A Case Study: Using a Comprehensive IT Risk Management Model

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Abstract - Risk management is a crucial phase in project management. High rate of failure in IT projects shows the necessity of using efficient and applicable risk management models. There are number of risk management models that are more theoretical than practical. This article presents a novel risk management model for IT projects. It is designed based on mathematical calculations which try to increase the reliability. The model has iterative nature and uses the historical data to recalculate the risk factors and risk amount. It initiates by risk identification and completes by risk budget estimation and allocation. In order to validate the model and formulae, a case study is applied. The project data of the studied case are fitted in the formulae and achieved results has regression with the real data.

Keywords: Risk Management, IT Projects, Risk Identification, Risk Cost, Budget Allocation.

1. INTRODUCTION

IT Risk Management Model (ITRMM) is a novel comprehensive model applicable for IT projects. The most significant feature of ITRMM is the ability to estimate the risk cost and budget. The model consists of mathematical formulae. To ensure the accuracy of the model a real case study data is used.

“PetroSleuth Incorporation” is a software development company. It carried out a case study in 2005 and gathered the relevant information by one of the Agile methods in two years (Richard, 2005). The data of this case study used to the acquired result by using ITRMM. This company produces web-based and windows-based software for oil and gas industry. Hence, designers and programmers use some tools like .Net and C#. The main objective of the software projects is increasing productivity on one side and providing better service to foreign clients on the other side.

2. ITRMM Principles

The ITRMM conducts of 7 steps. 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 (Pichler, & Pichler, 2005).

This is inspired by the historical data meaning (Jiang, Chang, Jinchun, & Cheng, 2007). 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 helps to calculate the risk factor amount. Step 2 finishes by prioritizing risks by biased risk factors. Step 3 to 7 calculates the risk factors, risk costs and risks budgets.
3. APPLYING THE MODEL

In this case study, load factor is 0.6 which means 40% of the consumed time for developers has been for support and possible bug fixes which of course is not negligible. According to case study, team members used to think that release is possible by 385 hours.

Management of the risks, which is "overtime" here, starts by drawing tables and analyzing all data available from previous iterations and historical data. The other steps are putting them in proposed formulae to calculate the amount of risks of next iterations.

3.1 Sketching the Risk Categorization Table

The following drawn Tables 1 and 2 features the assumed combinations of the effects of probable risks on the effects of identified risks are showed in table 1 and 2. The results are depending on the number of hours people have spent on eliminating unplanned problems (occurred risks) based on the categories high skilled, skilled, and semi-skilled people. Thus, the application of the tables and formulae has been illustrated in this way.

3.2 Computing Risk Factors for each Risk in Iteration 2

The following formula could be used to calculate the risk factor of risk i of iteration j:

\[ \text{Risk Factor} = \text{Total Overtime for Risk } i \]

<table>
<thead>
<tr>
<th>Risks</th>
<th>R1</th>
<th>R1</th>
<th>R2</th>
<th>R2</th>
<th>R3</th>
<th>R3</th>
<th>R4</th>
<th>R4</th>
<th>R5</th>
<th>R5</th>
<th>R6</th>
<th>R6</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>12</td>
<td>8</td>
<td>18</td>
<td>3</td>
<td>9</td>
<td>12</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td>7</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>8</td>
<td>18</td>
<td>3</td>
<td>9</td>
<td>12</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td>7</td>
<td>185</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>24</td>
<td>15</td>
<td>32</td>
<td>49</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>185</td>
</tr>
<tr>
<td>For Risk 1</td>
<td>For Risk 2</td>
<td>For Risk 3</td>
<td>For Risk 4</td>
<td>For Risk 5</td>
<td>For Risk 6</td>
<td>All Risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Risk details of the case study

