Validation of VRRM Process Model

Abdul Basit, Ghulam Murtaza, Naveed Ikram
Department of Computer Science
International Islamic University
Islamabad
Pakistan
abasitkh@gmail.com, murtaza.ghulam@live.com, naveed.ikram@iiu.edu.pk

Abstract: - Value Based Requirements’ Risk Management (VRRM) Process Model is first of its kind that provides a risk management process for requirements based upon the concept of value. VRRM is never been implemented in commercial environment. This case study aims to validate the VRRM Process Model by implementing it on two separate commercial projects. The first project was executed by a CMMI Level-2 company and other by the company having no standard practices. The implementation of VRRM on two different projects is done in order to validate its compliance with the CMMI and highlight the differences in its execution for both projects. The case study validates the claims possessed by the VRRM Process Model and highlights some problems faced by practitioners during its implementation. Its practicalities are presented in discrete manners to help generalize its use to treat the software requirements in value manners during the risk management process and outcomes are documented to provide a feedback that may be used for making necessary improvements in the process model.


1 Introduction
The Value Based Requirements’ Risk Management (VRRM) Process Model is first of its kind to provide a risk management process based upon the concept of value. It engages the success critical stakeholders to value the software requirements and risks being the ultimate owners of these requirements [1]. The success critical stakeholders keep in focus the impact of software on the business domain while valuing the software requirements. VRRM Process Model is based on IEEE standards for risk management (IEEE Std. 1540-2001). It comprises of almost all activities considered mandatory by CMMI Model [1].

The VRRM Process Model is not yet implemented on projects in commercial environment which is highly required in order to validate its practicality and claims. This case study is intended to validate the VRRM Process Model and highlight the potential problems, if any. The claims made by VRRM Process Model require to be validated in order to generalize its practices widely. The qualitative analysis shall focus on the comparison of implementation of VRRM in two companies one practicing the CMMI and other without having any standard in practice. This is done in order to validate either the VRRM conforms to the CMMI practices or not which is one of its major claims. In addition to this case study will also highlight the problems that practitioners may face during its implementation on commercial projects.

The case study shall highlight the importance of VRRM Process Model for managing the requirements related risks in value based manners contrary to the offering of general risk management processes which treat the requirements with equal value. The results would be greatly helpful in many ways to all those interested in project management, risk management, and process owners of overall processes of software development. These can include project managers, project team members, requirement engineers, risk managers, functional managers, company executives and students of related disciplines.

2 Process
The design of this case study is based upon the intent to validate the claims made by VRRM Process Model. The validation comprises of implementation of VRRM in commercial environment for two separate companies one employing the CMMI standards while other without practicing any industry standard. The main focus is to study practicalities of VRRM Process Model and its usage in comfortable manners. The questions to be answered are given as under:

- What problems practitioners may face during the implementation of VRRM Process Model as it is not yet practiced in commercial environment?
- Does implementation of VRRM Process Model validates the following claims?
VRRM Process Model is a practical model for risk management.

VRRM Process Model improves risk management by introducing the concept of value into it.

VRRM Conforms to CMMI standard

What is the difference between implementations of VRRM Process Model in companies one practicing CMMI and other without any standard?

The execution of case study starts with the selection of two companies, based upon the defined criteria. After selection of companies, the right projects of software development were selected as a primary unit of analysis. The software requirement specifications of these projects analyzed and the complete process of value elicitation executed in order to determine the values of software requirements. It is important to mention that the values of requirements were determined by the success critical stakeholders instead of project management team or implementers. The risks related to each requirement were identified in the form of Risk Profiles. The identified risks were then prioritized based upon the values of software requirements given by success critical stakeholders. At this stage, risk monitoring and control process invoked for effective management of VRRM process model. The data stores and artifacts were updated on as and when required basis and saved for further use.

The implementation covered the execution of all activities given in VRRM Process Model in theirs defined order. The covered activities are grouped into six abstract activities: Planning, Identification of Risks, Analysis of identified risks, and Treatment of identified risks, Monitoring and control and Evaluation. The execution involved data storage for defined data points: i.e. elicited values of software requirements, risk categories and risk profile. The risk management policies, risk management plan, risk treatment plan and contingency plan are other control points in the Case Study. However, the software requirements and their elicited values have major contribution in controlling the entire process of value based risk management.

