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A method to identify and prioritize potential risks of software projects based on C# codes.

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***Abstract*— Identify of potential risks is the first step in the management risk of software projects. It is a key step that other steps are based on it. In this paper a model is presented to improve the process of identifying potential risks. This model can vouch (assure) development of software projects. A matrix solution is given (is presented) to identify the levels of potential risks. Solutions and the causes of risks are classified based on the known and unknown, and also the levels were determind. The design of this model, in addition to strategy (admission, transfer) to avoid risks and probabilities are modified with new informations. A search algorithm (condition-action) is used to identify and prioritize potential risks based on sequence data structure. This algorithm has been implemented based on the C# codes and it also works on boolean variables. To implement the algorithm operating functions such as searching, planning, control, events, and management were used. To complete it these functions provided by the law-condition apply the potential risks are identified and then prioritized. Zero, and one decision variables to store intermediate results in their practice of inference, as intelligently manage event risks. The implementation of this model in various stages leading to optimized selection of the new solution, and output of model reduces the cost, schedule, and quality of software development. Also the risks and complexities and uncertainties are controlled. The validity of this method is assessed qualitatively using a practical example. This example relates to the users of ICT in training and education center in mazandaran were evaluated.**

***Index Terms*— Risk identification, operating functions, matrix solutions-causes, Boolean variables, C#, ICT.**

I. INTRODUCTION

The project is a unique process which involves a series of coordinated and controlled activities with requires limited of time, expenses, and resources [2]. Project management applying knowledge, skills, tools, and necessary techniques. Implementation of its activities to provide the needs and expectation of stakeholders. Risks is a situation that can lead to accident. Purpose of identifying risks, is providing a position to assess, reduce and eliminate risk at its best condition. Risks are the possibility of conversion to an incident or accident risk [5] risks are defined as: The probability that an incident or accident risk to be converted [11]. Project risks, that threaten the developing software and organization [1].Types of risks that may be effective projects, depending on project and organizational environment where software is developed. But manage risks are universal [1]. Managing project risk is any uncertainly, if it occurs, one or more project (time, cost, performance, quality, scope, customer satisfaction) are affected [8]. Risk management in software project development projects as an independent field research in 1989, it was recognized when bohm's book "software risk management" was published [10].The purpose of software development projects, building high quality software that provides customer needs in terms of time and budget [9]. However, a variety of risks, complexity and uncertainly in software development that it is hard to control. If you have not done a proper project management, software projects will not reach ang where [9]. Developing of management theories, planning, and developing of their applications, required the use of tools on risk management. In particular strongly felt in centered learning of environment. In general, the following objectives have always been about risk management:

1) Identification and definition of project risks and evaluate them in general.
2) Eliminate or reduce risks of project, regardless of which party assumes, underlying the risks of project.
3) Distribution, transmission of risk in a correct order among the project members.

In general, risk management increases the likelihood of success, and it will reduce the probability of failure and uncertainty in achieving the overall objectives of the organization. In this article there are 5 basic factors for risk project software management include: Recognize potential risks, analyze risks, planning to answer the risks, controlling and (risk monitoring), and decision variables.

Identify risk management of software projects is an essential step, as other steps are based upon it [6].

The main methods and tools employed in the identification of risks are discussed in the following six areas: Search on the list of potential risks, search on the list of prioritized risks, risk response planning, controlling and monitoring risk, event risk, management risk and the termination of the risk. Risk identification rules, based on historical data that is relevant to the project as strengthening ICT users in education training organization in mazandaran provience. Risk identification algorithm is based on the Boolean variable values ok, ok1, ok2, acts on the C# code [Appendix 1].

In this article the main objective is to identify and prioritize potential risks associated with the project strengthening ICT users. The selections of an appropriate strategy for those risks that have been prioritized. Later phases of the proposed model is presented in section 2. In the third section, case study, and forth section discussion and conclusion are presented.

II. PHASES OF THE PROPOSED MODEL.

First phase: Identification of potential risks phase.
Identify of potential risks is the first step in the risk management of software projects [1]. In this phase of the project risks are identified an recognized, then be documented. Also, include recognizing risk, detail, focusing

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on risk, and look at the process are used to determine the potential risks to the project(as an input). With these tools, the risks are identified and clearly defined and elected. After providing the required inputs, using techniques (interviews, or check lists) can be used to identify project risks. The outputs from risks identification basically are presented are kept in a document that it is called the risk document. Outputs identified in the first phase includes a list of identified risks is associated with their occurrence due. Also, These risks are categorized in three different levels (see Table I) according to the known and unknown solutions, and causes of these risks. Solutions and causes of these risks are categorized after they are identified and concentrated on those.

TABLE I. RISK IDENTIFICATION LEVELS[4]

1	2	Solution	
3	4	known	unknown
Reason for risks	known	‹valueless low	Risks need high technology(serious),large
	unknown	Risks need more accuracy (disaster),critical	Simple risk, tolerable(risks that don't need to be solved),middium

Risks that reasons of those are known, and solution are known, these groups of risks are simple, and tolerable, and valueless,(worthless). Because they lose less expense, and also less time (Table II). This means the risk effective decrease [1], and can pass the dangers [8], or dangers can be transferred transfer/share [8]. By using warrenty and yurantee can transfer the risks, also using preventional can decrease the risks.

TABLE II. SOLUTION MATRIX(REASON KNOWN-SOLUTION KNOWN)[4]

1	2	solution		
3	4	known		unknown
Reason for risks		‹tolerables‹Worthless simple	risks	
		Outside risk	Suitable for	
		transfer	situation	
		request	Solution risk	
	unknown	request		Solution risk

Risks that reasons are unknown, and solutions are known. These group of risks need accuracy, and are disaster, because they lose expenses and need more time (Table III). In general total of disaster risks have to be taken as a consideration.

TABLE III. SOLUTION MATRIX(SOLUTION-CAUSE)(CAUSE UNKNOWN-SOLUTION KNOWN[4]

1	2	solution		
3	4	known		unknown
Cause of risks	known			
	unknown	Need more accuracy(disaster)	risks	
		organization risks	Suitable for	
		Accept	situation	
		request	Solution risk	

Risks that causes are known, and solutions are unknown, this group of risks need higher technologies. Because lose a lot of expenses and times [Table IV]. This type of rise need more time, and less expenses, or less time, and more expenses. Also serious risks, have to be considered more than medium risks.

TABLE IV. (SOLUTION-CAUSES) MATRIX(CAUSES KNOWN-SOLUTION UNKNOWN)[4]

1	2	solution		
3	4	known	unknown	
Causes of risks	known		Need high technology(serious)	risks
			Technical risks	Suitable for
			(low)-(decrease)	situation
			requested	Solution risk
	Unknown			

Phase 2: Phase analysis of potential risks

Risk analysis is a major part of risk management. Qualitative risk analysis includes methods for prioritizing the identified risks. This phase could lead directly to risk response planning. Risk effects might be disaster, serious, tolerable or worthless. When risks are analyzed, it must be decided what the risks are considered in the project. This judgment depends on the combination of likelihood and impact of risks. The most important and the likehood and impact of risks. The most important and the key input qualitative risks analysis phase is, the previous phase of the output, same as the identified risks.

Techniques and tools used in the second phase is to assess the likelihood and impact of risks. Probability of each specific risk will be reviewed. Grading and classification risk analysis process, each risk identified, and is considered likely to occur and can be seriously discussed. There is no easy way to do this, and depending on the experience and judgment of management. The following techniques are considered. In the quantitative analysis phase, risks are classified as known and unknown. Their causes and solutions, as known or unknown. Each of them will receive the following values low, medium, big crisis, are shown in Table I.

For simple, and tolerable risks (risks that are not worth solving) the average value, and the risk of serious (solving them requires high technology great value, and for disaster risk controversial (risks that require high a accuracy) is considered a critical value, the output of this phase is a prioritized list of risks.