<table>
<thead>
<tr>
<th>Risks(Parameters) →</th>
<th>Risk1: Product managers located remotely</th>
<th>Risk2: Lack of experience in creation user stories</th>
<th>Risk3: Technology issues such as Data access</th>
<th>Risk4: User and service Doc. not be Trans. into proper language</th>
<th>Risk5: Requirements currently unclear</th>
<th>Risk6: Some team members not assigned fulltime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initiation Phase</td>
<td>Feasibility</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Business Study</td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Functional Model Iteration</td>
<td>Agree Schedule</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Create Functional Prototype</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Review Prototype</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Identify Functional Prototype</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Agree Schedule</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Create Design Prototype</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Review Design Prototype</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Identify Design Prototype</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Implement</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Review Business</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>User Approval and User Guidelines</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Train Users</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

The overtime in this case study is 185 hours based on the table1. This overtime is the exact amount of rework, of involved people.

\[
RiskFactor_{ij} = \sum_{k=1}^{K} k \left[ h_{i,j,k} * N_{i,j,k} + h_{i,j,k} * H_{i,j,k} \right]
\]

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

*Note: H=Overtime (for all risks), h=Overtime (for each risk)
For Risk 1, Iteration 2:

\[
\text{RiskFactor}_{i,2} = \frac{1*1 + h_{i,1} + h_{i,2} + h_{i,3} + h_{i,4} + h_{i,5} + h_{i,6}}{1 * \sum_{j} H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j}}
\]

For Risk 1, Iteration 2:

\[
\text{RiskFactor}_{i,2} = \frac{1*1 + h_{i,1} + h_{i,2} + h_{i,3} + h_{i,4} + h_{i,5} + h_{i,6}}{1 * \sum_{j} H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j} + H_{i,j}}
\]

For Risk 1, Iteration 2:

\[
\text{RiskFactor}_{i,2} = \frac{1*[12*1 + 8*2 + 18*3]}{1*[62*1 + 44*2 + 79*3]}
\]

For Risk 1, Iteration 2:

\[
\text{RiskFactor}_{i,2} = \frac{8*2}{387} = 0.21
\]

For Risk 2, Iteration 2:

\[
\text{RiskFactor}_{i,2} = 0.14
\]

For Risk 3, Iteration 2:

\[
\text{RiskFactor}_{i,2} = 0.07
\]

For Risk 4, Iteration 2:

\[
\text{RiskFactor}_{i,2} = 0.14
\]

For Risk 5, Iteration 2:

\[
\text{RiskFactor}_{i,2} = 0.26
\]

For Risk 6, Iteration 2:

\[
\text{RiskFactor}_{i,2} = 0.15
\]

At the end of this step, Risk Factor amounts for R1 to R6 in iteration 2 are obtained.

3.3 Calculating Function Weight Function \( w(r,n) \) for each Risk Factor in Iteration 2

According to the chosen six risks of table 2, the weight function and its two related variables (relevancy and necessity) are assumed as follows and replaced in \( w(r,n) \):

\[
\begin{align*}
w(r,n) & \text{ for Risk1}: = 1 \\
& \text{ for Risk2}: = 0 \\
& \text{ for Risk3}: = 2 \\
& \text{ for Risk4}: = 1 \\
& \text{ for Risk5}: = 1 \\
& \text{ for Risk6}: = 2
\end{align*}
\]

3.4 Obtaining Biased Risk Factor for each Risk in Iteration 2

The biased risk factors for each risk \( i \) of iteration \( j \) could be achieved by following formula:

\[
\text{Risk_i: Iteration j} = \text{BiasedRiskFactor}_{i,j} = w_i \times \text{RiskFactor}_{i,j}
\]

For 6 risks of this case study the following calculations gain the amount of biased risk factors:

\[
\begin{align*}
\text{Risk 1: Iteration 2} & \quad \text{BiasedRiskFactor}_{1,2} = 1*0.21 = 0.21 \\
\text{Risk 2: Iteration 2} & \quad \text{BiasedRiskFactor}_{2,2} = 0*0.15 = 0 \\
\text{Risk 3: Iteration 2} & \quad \text{BiasedRiskFactor}_{3,2} = 2*0.07 = 0.14 \\
\text{Risk 4: Iteration 2} & \quad \text{BiasedRiskFactor}_{4,2} = 1*0.14 = 0.14 \\
\text{Risk 5: Iteration 2} & \quad \text{BiasedRiskFactor}_{5,2} = 1*0.26 = 0.26 \\
\text{Risk 6: Iteration 2} & \quad \text{BiasedRiskFactor}_{6,2} = 2*0.15 = 0.30
\end{align*}
\]