3 Introduction to VRRM Process Model

VRRM is a Risk Management Process for software requirements. It is mainly based upon IEEE Std. 1540-2001 Risk Management Process and conforms to CMMI as it employ almost the activities that are deemed important and to be taken into consideration for software risk management.

VRRM Process Model introduces the concept of value in risk management however; the focus of this process model is only those risks which are originated from software requirements. Software requirements are which are owned by the stakeholders. Since, a huge list of stakeholders exists for every project so VBSE introduces the success critical stakeholders (SCSs) to represent those stakeholders which are highly critical for the success and failure of the project. SCSs value the requirements and related risks in order to prioritize and monitor the identified risks. Active participation of success critical stakeholders is highly required for successful implementation of VRRM process model.

VRRM Process Model is presented at two levels of abstraction. The first level is called as Abstraction Level-1 and the second level is referred as Abstraction Level-2. At the higher level, the Abstraction Level-1 comprises of Management and Assessment and Mitigation of risks. The Management part contains the Planning and Monitoring and Control. The Assessment and Mitigation part comprises of Identification, Analysis and Treatment of Risks for a software development project.

The second level of Abstraction presents the complete set of 31 activities divided into six major categories which are given as under:

- Plan
- Identify
- Analyze
- Treat
- Monitoring & control
- Evaluate

The first abstraction level is rather simple and gives a good overview of the main activities carried out. The second abstraction is designed at a more detailed level and presents all the activities that have to be performed for VRRM.

3 Case Study Design

The VRRM Process Model implemented on two different commercial projects in two different companies. The first project refereed as “Project A” was examined during its development for Telecommunication Company by a CMMI rated software development company (Company A). The second project referred as “Project B” was examined during its development by small scale software development company (Company B) which is not following any industry standard practices. Both projects were executed in parallel to avoid any external environmental differences. The project resources were planned and given the responsibilities to carry out the necessary activities for the VRRM Process Model. The responsible teams inclusive of risk management staff
closely coordinated through physical meetings and monitoring in order to identify the problems they face during the entire implementation process. The necessary trainings to implementation team and success critical stakeholders were planned and delivered to build the common understanding about VRRM Process Model and value based software engineering. Day to day problems was documented for record and future reference along with their treatments in order to complete the implementation and provide feedback with regards to the practicality of VRRM Process Model. The resultants were carefully analyzed and documented throughout the execution process.

4 Case Study Execution
In compliance to the VRRM Process Model, all the 31 activities were executed separately for both projects. The outcome of these activities documented separately which is shared in this paper in summarized form. The execution of abstract level 1 activities is described with necessary details in following sections:

4.1 Plan
There are total 8 activities in this group that are performed in order to produce 3 deliverables: Risk Management Plan, Risk Categories and Risk Assessment Register. The risk management plan is part of the project plan and it gives the overall risk management process overview that how it will be implemented, how the activities will be carried out, who will be responsible for which activities and how will be the process evaluated for improvement purposes. The planned information is also passed on to data stores of Risk Profile and Risk Categories. The planning was done separately for both selected projects; however, the planning at Project B project was very difficult due to lack of specialized risk management and project management resources. This was the major risk during the implementation of VRRM process model at Project B. Most of the planning and execution work was done by author himself. However, for Project A the proper risk management team was allocated with the clearly defined responsibility. The scales and measures for risk analysis and data stores were defined for common use on both projects. The data stores are given as under:

- Risk policies
- Risk Management Plan
- Risk categories
- Business Objective Document
- Requirement Document
- Risk Assessment Register
- Value Assessment Register
- Risk Treatment Register

4.2 Identify
In this group of activity, risks were identified for both projects separately according to the companies’ risk management policies and risk management plans. As VRRM Process model does not recommend any specific technique for risk identification, best practices from risk management literature (project information, brainstorming, interviews, analysis of historical data and cause & effect analysis) were used for risk identification. 24 risks were identified for Project A and 13 for Project B. The risk identification exercise was done by risk management teams at both projects in close coordination with author. Success critical stakeholders were highly engaged during the identification process. All information was recorded in the data store of Risk Assessment Register.