Phase 3: Programmed phase to respond to potential risks(risk response)

In this phase, according to the results of the previous phase, we can answer in relating to planning and responding to the risks. Risks response planning is the process in which the necessary activities are being aimed to reduce the threats. In this phase, the most important, and key input, is the output of the previous phase. That is, The list of prioritized risks, because the process of responding to the risks, considered to the priorities of risks. There are several strategies to respond to risks. A strategy or combination of strategies that seen to be

selected for each risk. If the selected strategy was not quite effective, or accepted risk occurs, we can use run a retreat. Often a contingency reserve for time or money will be considered. Usually, Threats or risks associated with negative impacts on project objectives, the following four strategies will be considered:

4) Avoiding: Change management program to remove the threats.
5) Transmission: Shifts negatively associated with ownership of the response to the threat of the third party.
6) Reduction: Primary measures to reduce the probability or impact occurred around the threshold of acceptable risk.
7) Reception: Where it is rarely possible to eliminate all the risks of the project it will adopt this strategy.

Now it should be investigated which of the above strategies to respond to each of the identified risks, are more effective. As a result, The output will be determined by the risk response process.

Risk response planning process, appropriate responses are chosen and agreed upon, and are included in the risk register.

It is important that the risks are high and the attention to detail moderate, and low risk are on a separate list for the periodic review.

Phase 4: Phase control and monitor risks

Risk monitoring includes regular assessment of risk has been identified to be decided whether the probability of that risk is reduced or not [1]. Is the effect of risk can be changed or not. Risk monitoring is an ongoing process, and the review by management, The key risks should be considered separately and will be discussed by the supervisor [1]. If any changes occur, new risks can be identified through the ongoing monitoring and evaluation mechanisms, like other planned project risk management process is an interactive process that continues throughout the project. When initial plans were drawn, the situation will be monitored. By providing more information about the risks, remodified with new information [1]. This process is simulated using C# codes (Appendix 1).

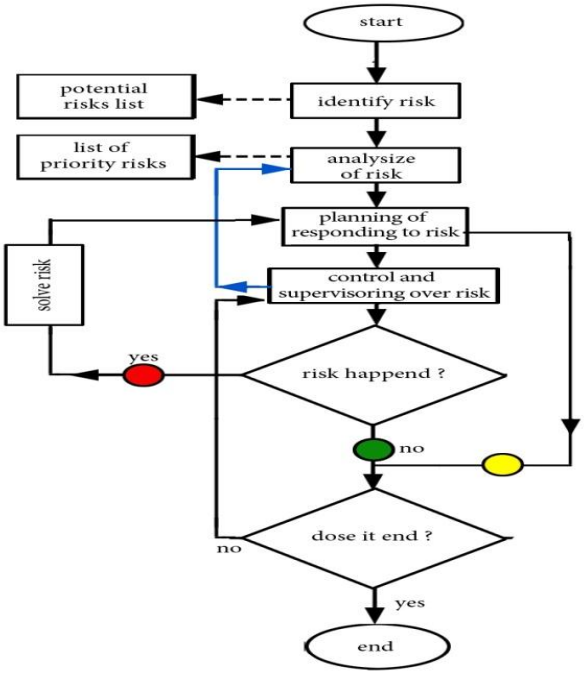

Figure I. Identification processing risk model of software projects

III. Case Study

First Step: Identify Potential Risks

As it was noted risk identification is the first step in the risk management of software projects. Project risk identification process to reinforcement users, information and communication technology (ICT) in education of mazandaran is shown in Figure :I identify risk factors, defines the whole process from input to output this process includes input, output, processing mechanism, which is shown in Figure II.