3.5 Computing Total Risk Amount in Iteration 2

Total risk amount for iteration \( j \) could be calculated by summation of all biased risk factors of all risk categories in iteration \( j \) (Nerur, Mahapatra, & Mangalaraj, 2005):

\[
\text{TotalRiskAmount}_j = \sum_{\text{risk category}} \text{BiasedRiskFactor}
\]

For Iteration 2: \( \text{TotalRiskAmount}_2 = 0.21 + 0.14 + 0.14 + 0.26 + 0.30 = 1.05 \)

3.6 Gaining Requested Risk Budget in Iteration 2

Requested Risk Budget can be calculated by the value of Expected Cost. Where, Expected Cost is estimated by the project manager, based on the total hours of each category of involved people (hs, s, ss) multiply by their
payment per hour for each (Beck, Kent, et al., 2001). The payments here are assumed 80$, 50$, 30$ for hs, s, ss. In addition, the total hours of each category of people are clear in tables 1 and 2.

Requested Risk Budget is the real budget needed to manage the risks of any iteration of the Agile project. Although, most of the time the assigned budget is not compatible with Requested Risk Budget.

**Assumption:** Total hours of ‘ss category’:135-‘s category’:100-‘hs category’:150
Where: 135+100+150=385  
*The expected total hours*

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

Requested risk budget for iteration j is equal to risk cost of iteration j and could be achieved by multiplication of expected risk cost of iteration j by total risk amount of iteration j. For Iteration 2:

\[ \text{Expected Cost}_2 = 62 \times 30 + 44 \times 50 + 79 \times 80 = 10,380\$

\[ \text{Requested Risk Budget}_2 = \text{Risk Cost}_2 = \text{Expected Cost}_2 \times \text{Total Risk Amount}_2 \]

\[ \text{Requested Risk Budget}_2 = 10,380 \times 1.05 = 10,899\$

The Requested Risk Budget in this case study is 10,899$, which is our estimation of real cost of the risks in iteration 2 in the current case study.

### 3.7 Assigning the Real Budget to each Risk based on Total real budget

Assume almost 80% of Requested Risk Budget (8500$) is assigned for risk management in iteration 2. The most important duty of risk manager is to allocate real, available budget to the existing risks (Kutsch, & Hall, 2009).

Therefore, the real budget of each risk from R1 to R6 is calculated by relying on the following formula:

\[ \text{Budget Risk}_{2,1} = \frac{\text{Biased Risk Factor}_{2,1}}{\text{Total Risk Amount}_2} \times \text{Requested Risk Budget}_2 \]

\[ \text{Budget Risk}_{2,2} = 0\$

\[ \text{Budget Risk}_{2,3} = 1133\$

\[ \text{Budget Risk}_{2,4} = 1133\$

\[ \text{Budget Risk}_{2,5} = 2104\$

\[ \text{Budget Risk}_{2,6} = 2428\$

For testing:

\[ 1700 + 0 + 1133 + 1133 + 2104 + 2428 = 8498 \approx 8,500\$

### 4. CONCLUSION

This is a novel way to allocate real budget to the risks of each iteration. It does not need complicated calculation. In addition, the meaning of “historical database”, which was the key point of ITRMM is shown here, meaning that the information of each iteration risks will be logged to the next iterations; therefore, gradually a historical database will be made in each company for IT projects. This shows that the ITRMM is not an imaginary and unreal risk method. Budget allocation of the project will be improved by identifying risk costs and all of these points lead to an improvement in risk management method.

For the time being, we can have a precise planning for next iteration according to the gained figures and also, in order to allocate people with different levels of skill to software production tasks and the number of hours needed for each task, we can present a more appropriate design to each task. Together with mentioned planning which is the management of potential risks in the next iteration (and naturally the ones which occurred in previous iterations), the estimation of the sums to do with financial resources meaning that the required budget for tasks will be done. This would be ideal to manage and mitigate the risks in the next iterations.
REFERENCES


