addressing the project around paying attention to the risk management field is the risk identification which introduces its required instruments. According to the expansion of the project fields during spending project studies process, some risks may not be paid attention to. However, organizations are not able to have a plan for all of the risks. Project risk can increase project cost in relation to its predicted amount which can cause more time consumed as what is predicted. This may cause undesired quality, company credit decrement, and consequently costumers lose. Opportunity and uncertainty are close to each other. When a risk happens, it can convert to the opportunity and the opportunity associated with the risk can exit the project from the mainstream. Finally, prior risks in ICT projects were evaluated with Shannon Entropy method in one of the ICT projects which recently exploited. It was realized that in this project, which risk has more occurrence probability in each of its 4 phase and eventually what can be done to prevent from or reduce them. Since each organization can economize its project design from this conclusion, national economic and social goal attainment would be possible easier to achieve us to a national macro planning. A few minutes of risk management on even the smallest project gets a good return for the effort. We just need to scale risk management, so the payback is proportional to the cost. In this era, because of the quick technological changes, globalization and the development of enterprises activities, possessing of an efficient information system is necessary to attain a competitive advantage.

Corresponding Author:

Maryam Teimoorirad
Shiraz Payam-e-noor University
E-mail: teimoori.rad@gmail.com

References:

- Ahmadpour M, Agharezaiee M., A Guide to Project Management Body of Knowledge. PMBOK. project management institute.2000 edition, 2005.
- Ali M, Hassani A.,Project Management Knowledge. Semnan University, 2006.
- Ameli J, Saeedi M, Rezaiefar A,Designing Risk Management Information System in Industrial Investment Projects, 2005.
- Azar A, Rajabzadeh A,Applied Decision Making, M.A.D.M. Approach, Tehran, Negahdaneh, 2009.
- Galway L Quantitative Risk Analysis for Project Management. a Critical Review. Rand corporation,working paper, 2004, 1-40.
- Hargraves T,Effective Management of Project Risk. risk management in the public sector CIPFA London division meeting, 2005, 1-18.
- Harrop M,Risk Management Strategy. Approved by the SPHA Board, 2005.
- Hilson D., Risk Doctor Briefing. Retrieved from, 2005. "www.risk-doctor.com"
- Hue K, Baoding L.,Project Scheduling Problem with Mixed Uncertainty of Randomness and Fuzziness. Elsevier, 2007.
- Lawrence P L,Putting Quality in Project Risk Management Understanding Variation. Advanced project institute, 2000.
- Malekzadeh GH, Sakhtianchi S,Project Management, Control and Programming Methods. Tehran. Jahanefarda, 2006.
- Mohtashami N, Bashardost P, Nasirzadeh F,Analysis of the risks affecting the development of an oil field using techniques Tamil – Fuzzy. 6th international project management conference, 2010.
- Momeni J. Project Management Life Cycle. applied guide for begins. Programming, implications, and ends project. Tehran. Arianaghalam, 2010.
- Pezzullo L, De Filippo R, Perceptions of Industrial Risk and Emergency Management Procedures in Hazmat Logistics. A qualitative mental model approach Department of General Psychology.Italy University of Padova, 2009.
- Project management group, Risk Management. Retrieved, 2010. from www.pme-gw.com.
- Soltanzadeh J,Developed Strategic Programming in IT & ICT in Mazandaran University. Mazandaran province telecommunication, 2010.
- Washington state department of transportation, Project Risk Management. guideline for WSDOT projects, 2010, 1-74. www.wsdot.wa.gov.
- Zwikael O, Sadeh A, Planning Effort as an Effective Risk Management Tool, 2006.

10/2/2012