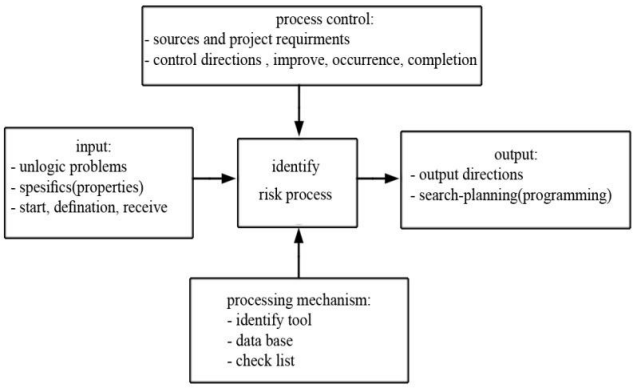

Figure 2. Frame of risk identification.

A. Input

This section is made up of parts begin, define, and receive a risk. At the beginning string variable is used to define each risk. Then an array of type string are defined to hold the list of potential risks. In this paper, 13 risks are determined according to the results of a research project [4]. Also in the definition, the list of potential risks and prioritize risk is defined, and using production rules (if…then…) are stored in the data base. At the reception section, the risks entered into the system by the function Readline() are received.In this section the division between the data base and the system is established based on the production rules (Appendix 1).

Type of risks are associated with the effect (the mean percentage), and probability of risks (qualitative) are shown in Table V.

B. Output

A simple method was used for the identification of risk commands. The instructions for operating functions (search,planning), were implemented by simple structures. Instructions for identifying risks in the search result is prioritized list of potential risks. Search is a function that at each stage, searches for a risk among the potential risk. If it is find, another search function, the risk identified in the list of prioritized risks searches.

If you find it, the active risk response plan is based on four strategies (avoid, transfer, reduce, accept) the appropriate response to each risk. The output of the search algorithm, based on production rules (if…then…) . It will be solution, or failure(Appendix 1).

C. Process Control

These statements relate to operating functions (control, event management, completion), which were implemented by simple structures. Also by keeping intermidate results, avoid risks and contingency plans are modified with new information. Thus, These risks are monitored and controlled.

The zero-one deciosion variables to store intermediate results of operations itself with reasoning (inference), an intelligent even and non-event to manage risk. If (term or condition) then (Conclusions or actions). Appendix 1.

D. Processing mechanisms

Types of risks in the data base relating to risks and risks are prioritized. The risk of a variety of administrative, technical, and so on.This means that the risk to the environment by the system function (search function, potential risks) using the condition, is to identify and prioritize actions. Risk logged in the list of potential risks that have already been defined in the list, whether it is or not in the list. If it was in the list it goes to the next step, and checks the prioritize list. if it was in the list of prioritized, then planning of the risk response it is activated and the run of the selected of strategy. In the case, the suitable of risk response is presented (A good solution is selected according to Table IV). Since the observations after each act of perception may provide new information about current state,Since the observations after each operation may provide new information about the current state and the leaves, each observation defines a probability that can be programmed for it. In this case, the solution can be implemented as a tree, and it is often search and run for an alternate (interleave). In this case, Algorithm by storing intermediate results (If Control and monitoring risk done And the risk is among of the risk prioritization), Avoidance strategy of risk And potential Will be correct with new information. Otherwise, Do not planning of response to the risks and program completion is invoked (see Appendix 1). Thus, These risks are monitored and controlled. Finally, decision variables to zero and one keeping a inference intermediate results in it action, event and non-event intelligently managing risk. Selected risk response strategies given in the Table III are done. A few steps load to the selection and implementation of solutions in risk categories are done based on the serverity of the consequences and probabilities. As a result, high priority risks, low and medium identified and appropriate strategies should be chosen according to the Table V, and VIII.

This step begins with the first phase of the project risk management process, risk that may threaten the project should be identified. Various categories of project risk can be defined depending on the project that will be changed. It is required for each risk and it is estimated influence on the probability of occurrence of each of the objectives of project. But the actual project, a detailed estimated of the probability of a risk and its influence on each of the goals of the project is not possible. Only a small number of well known risks, the probability and impact of the risks on project objectives can be identified. The other risks due to the lack of historical data is the probability measure of risks can not be a criterion (to measure the uncertainty of expert estimates of risk occurrence). Indeed, rather than the probability of each risk, we will face the degree of Possibility of risk occurrence. Also influence of the risk of ambiguity objectives of the project are covered. In this project 13 risks are identified from article (factors affecting users of ICT in strengthening education of mazandaran provience) of research project of education in the mazandaran provience with the same name it is shown in Table V [5]. The amount of effect, and extent is occurred in each category is shown in table. In total 13 different projects and there risks are included, and their risks are shown as of k={1,2,…,13} according to the Table VI.

TABLE V. RISKS IDENTIFIED ON PROJECT IN ENHANCING USER OF ICT IN EDUCATION OF MAZANDARAN[3].

solutions	Probability of occurrence	Effect or serverty of the consequences	causes (reasons)	Risk identified	Kind of risk	Number of risks
unknown	low	4.64 % worthless	Not interested in using ICT continued	interest	management	1
Introduction of using ICT	high	11.29 % disaster	Not having enough knowledge of user, using ICT	Get familiar	management	2
Empowerment by practice	high	10.41 % disaster	Not having enough skills using ICT	skill	management	3
unknown	high	9.10 % serious	Not having enough creation using ICT	creation	management	4
unknown	high	10.90 % disaster	Not having enough innovation using ICT	innovation	management	5
Enowgh software in education center	middium	8.02 % serious	Not having suitable software in education center	software	technical	6
Enough hardware equipments in education center	low	5.76 % worthless	Not having enough hardware equipments in education center	computer	technical	7
Network setup and installation in education center	low	5.70 % worthless	Not access to network in education center	network	technical	8
Connect to the internet an lower the connection expense	low	5.40% worthless	Not access to the internet	The internet	technical	9
Buying magazines and books necessary for education center	low	6.63 % worthless	Not having enough books and mazandaran in education center	Magazine and books	technical	10
Guide book for software & hardware trouble shoot through telephone, web, site,email.	middium	8.42 % serious	Not enough support with ICT	support	technical	11
Goals are known, up to date text books,software, hardware, accuracy of materials, software, hardware for education, using new method,for education and	low	7.91 % serious	Not enough training for ICT	education	technical	12

new perspectives						
Support of management of using ICT	low	5.77 % worthless	Not enough mazandaran support of using ICT	protection	technical	13

TABLE VI. THE MAIN RISKS IDENTIFIED IN ENHANCING PROJECTS OF USERS OF ICT OF EDUCATION IN MAZANDARAN[3]

Not having enough access to network in education center & work	K8	Not having enough desire to reuse and continues user with ICT	K1
Not having enough access to the internet in education center & work	K9	Not having enough knowledge, user with ICT	K2
Not being equipped with magazine, and book in education center & work	K10	Not having enough skills, user with ICT	K3
Not having enough support work with ICT	K11	Not having enough creation,user with ICT	K4
Not having enough training with ICT	K12	Not having enough innovation with ICT	K5
Not having enough support from management Using ICT	K13	Not having enough software needed in education center, and work	K6
Not having enough system of equipment of the internet in education center and work			K7

TABLE VII. RISK CLASSIFICATION BASED ON THE MATRIX OF CONSEQUENCES AND PROBABILITY OF DESCRIPTIVE(QUALITATIVE)

Probability of occurrence	consequences		
	low	medium	high
	1	2	3
low	Worthless risk-low risk	Low-low risk	Serious-nedioum risk
medium	Low,low risk	Serious, medium risk	Low-low risk
high	Serious,medium risk	Low, low risk	Disaster risk, high

TABLE VIII. TYPE OF RISKS, AND DESIGNED STRATEGIES

strategies	Variable 2	strategy	Variable 1
Acceptance of existence method	introduce	Acceptance of existence method	interest
Introduce operator(user) using ICT		Internet creation for ICT operation(users)	
Absorption of educated users		Absorption of interested staff	
stratigies	Variable 4	strategy	Variable 3
Acceptance of available method	skill	Acceptance of existence method	creativity
Create skill on users		Creation of creativity using ICT	
Absorb skilled users using ICT		Absorption of creative operators(users)	
strategies	Variable 6	strategy	Variable 5
Acceptance of available method	software	Acceptance of existence method	innovation
Provision of adequate software		Creation of innovation using ICT	
Efficient use of software		Absorption of innovator operator(user)	
strategy	Variable 8	strategy	Variable 7
Acceptance of available method	internet	Acceptance of existence method	computer
Providing access to internet users		Supply enoughcomputer	
Increase speed access to internet		The use of existing computers	
strategy	Variable 10	strategy	Variable 9
Acceptance of available method	The internet	Acceptance of existence method	network
Avoiding magazines and books		Providing access to internet users	
Providing softwares necessary digital library		Improve network performance	
strategy	Variable 12	strategy	Variable 11
Acceptance of available method	education	Acceptance of existence method	Method support or guidance
Appropriate training		Help with software, hardware support or guidance	
Using new training & various methods for users(virtual)		Support software, hardware through the telephone, web site, email,inspection and technical assistance	

strategy	Variable 13
Acceptance of existence method	protection
Acceptance of available methode	
Protection of management using ICT	

TABLE IX. SELECT APPROPRIATE STRATEGIES FOR ACCEPTABLE AND UNACCEPTABLE RISKS

Appropriate strategy	Effect(severity of consequences)kind of risk	Kind of risk	row	
Acceptance of available method	4.64 %	Interest	1	(A) Acceptable risks with law impact percent
Acceptance of available method	5.40 %	internet	2	
Acceptance of available method	5.70 %	network	3	
Acceptance of available method	5.76 %	computer	4	
Acceptance of available method	5.77 %	support	5	
Acceptance of available method	6.63 %	Magazines & books	6	
Software & hardware, the internet, guide	8.41 %	Help or	7	(B)

,books		support		Tolerable risks with medium impact percent
Appropriate and ontime training	7.91 %	training	8	
Supply enough software	8.02 %	software	9	
Absorbtion of creative users	9.10 %	creative	10	(C) Unacceptable risks with effective percent
Absorbtion of skilled users using ICT	10.41 %	skill	11	
Hire innovator users	10.90 %	innovation	12	
Hire users with sufficient information literacy	11.24 %	Familiarity knowledge	13	

Step Three: Select the response risk strategies after identifying the key risks for the project must be designed to appropriate risks response strategies to deal with them. The first phase of the project design appropriate strategies for risk management, plan risk response phase of the project. For each risk can be a strategy or combination of strategies designed and selected for example, if you select one of the two risks have generally contradict each other, we are not allowed to have another choice. How to select and combine the strategies that can be selected for each risk as an important strategic constraints in order to be considered a project risk.

The amount due the unknown impact strategies, are often ambiguous, unless the strategy is on target to eliminiate completely the risk (probability or impact on the target become zero) [5]. For each k-risk, one or more strategies are designed, using indices , L={1,2,3,……., Lk}, we have shown in Table [8]. It is clear that strategies to deal with risk Boolean decision variables are zero-one problems in C# CODE.

The first strategy is to accept the status situation that is related to the risks with high probabilities, or unacceptable risks. The second strategy is related to the risks with medium probabilities, or tolerable risks. The third strategy is related to low probability risks, or acceptable risks.

IV. Conclusion

In this paper, a model was developed for identifying software project risks. In this model, four strategies is anticipated (is discaused) (have been studied) for dealing with risks. Notable cases of this model is , programs to avoid risks, and that may be amended with new information. Model for risk identification process, the initial group project, group planning, group process, group process monitoring and control, process termination is made . The initial group is defined includes starting the process, and the risk. Phases of the planning process of risk identification is made, qualitative, quantitative risk analysis, and risk response planning.

First processing group is included starting section, definition, and receiving risks. Program processing group has formed of identification phase risks, qualitative analysis, and risk response planning. Process group(group process), to implement new solution uses PDCA (plan-do-check-action) risk planning,(implementation, control and monitoring, and corrective action). Process end group, uses function factors (control, occurrence, therapy) with simple structures were implemented and control, and monitoring the risks.

To identify risk it is used from example application (potential project of ICT users in education of mazandaran). In this example were used real data. Data base for potential risks and prioritization occurs. Algorithms, risk logged in the data base search function, and algorithms if there is existence, gives the appropriate response to it. This response is based on four strategies. It is clear that strategies to deal with the problem of risk decision variables are zero and one, which is designed in C# code [Appendix 1] so the Boolean variable values of ok, and ok1 are used, to identify, and prioritization of risks. Zero decision variables and a response plan do control, and monitoring, and response planning for risks. On other section decision variables zero and one (0k2) managers the occurrence and or non-occurrence of risks. For worthless and low strategy risks are selected with least probability. For medium risks (seriously strategy with most tolerant (transfer strategy), and for the most disaster risks as appropriate response strategies most likely to be selected as shown in Table VII and VIII. The first strategy is the same as accepting the status situation. Means risks with high probability, and unacceptable risks, second strategy relate to risks with medium probabilities or tolerable probabilities. Third strategy related to risks with low probabilities, or acceptable. The advantages of this method is a simple algorithm to evolve a simple mechanism on and off for each risk, and the strategies for tolerable risks acceptable and unacceptable risks.

Note that the values of the intensity of effect of risks have been carried out from project, as a result using qualitative variables to classify and prioritize risks may be a good way. Also using the values of Boolean ok, ok1, ok2 in c# code. Boolean variable design help identify a strategy for each of the risks.

The resulting optimization solution and select of an appropriate solution to deal with the risks. The distinguishes of the results of this paper with the paper [5] is, in this paper the research have access to numeric values (percent boost users factors influencing ICT), have been extracted from the project. Thus, structural constraints and criteria were involved for selection of risk management used to derive conclusions. Considering the range of numerical values for the mean of the impact of 4.64 to 11.24, and Table VII and IX. These values were classified into 3 intervals. Experts with linguistic variables in this paper in three categories (low, medium, high) were classified. The implementation of this model is varies stages leading to optimized selection of the new solution transparent and effective management. Output reduces the cost, schedule, and quality of software development. Risks and complexities, and uncertainties are controlled. Finally it is suggested that this model is implemented as an expert system using a suitable software.

Appendix 1: C# Codes

```
using system;
using system.text;
using system;
 namespace Risk
{
 public main[]
```

```
{
String [ ] RiskListPotential=new string []{List of Risks
Potential};
String [ ] RiskListPriority=new string []{List of Risks
Prioritize};
var  Risk="";
boolean ok,ok1=false;
Readline(Risk);
ok=SearchRiskPotential(Risk);
if(ok==true)
{
ok1=SearchRiskPriority(Risk);
if(ok1==true)
{
 label  100:
if(PlanningRisk==true)
{
if(Control&RiskOversight==true && ok1==true)
{
if(ok2==true)
{
RiskTreatment();
goto 100;
}
else
{
Completion();
}
}
else
{
Completion();
}
}
}
}

boolean SearchRiskPotential (String Risk)
{
if(RiskListPotential.Find(Risk))
return true;
else
return false;
}
boolean SearchRiskPriority (String Risk)
{
if(RiskListPriority.Find (Risk))
return true;
else
return false;
}
boolean PlanningRisk (String Risk)
{
if(Risk.isprogramed)
return true;
else
return false;
}
boolean Control&RiskOversight (String Risk)
{
if(Risk.Iscontroled&analyzed)
return true;
else
return false;
}
boolean EventRisk (String Risk)
{
if(Risk.Isactive)
return true;
else
return false;
}
void RiskTreatment (String Risk)
{
Risk.Treatment();
}
boolean Completion()
{
int flag=Readline();
if(flag==1)
return;
else
close;
}
}
}
```

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