FROM IDENTIFICATION TO BUDGET ALLOCATION: A NOVEL IT RISK MANAGEMENT MODEL FOR ITERATIVE AGILE PROJECTS

1AHDIEH KHATAVAKHOTAN 1NAVID HASHEMITABA 3SIEW HOCK OW

khotan@siswa.um.edu.my nhtaba@siswa.um.edu.my show@um.edu.my

1Department of Software Engineering, Faculty of Computer Science and Information Technology, University of Malaya, 50603, Kuala Lumpur, Malaysia

ABSTRACT

The increasing advancement in information technology industry is compatible with the changing nature of the world. While software is important for all facets of the modern world, software development itself is not a perfect process. Agile software development methods have recently emerged as a new and better way of developing software as compared to traditional methodologies. These methods are developed to make prompt changes in a constantly changing world. The more modern the technology and the methods are, the newer the risks that must be properly controlled and managed. Therefore, focusing on risk management process in Agile projects will lead to applicable results. Due to the high failure rate in IT projects, increasing the focus on risk management seems essential. This research is carried out to explore and determine a new risk management model for iterative Agile projects. The model starts by risk identification of each iteration based on the historical data and ends with risk budget estimation and allocation. Therefore, a comprehensive IT risk management process will be performed based on Agile approach. The risk estimation is by mathematical formulae which makes the calculation defensible and reliable.

KEY WORDS

Agile approach, Risk management, Budget estimation, Risk identification

1. INTRODUCTION

The management of risk considered as a key discipline for project management [1]. According to the latest research done in 2007, 32% of software projects fail [2]. Failing a project means not implementing the planned program. The risk management role is vital to decrease the failure rate. Although, different risk management methods are argued in the past years, but still there is not a formal reliable model for risk management [3]. Especially in Agile projects risk management must be done promptly and accurately to avoid rework. The main point of the Agile manifesto is responding to change [4]. As the software development process becomes faster by Agile approach, risk management process must be adapted with that. Therefore all phases of risk management should be done completely but promptly in and Agile process [5]. Agile approach is more human based rather than process based [6]. Therefore, the major risk is people in risk management process.
In this paper the main issue is to present a model which provides a wide scope from risk identification to risk budget estimation and allocation. The aim is to explore the existing risks of the Agile method and present an appropriate model for a comprehensive rapid risk management plan.

2. THE STEPS OF THE MODEL

Step 1 - Identifying the risks by categorizing them.
Step 2 - Analyzing each risk in any iteration to determine:
   I. Which tasks are affected by the mentioned risk
   II. Computing the weight of risk by:
       • How relevant each task is (low to high)
       • If removal of the risk is necessary for system accuracy based on historical data
   III. Calculating the Risk Factors amount (F1)
   IV. Prioritizing the known risks based on the Biased Risk factors (F2)

Step 3 - Obtaining the cost of each risk
Step 4 - Calculating the total risk amount (F3)
Step 5 - Calibrating of total risk according to the used Agile method
Step 6 - Computing the requested risk budget (F4)
Step 7 - Calculating the real budget for each risk (F5)
Step 8 - Monitoring the risk removal process
Step 9 - Analyzing the acquired results in order to apply in the next iteration

3. AN EXPLANATION OF THE MODEL

In step 1, risk identification will be completed and a preliminary list of potential risks based on previous iterations (except for the first iteration) will be provided. This is inspired by the historical data meaning [7]. Step 2 has four stages. Stage I, logs the affected tasks by the aforementioned risks in the preliminary list, while the second stage (II) considers two important features for any of the risks, relevancy and removal necessity. These features facilitate the risk identification to prioritize the significant risks and update the initial list. By entering the stage III the original formula (F1) helps to calculate the risk factor amount. Step 2 finishes by prioritizing risks by biased risk factors (F2).

3.1. RISK FACTOR AND TOTAL RISK AMOUNT CALCULATION

Each ‘Risk Factor’ has a definition and a value. \( h_{(i,k,ss)} \) shows the amount of rework hours (overtime) for risk \( i \), to be performed by semi_skilled person in iteration \( j \) (\( k \) is the counter variable for \( j \)). \( H_{(k,ss)} \) is the total amount of rework hours (overtime) for all risks , to be done by semi_skilled people in iteration \( j \). For Risk \( i \), Iteration \( j \):(F1)
RiskFactor\textsubscript{i,j} = \frac{\sum_{k=1}^{j-1} k \left[ h_{(i,k,ss)} \ast N_{(k,ss)} + h_{(i,k,s)} \ast N_{(k,s)} + h_{(i,k,hs)} \ast N_{(k,hs)} \right]}{\sum_{k=1}^{j-1} k \left[ H_{(k,ss)} \ast N_{(k,ss)} + H_{(k,s)} \ast N_{(k,s)} + H_{(k,hs)} \ast N_{(k,hs)} \right]}

Where N is a “Normalized Coefficient”, it is calculated according to the ranking of involved people in the needed hours (high\_skilled, skilled, and semi\_skilled). The “Normalized Coefficient”, which is mentioned above, is used in the method just for first iteration and have to be calibrated based on the historical and the environmental data that formed the following metrics for the other iterations. The meaning of metrics and “Calibrated Normalized Coefficient” which is shown by “n” symbol are presented in next section.

\[ N = \begin{cases} 
1 \text{ semi\_skilled (ss)} \\
2 \text{ skilled (s)} \\
3 \text{ high\_skilled (hs)} 
\end{cases} \]

For each identified risk “i”, in iteration “j”, the criteria of RiskFactor calculation will be as follows: For the first iteration, the sums will be used just based on the experience had been acquired from similar projects. Therefore, risk enacting in this model will be from the second iteration. To calculate risk factors in iteration (n), all risks in first iterations to the iteration (n-1) will be considered. Just the only difference, is that like “COCOMO” estimation model, which was presented by Boehm, the last iterations will have more weight than the first ones. Hence, risk management normalized hours in each iteration, will be multiplied by the number of that iteration and in this way will gain weight in accordance with the closeness of that iteration to the current iteration. The variable is used for the display of iterations (the weight of each iteration is K).

### 3.1.1. Metrics and its Usage for the Calculation of “n”

The metric used in this paper is based on the number of lines of code (LOC) produced by each category of people. Hence, the ratio of the number of lines written by high\_skilled, skilled and semi\_skilled to the total number of lines will be normalized quotient (calibrated N). This amount is obtained on average, for three categories of high\_skilled, skilled and semi\_skilled people, as the following formulae:

\[
\frac{LOC_{j,hs}}{LOC_{j,\text{total}}} \ast \frac{NOP_{j,hs}}{NOP_{\text{total}}} = \eta_{j,hs} \\
\frac{LOC_{j,s}}{LOC_{j,\text{total}}} \ast \frac{NOP_{j,s}}{NOP_{\text{total}}} = \eta_{j,s} \\
\frac{LOC_{j,ss}}{LOC_{j,\text{total}}} \ast \frac{NOP_{j,ss}}{NOP_{\text{total}}} = \eta_{j,ss}
\]

Where \( NOP_{\text{total}} \) is the total “Number Of People” involved in process (hs, s, ss), also \( NOP_{j,hs} \) means the number of high\_skilled people in iteration j.

\[
\sum_{k=j-1}^{k=1} k \left[ h_{(i,k,ss)} \ast N_{(k,ss)} + h_{(i,k,s)} \ast N_{(k,s)} + h_{(i,k,hs)} \ast N_{(k,hs)} \right] \\
\sum_{k=j-1}^{k=1} k \left[ H_{(k,ss)} \ast N_{(k,ss)} + H_{(k,s)} \ast N_{(k,s)} + H_{(k,hs)} \ast N_{(k,hs)} \right]
\]
LOC(j,hs) \approx N(j,hs) \quad LOC(j,s) \approx N(j,s) \quad LOC(j,ss) \approx N(j,ss)

3.1.2. Calculation of weight Function and BiasedRiskFactor

Risk calculation in a historical stream is the amount of Risk Factors in every running or development of a system that is multiplied by relevancy and necessity factors. In a history based model of Cheng and Jiang [35] the only factor which is considered is relevancy; however, in the suggested model here, the weight of any factor \( w \), is a function of two variables \( n, r \) (necessity and relevancy both). To make it simpler, this function is defined as discrete function between 0 and 2.

\[
\begin{align*}
   w(r,n) = & \begin{cases} 
   2 & r = 1, n = 1 \\
   1 & r = 1, n = 0 \\
   0 & r = 0, n = 0 \\
   
   & \end{cases} 
\end{align*}
\]

Risk : \( i \) – Iteration : \( j \)

\[
\text{BiasedRiskFactor}_{j,i} = w_i(r_j,n_j) \times \text{RiskFactor}_{j,i} 
\]

\[
\text{TotalRiskAmount}_j = \sum \text{BiasedRiskFactor}_l 
\]

3.2. RISK REQUESTED BUDGET AND REAL COST ESTIMATION

After accomplishing the risk identification and analysis stages, the risk budget request and the allocation policy would be initiated.

\[
\text{RequestedRiskBudget}_j = \text{RiskCost}_j 
\]

\[
\text{RiskCost}_j = \text{Expected}_j \times \text{Cost}_j \times \text{TotalRiskAmount}_j 
\]

\[
\text{Expected}_j \times \text{Cost}_j = H_{ss} \times \text{Fee}_{ss} + H_s \times \text{Fee}_s + H_{hs} \times \text{Fee}_{hs} 
\]

Fee is the payment for each hour of human work. For more accuracy in this formula, considering the cost based on ranking of people is important.

For risk management, first the sum of total needed budget and costs of each risk is calculated. The budget can be computed by the following formula: \( F4 \)

\[
\text{RequestedRiskBudget} = \sum_{t \in E_{\text{risk}}} \text{RiskCost}_t 
\]

The risk management has to be applied based on the assigned budget, not the requested budget, because, these two budgets are not often equal. The real allocated (given) budget to any risk \( i \) could be calculated by the following formula: \( F5 \)
\[
BudgetRisk_{j,i} = \frac{BiasedRiskFactor_{j,i}}{TotalRiskAmount_{j}} * AssignedRiskBudget_{j}
\]

4. CASE STUDY

In order to verify the model, a case study has been completed. This case study has depicted accurate risk costs and estimation of an IT company which produces web-based and windows-based software for oil and gas industry [8]. The relevant information by one of the Agile methods (Scrum) in two years is gathered from this company and applied to this formula-based model. Therefore, comprehensive risk management plan including budget estimation and allocation is produced for the aforementioned company.

5. SUMMARY

Agile methods are almost newfound in IT era. Therefore, there are unknown risks in this emerging method. The Agile development process is also faster than conventional models, which makes the risk management more difficult to be applied. In an iterative Agile approach the process risks occur and repeat and intensify gradually. The impacts will be amplified promptly. The reason is the rapid iterations in Agile approach.

This paper presented a novel model for risk management. Nevertheless, this theoretical model would not be sufficient and risk management process is not applicable unless the risk costs and estimation complete. Therefore, correspondent risk budget estimation formulae are added to make the model complete. By completing each iteration, the historical data become more accurate and real. Finally, to verify the model a case study of an IT company with Agile infrastructure examined the correctness and accuracy of the formulae.

REFERENCES