4.3 Analyze
Risk analysis is the third group of activity in the VRRM process model. It starts immediately after identification of risks. The core activities of value-based requirements’ risk management process model belong to this group. During the risk analysis, the success critical stakeholders were involved actively as they assess the requirements’ and risks’ value for the acceptance of risk. The complete analysis process was performed separately for both projects covering the following activities:

- Risk categorization
- Estimation of likelihood and consequences
- Linking risks to the requirements
- Linking requirements to business objectives
- Identification of success critical stakeholders
- Assessment of values for requirements and their related risks in TOP (Technical, Organizational and People) perspectives
- Calculate net value
- Evaluate risks against the threshold
- Establish contingency
- Prioritization of risks based their values

The execution of analysis activities resulted into the qualification of all identified risks to be considered as critical and decided to be treated in next stage. Further, the data stores were updated accordingly.

4.4 Treat
After completion of the analysis stage, all the accepted risks were passed on for the treatment. In this group of activities, the mitigation strategies for the accepted risks
were defined and executed in value based manner. This stage of implementation of VRRM process model is very crucial, as it needed too many resources and extra efforts to mitigate the risks before their occurrence. At this stage too many problems were faced at both projects due to the reluctance of companies in putting extra human and material resources. Further, the issue remains to improvise the willingness of management to mitigate risks. In the case of Project A, the situation was satisfactory. Although, its management was reluctant to put extra resources on the process but minimum required resources were provided by the company to mitigate the risks. But in the case of Project B, the necessary willingness of risk management was not there along with the non availability of dedicated resources for implementation of alternate treatments. However, we tried our best to work with limited resources and given situation. The executed activities were:

- Define treatment alternatives
- Definition measures for effectiveness of alternatives
- Assess value for each alternative
- Calculate net value
- Evaluate acceptability of treatment alternatives
- Define implementation process for selected treatments
- Implementation of treatment alternatives

This group comprises of two activities:
- Definition of evaluation process
- Evaluates risk management process

In case of Project A, the quality assurance team was involved in order to ensure the execution of each and every activity of VRRM Process Model with necessary process flow. The process execution was monitored and necessary updates to the artifacts data stores are recorded. However, in the case of Project B, Company B did not have any team entrusted with quality assurance activities. Hence, the evaluation process was carried out by the author himself.

4 Case Study Results/Experiences

The following are the findings documented as a result of execution of VRRM Process Model on two separate projects.

- The implementation of VRMM Process Model remained successful for both projects one executed by company employing CMMI standard processes while other company was not practicing any industry standard.
- The VRRM Process Model provides the improved risk management which is utmost important in terms of successful delivery of software projects.
- The concept of success critical stakeholders to value the requirements were greatly welcomed on Project A.
- The problems were faced in creating the awareness regarding the value based risk management process. It took fewer efforts in communicating its concepts on Project A and greatly pushed on the Project B.
- The management required to be convinced to employ VRRM Process Model and dedicate their resources to participate in the activities of implementation process. The influence of senior management and peers were used before the start of implementation.
- The resources engaged in the implementation process were given formal training sessions on Project A. However, in the case of Project B, only the project manager/owner of the company was engaged in the process of learning.
- The communication remained an issue especially with the success critical stakeholders of Project B where company did not permit to talk or exchange emails with the stakeholders outside the country. However, the necessary communication was made through the owner of the company.
- It was observed that the software developers were having very little understanding about the general
risk management process and especially for the concept of value in the overall software engineering.

- The author himself involved very actively in managing the implementation process in Project B due to the absence of risk and project management resources and necessary awareness.
- The alternate treatments could not execute for three risks in Project A and three risks for Project B despite repeated efforts due to cumbersome negotiations in terms of bringing the whole management to consensus.

The overall implementation of VRRM Process Model remained successful on both projects as all potential risks were identified and analyzed during early stages of the project lifecycle and no surprises were recorded at later stages. However; some risks were occurred due to the non implementation of the suggested treatment alternatives which was lack of cooperation from top management rather than process failure.

Table 1: VRRM Case Study Result Summary

<table>
<thead>
<tr>
<th>Items</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identified Risks</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Process Related Risk</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Product Related Risk</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>No. of Requirements related to Risks</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>No. of Business Objectives Related to Requirements</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Total Success Critical Stakeholder</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td>Minimum Value assessed for a risk</td>
<td>5.11</td>
<td>5.10</td>
</tr>
<tr>
<td>Maximum Value assessed for risk</td>
<td>7.19</td>
<td>6.95</td>
</tr>
<tr>
<td>Average Value assessed</td>
<td>6.1</td>
<td>6.05</td>
</tr>
<tr>
<td>No. of risks qualified for treatment</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>Total No of treatment alternatives identified</td>
<td>33</td>
<td>13</td>
</tr>
<tr>
<td>No. of risks mitigated</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>Risks occurred</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Overall success rate of Risk Management</td>
<td>87.50%</td>
<td>76.92%</td>
</tr>
</tbody>
</table>

4 Discussion & Analysis

Value-based Requirements’ Risk Management Process Model brings the innovation to the traditional risk management process, by introducing the concept of value into it. The value based management of the risks is introduced in this process model at two stages. Firstly, during the analysis phase risks are selected and prioritized in a value-based manner by keeping all success critical stakeholders involved. Secondly, the treatment of risk is also made value-based. During the selection of treatment alternatives, success critical stakeholders were consulted for their assessment about the treatment alternatives so that treatments having high values should be executed.

As discussed in the introduction section, this implementation of VRRM Process Model is first of its kind, the VRRM Process Model implemented on two separate projects by different companies one having the CMMI standard processes while other without any related industry standard. The two implementations were carried in parallel to verify the claims of its practicality for CMMI and no-standard set of processes environments. It is successfully verified that VRRM Process Model is CMMI compliant as it was seamlessly executed in the environment employing the CMMI compliances processes. In addition to this, VRRM Process model provides improved risk management process due to the fact that identified risks appeared to be certain problems towards the end. Hence, the identified risks were critical in nature and few of them occurred due non application of their suggested treatment activities. Apart from the few risks, the rest were mitigated as a result of execution of their suggested treatments and did not surfaced again.

The clear differences were observed on the project B where the management where not willing to apply the resources for risk management and generally avoided the documentation necessary for this process. Further, the activities related to evaluation of VRRM Process Model should have been executed by the quality assurance team which was not available with Company B. However, the smooth execution was experienced on Project A where management was more concerned to have successful delivery of software solution for the upcoming chartered revenue stream.

The problems faced by the practitioners have been highlighted during the proceedings presented in above sections. These problems should be used as lessons learned for future implementations. The important observation is the non existence of formal mechanism to keep and maintain the project records and related data stores in software development companies. This may lead to the non-availability of historical data to these companies for future implementations.

During analysis phase, the activities of “Estimate Likelihood” and “Estimate Consequences” were observed as isolated work to be performed in the risk management process. These activities were performed and are part of risk register for both projects. However, there usage requires more clarification and linkage with the other activities of the process model.
It is strongly suggested to develop a software tool for the automation of the activities of the VRRM Process Model so that it can easily be adopted by the companies. The software tool shall help to minimize the management efforts required for its repeated usage by the industry. The project records and historical shall remain available for future reference and repeatable artifacts and deliverables.

In the end, the companies’ willingness is required to amend their risk management policies and take risk management seriously in order to deliver the successful software solutions.

4 Conclusion

Keeping in view the objectives of the case study, the VRRM Process Model implemented on two projects in separate companies to validate its claims and to know the practicalities and differences in implementation between two companies one employing CMMI standards and other without practicing any industry standard. The implementation process remained successful on two projects yielding the desired outcomes with known problems as the risk management team highlighted these risks to be occurred well before time. However, few of the risks occurred as the both companies did not invest their resources timely to implement the suggested treatment alternatives. The awareness at the executive level was not realized along with the desired decisions for the purpose. The documented results show that the success rate remained high for the company employing the CMMI standard as compare to the other company which was not having the realization for the benefits to employ the industry standards or the standard risk management process.

The future research should focus on further elaboration in Monitoring and Control activity to make it more robust and having controls at each stage of the abstract level-1 of the VRRM Process Model. Also, the activities of “Estimate Likelihood” and “Estimate Consequences” are somewhat isolated in the whole process. Further, a software tool should be developed to reduce the efforts required for the repetitive use.

References: