# Proposing a Distributed Risk Management Process Model for Dynamic Environment in an IT Industry

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**Abstract**

The risk involved with globalization and other market issues are making the risk management an important area to deal with all the kinds of technical and social issues within the companies planning and programming schedules. Most of the multinational companies like International Business Machines (IBM) are challenged due to the distributed methods of working culture across the globe. To keep a note of such risks at different places and on multiple projects at a time by monitoring and programming in such a way to handle the risk carefully, IBM is following its own methods using Distributed Risk Management Process (DRiMaP) module to find a suitable solutions to the risk based on its priority. In this research the testing of IBM's DRiMaP process studied keenly and developed a dynamic approach for current IT industry to implement with ease to handle the risks evolved due to the dynamic nature of the current market.
**Keywords:** DRiMaP, IT, Information System, Risk Management, Monte Carlo, SysML.

## 1. Introduction

### *1.1. Overview*

Software companies across the globe are getting wide range of advantages of globalization along with new challenges in the market to jeopardize further business prospects. Such competency always makes the IT companies to review their development process and structures so as to compete with the global organizations. For reaching the needs of global market competence they are making risk management as a driving wheel with highly heterogeneous developments. It was also observed that International Business Machines (IBM) alone is running various distributed and wide range of developmental projects across different parts including wide range of people (approximately 700) working at 20 locations (Mattsson et al. 2011). For solving such challenging issues IBM commissioned to work on the distributed risk management models as a process run by IBM and its subcontractors. Distributed Risk Management Process (DRiMaP) Model, mainly involved with the process phases, roles involved, communication channels and co-ordinations of risk managements among various partners involved between IBM and its partners. DRiMaP Model will include the business and engineering levels as well. The purpose of this research is to identify the risk management models used in software development firms and to find out the capacity of risk they can manage while solving the software development projects.

This research also includes an event based risk management model for wide range of IT projects, and also focuses on the relationship between risk management and cross organizational crises management in the organizations such as IBM.

*1.2. Risk Management for Large scale IT Projects*

In the massive IT Companies Risk Management is a method or a process that provides an opportunity for analyzing risk associated with project development and execution process (APM, 2008). Information Technology projects are driven by dynamism or incessant changes in IT infrastructure and dynamic market which are global in nature. Due to the strong impact of globalization the IT projects are in need to find a different approach to design an implementation model or frame work to meet the challenges associated with the risks in the existing project. However risk management models are generally designed for mitigating the risks involved due to threats while executing a project work (SAS, 2002). These models are bound to work as a tool or integral part of the project planning and it cannot be overseen but are considered to be the picture explaining the organizational risk. However in the case of IT projects the scenario will be totally different due to the involvement of strong technical, innovative and strategic content with properly defined structures and systematic approaches. However in practice most of the managements and project managers avoid the risk management processing steps to avoid wastage of time by assuming that paper work for mitigating situations involved with various risks. As a strong suggestion for the risk management process Muhlbauer (2004) suggested five steps that help most of the IT organizations to find solutions for the major challenges due to various threats within and outside the organization. Those are: risk modeling, data preparation, segmentation, risk assessment and managing the risks. Most of these steps are considered to be self-evident as the risk assessment efforts are under way. Due to the size of the organization like IBM and its critical nature of work distribution with different employees working under different subcontractors, the role of DRiMaP is playing a key role towards solving the challenges due to various market demands. This process is working as a twofold tool for managing risks in the organization: in the first case it needs to help subject matters and the communication between primary contractors and sub – contractors; and secondly by using the risk management as a tool for the communication it will be useful to reduce the risks involved with major software projects at a time in different locations. Therefore, the present research will be focusing on the impacts of DRiMaP processing steps in IBM towards solving and managing the risks in major IT and software projects.

*1.3. Aim and Objectives*

Aim: To investigate IBM's Distributed Risk Management Processing (DRiMaP) Model in detail and to apply the same suggested models for all major projects in Information technology/ system (ITS) project developments.

Objectives:

1. Identify methods used in the development of IBM's Distributed Risk Management Process (DRiMaP) for IT projects and also study its application to IT projects.
2. Suggest improvements to DRiMaP involving:
    a. The relationship of risk management to organizational cross-organizational crisis management.
    b. A better environment for controlling and monitoring of risk.
3. Propose and design extensions to DRiMaP to practically implement outcomes of the suggestion improvement.
4. Evaluate the effectiveness of the suggested extensions.

*1.2. 1.4. Motivation and Contributions*

The Present research is the outcome of a though study on various IT industries and articles published in various sources of information about risk management and its role in solving critical issues. In most of the times it is observed that, major IT projects are either uncompleted or delayed or facing a problem of overrun and extended cost or total project is failed. Such situations needed to are either a result of failures in planning or analyzing the project thoroughly and etc. In such situations most of the IT companies face a worst situation due to the negative impact on other projects and need to fight again to survive in rapidly growing market with high pressure of competitors and etc. Hence the role of risk management by identifying the risks in the initial stages will help the project development and project team to design a fruitful project with large benefits. Contribution of this research will involve various experts working as risk managers from wide range of software companies and a survey will be conducted among them related

to wide range of risks they come across and the techniques they use to find solutions in all kinds of circumstances.

Ahead of that the research also conduct secondary research using previous notes and records from different material and then test them with the primary research content and propose new methods to solve the risk associated with major IT projects in big organizations. The outcomes of this research will be useful to all kinds of IT organizations so as to ensure that they are working under risk free environments in the organization.

## 2. Background and Related Work

### *2.1. Project Statement*

In IT industry the role of Risk Management defines the size of the risk and also the suitable method of solving the issues related with them. Mills and Walle, 2007 consider the risk as a negative term that can impact very badly to the organization and will impact on the key objectives of the organization goals. Hence it is very much essential to the top management to implement the plans and policies in a strategic method so as to deal with the risk in a controlled approach. For a controlled approach management needs to indentify the risks within the organization so as to design, operate and monitor it in an effective way. The statement of this project is to introduce the DRiMaP model for controlling the risk associated with large scale IT Software and Developmental projects. DRiMaP models aims to emphasize the process phase, roles among the phases, communication among them and coordinating the risk management with the business cycle model of the organization (Mills and Walle, 2007; Mattsson et.al, 2011).

### *2.2. Background of the Study*

Due to heavy changes in the market strategies and developments most of the global IT and Software companies are facing wide ranges of risk failures. In the recent past most of the IT companies lost billions of dollars every year due to project overruns or for reviewing the software projects. It is also observed that most of the risks in software companies are due to the threats caused by unknown quantity like external threats from shareholder groups that are associated with managements which create complex situations for the project managers working with the IT projects. Such risks involved with managements in most of the IT companies are bound to lead a situation where an organization may go out of business. Considering all these situations most of the major IT companies are looking forward with wide range of risk management models, tools and techniques to implement in the organizations for analyzing the risk associated with different issues related with an IT project (Wallace et.al, 2004). Hence managing the risks in IT companies become a fundamental role and the role of management which is not directly involved with the project risk management but it is the duty of project manager to ensure the risk process to mitigate the risk evolved during the project development. These are the people to identify, evaluate and mange risks faced by projects. Such type of risks are considered to be event based risk and need to ensure that all problems and issues are identified in advance and are documented properly with the solutions provided during the execution time.

### *2.3. Context of the Study*

Due to the fast growth in the number of IT companies and their infrastructure most of the companies are focusing on global developments to adopt research engineering tools and techniques for developing most of the major projects. However due to wide range of project failure issues in project development and complex nature to mitigate or difficulties to curb as it was in the past where most of the IT infrastructures were centrally located as against the distributed network infrastructure. The study in this research will study the DRiMaP model developed by IBM to meet the requirements of other IT companies to mitigate the risks that are prone to arise during the software project implementation.

The other important reason for selecting this model is the quality of the model to support the globally distributed organizational functionalities with a grounded notion of collaboration (Mattsson et al. 2011). This process can be utilized in almost all the organizations collaboratively where one will consider the risk management as one of the integral part of their proceedings. However most of the IT organizations implement different kinds of risk management models for managing risks but in this case the collaboration is not in existence. Lack of uniformity or collaboration of risk management highlights the risk in the project development. Irrespective of this the better understanding of risks in the project implementation and its possible impacts will create a great exposure for the project manager to understand the risks to mitigate and allocate the suitable solutions to solve the problems in project handling.

### 3. Research Hypothesis

To arrive at this juncture, the researcher made a wide and intensive study of existing publications within the domain of the proposed work. Researcher read sundry articles; review models i.e. standard risk management models focusing on the subject of distributed development and risk management. As the proposed research transcend the level of methodology, a clear understanding of the answers to the research questions set above emanate from the studies with critical elements of event based risk management for IT projects are underscored. Also, the studies revealed that distributed risk management model has an edge over other models revealed and encountered during compilation of this proposal. Also, the profound study also showed that IBM's documentation is the only obtainable documentation reviewed which cannot be totally relied on.

**H1:** Risk management processing steps will help the IT organization to improve quality of their outputs.

The IT companies aims to deliver the value for their products by creating capabilities and outcomes for their organization so as to deliver the risk free ventures to manage the related risks. Wallace et al. (2004) explained that most of the projects in the real life are strongly linked with various rewards within the organization. Hence, the top decision making personalities in the industries need to keep this as a part of their design to keep the risks in mind and also need to provide an approach gaining benefits to the organization within the controlled manner. This method will identify the risk management process modules to help the software product development teams, project managers and top business managements to evaluate and plant the business prospects in a cost effective manner. At the same time it will be helpful for project managers, software developers and programmers to make them understand the major risks associated with IT and software development projects by providing them by enabling them to plan, organize, direct and controls the software projects. Risk management can also be described as a process. Bakkar (2008) explained the standard risk management process as containing a linear relationship between finding and giving solutions for problems in the IT organizations to overcome the problems raised from traditional risk management process. This is described in the figure below as a cyclic model compiled from the steps or activities offered by many authors for risk management.

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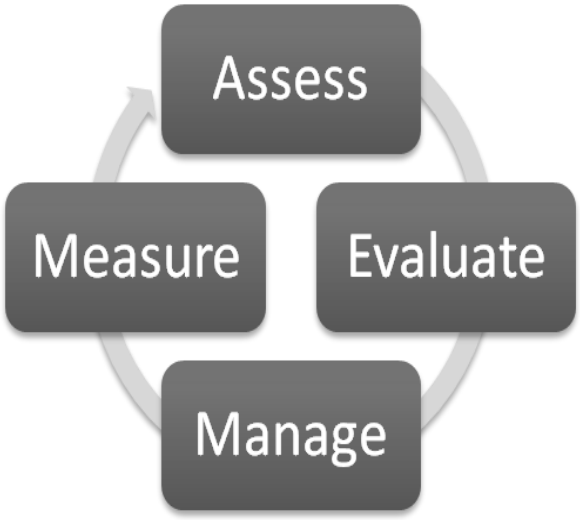


Figure 1. The Traditional Risk Management

Model (Bakkar, 2008)

Two of the key steps in the model above are Assess and Evaluate. Other authors use slightly different terminology; often risk identification and risk estimation respectively. Molenaar et al. (2010) show the importance of risk identification during project development, an activity that is used to find and classify risks that may hinder the progressive or operatives of the project execution. This requires a close observation of the organization, market environment, and legal, social, political and cultural environments and broad comprehension of its strategic and operational objectives that are encrusted in the factors that determines the success of project development and execution. However, risk identification should be approached in a logical manner to satisfy every part of the organization (IRM, 2002).

**H2:** IBM is adopting Risk management techniques to solve it internal issues and complex work environments across globe are helping it.

IT companies that are collaboratively in alliance with the IBM will form the sample space of the participants to survey. The resulting questionnaire from this approach would aid the fundamental understanding of the general opinions, practices or ethics underlying risk management in different organizations. However, these variations within the sampled population would give clear strength and efficiency of DRiMaP over other models reviewed above. Saunders et al, (2009) diagram present Saunders Onion Diagram which describes the initial results methodology. Bakkar (2008) explained the standard risk management process containing a linear relationship between finding and giving solutions for problems in the IT organizations to overcome the problems raised from traditional risk management process. According to Higuera and Haimes (1996) the basic methodological framework with which functions are managed is composed of the Software Acquisition-Capability Maturity Model (SA-CMMSM) and the Software Capability Maturity Model (SW-CMMSM) and their supporting practices and constructs. This framework, however, is supported by three groups of practices which are mentioned below (Higuera and Haimes, 1996) these are:

- Software Risk Evaluation (SRE)
- Continuous Risk Management (CRM)
- Team Risk Management (TRM)

The methodological context about the complexity of software risk management stated above is understandable. However, the hierarchical holographic modeling to capture the diverse aspects of these complications is suggested to be used. According to Higuera and Haimes (1996) modeling it is required to consider two additional visions or dimensions: the temporal and human dimensions. However, the three dimensions adopted represent the holistic vision of software risk management and are the temporal dimension, the methodological dimension, and the human dimension (Higuera and Haimes, 1996). Achievement, growth, and exploitation programs continue to experience great cost overruns, calendar delays, and poor technical piece. This will be a result of failing to deal appropriately with uncertainty in the acquisition and development of complex, software-intensive and software-dependent systems. Further studies in Higuera and Haimes (1996) revealed that all areas in systems development are potential sources of software risks see Figure – 2. Since it involves technology, software, hardware, cost, people and schedule.

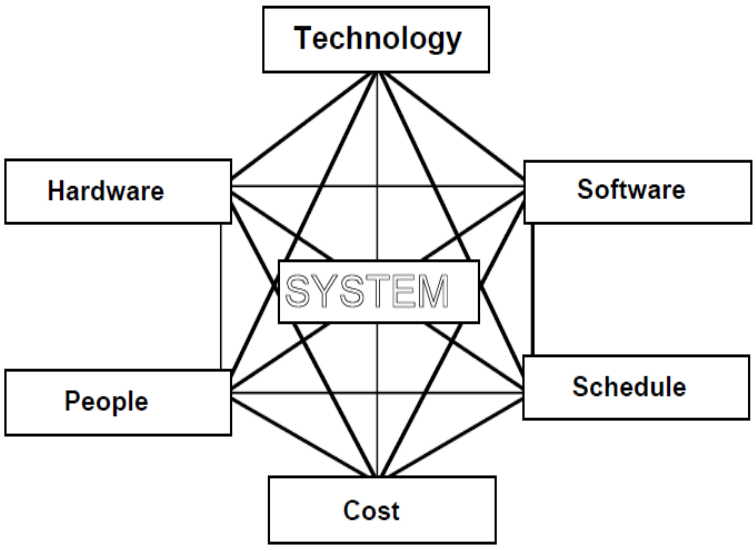


Figure 2. Shows the Risks within a System Context
(Higuera and Haimes, 1996).

**H3:** The impact of the DRiMaP method is more on IT industries to solve and mitigate risks.

The impact of information technology has maintained a core role in the economy, also, the distributed nature of the networks among the companies have immensely grown and, however, have effect on the successful delivery of information technology projects. However, due to the distributed nature of the current network in use, great number of projects are attributed to failed systems that could not attained the set objectives or, simply put, that never achieved their aim (Gordon, 1999), for instance, the CONFIRM and UKeU. The time and capital vested into management of the associated risk to the information system (IS) project is tagged within the context as a critical apprehension. However, the inability to comprehend, spot out, and manage risk is considered as actual cause of Information Technology project challenges that are identified as the following:

- Cost.
- Schedule overruns.
- Unattainable user requirements.
- Development of systems that fail to provide business value.

Additionally, the supporters of risk management within IT domain claim that earlier identification and analysis of threats to success in a proactive manner reduces the possibility of project failure and conversely enhances project success. Unfortunately, Wallace et al (2004) revealed through their findings that availability of software tools to spot out risk in IT projects i.e. software project risk factors is limited. Also, nonexistence of principle to illustrate the relationships that exist among the phases of software project risk and project enactment render risk management processes to be inefficient to an extent to mitigate the identified risk. The literatures further proposed checklists and frameworks respectively to establish the missing relationship and provision of the tool to identify and analyze risk in IS projects. The difficulty frequently encountered by the project managers would only be eased until improved comprehension of risk and its impact on IT projects, Wallace et al (2004) concluded.

**H4:** The relationships of risk management to organizational and cross-organizational crisis management in IBM are identified as critical matter.

In an organization identification of risk and prioritizing them with a keen foresight towards following the consequences of disasters has become one of the major activities of top business models. These models are considered and discussed among a team of specialist members in the organization by involving the top management of the companies in most of the situations. In most of the top organizations this issues are risks are supported by a backup of having a proper insurance or by transferring or by having few financial products by involving rigorous planning and using the techniques of crisis management (CAS, 2003). However a company's risk culture and risk management strategy will be vital in terms of making the organization understand and decide the tolerable risk factors within the company operations. Very few companies in the market are aware of operational risk management spectrum and these methods of defining the risk factors vary from company to company and the integration process of work structures will depend on the risk measurement methods (Culp, 2001). Lack of information on the operational losses in wide range of organizations is main reason for wide range of inconsistency for measuring operation risks in the organizations. In a broader perspective the risks can be classified in many ways as follows: liquidity risk, operational risk, legal risk, customer loss risk, strategic risk, supply chain risk and reputational risk. Out of all this few are considered to be financial risks and other as business risks. Operational risks are generally examined by the organizations that are taking care of industries and regulatory. Measuring the operational risk sounds to be more fashionable but regulatory risks depend strongly on the legal issues of current policies, regulatory environments and countries policies (Culp, 2001). Now – a – day most of the organizations like IBM are trying to keep a "Basic Indicator", which relies on one or two important risk factors that are defined coarsely. However there are other methods considered to be playing vital role in indentifying the risk factors like internal ratings, internal models, operation risk monitoring and etc. Generally the internal ratings method uses the quantitative approach for a specific topic for individual business unit to identify and understand the risk within the organization to for individual business units (Culp, 2001). In internal model approach risk measurement will represent very resent and advanced available operational risk management tools. These kinds of tools are very focused towards specific loss data of a particular institute and sometime they may or may not rely on structural economic models. Inter organizational information system (IOIS) models are developed to solve the crisis management domains as they are designed with the view of cross – organizational collaboration (Dury, Beaton and Boiney, 2010).

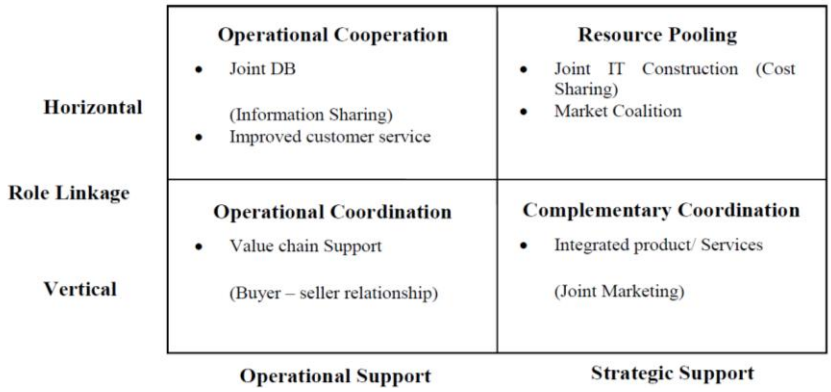


Figure 3. Shows Hong's Framework for IOIS

(Source: Dury, Beaton and Boiney 2010, p. 15)

However, most of the organizations consider the importance of work produced by crisis management and communication as key information collected by the public relations and presents the corporate reputation in the market as its content dominates due to involvement of most of the academic expert's literature (Coombs and Holladay, 2011). Crisis management involves two types of links (vertical and horizontal) across any organization as shown in figure – 3. Vertical links will connect the cooperating heterogeneous organizations and horizontal links will connect homogeneous organizations. However in the strong argument made by Hong explains the necessary of two linkages with the need of different collaboration mechanisms, approaches and procedures (Dury, Beaton and Boiney, 2010). In case of an organization like IBM the collaboration mechanism will have to support the horizontal linkage for competing with other similar organizations for the shared documents and regulatory rules that affect entire industries of similar nature of works. However the collaboration mechanism will have to support the vertical linkage for two parties to view interactively and discuss the effects of dynamic changes in the global market for their business strategies and additional risk factors.

**H5:** Good crisis prevention at work place in IBM improved the outputs of the company by using suitable communication techniques and methods.

In another context the crisis prevention works as a tool to avoid negative media attention. Coombs and Holladay (2011) explained crisis as a dramatic and newsworthy situation where it raises many questions related with preparation, response, media and relations with business managements. The authors highlighted the importance of one bad news creating serious damage to the business planning strategies. However, a good strategic business plan always includes the parameters like crisis prevention, mitigation and communication response. Hence proper communication methods will be the key for a good business planning strategy and thereby one organization can reduce the risk of negative media effects. Crisis management keeps the intensity of crossing all the organizational boundaries and their impact will be directly or indirectly on stakeholder as to create a positive or negative impact on the business statistics (Caywood, 2004). Due to heavy involvement of information and communication technology (ICT) in most of the multi-national companies the companies like IBM need to follow a strategic planning in which all modules of work structure needed to be included in appropriate way for reaching the level of global competitors expectations and to stabilize in the market. As per the discussions made by Haselkorn (2007) most of the multinational companies are learning about organizational operation and management than technology to overcome or avoid the crisis and risks. The author suggested few tips for managing the companies complexities related with ICT can be applied for solving issues of crisis management can be summarized as follows:

- Broader and largely integrated efforts are needed to manage enterprise ICT.
- The focus of ICT management of most of the Multinational Companies (MNC's) must shift from hardware, software to data, knowledge and organizational goals.
- The business planning must include ICT and operational goals.
- The focus of total information strategy should be on the people, information and goals of the organization (Haselkorn 2007).

The progression of this report is to address reliable measures for developing an appropriate risk management model to demonstrate a critical measure line for the Major IT industries and their projects. The research questions for this research are defined very carefully as follows:

1. To identify the major risk management model and processing steps adopted in the major IT/ Software industries to deal with the biggest projects.
2. To identify the key approaches of IBM DRiMaP by comparing with the other organizations approach and how it is applicable strongly when compared with other organizations models.
3. To identify the driving forces for regular changes in the risk management model approaches to mitigate the risks across multinational organizations to enhance management of crisis or towards monitoring risk associated within the industry. .

With respect to the above points this project partially fills a gap that Olsson (2008) identified between contemporary risk management and the needs of the distributed development environment. It also introduces an enhanced and extended model based on the DRiMaP model, emphasizing in particular the process phase, roles among the phases, collaboration and communication between them, and coordinating the risk management with the business cycle model for the organization. These aspects have been identified as important and lacking by Mills and Walle (2007) and Kajko-Mattsson *et al.* (2011).

## 5. Research Methodology

For the present research, survey method was selected for collecting the related data on risk management process for IT/Software projects because Surveys are generally considered as the way of obtaining the data from people usually by posing the questions followed by options and the respondent need to select their choice from the options provided (Saunders et al., 2009). This method enables the researcher in gathering the accurate information from the participants as it allows them to express their opinions and produces the data based on their knowledge on the research problem. The survey questionnaire will be a set of questions followed by options where the answers are selected by the respondents. In this method the participants initially read the questions and then choose the appropriate answers (Sugandhi, 2003).

### *5.1. Existing Method*

Previously lots of theories were discussed and the simulation was conducted based on the theories to test the risk models proposed in present research. DRiMaP extension model was tested for various scenarios and compared the results with the results obtained using the Monte Carlo Method and SysML method. There are individual advantages, disadvantages and apart from these they are having their own limitations. However, the proposed technique in the current implementation overcome all the loopholes of the above mentioned two existing systems to work in a dynamic environment where the risk levels, parameters and entities will change along with time. The model was tested based on cost versus various factors in an organizational environment towards finding the risk levels during different scenarios. General factors of an organization tested in this research were based on project, phase and phase item along with deadlines of all these entities. In the following sections the advantages and disadvantages of using Monte Carlo method and SysML method are discussed in detail along with presently proposed DRiMaP method and its outcomes compared with the above two methods.

### *5.2. Monte Carlo Simulation Method*

There are many useful advantages of using Monte Carlo method in project management towards various applications at different research levels. However, the limitations and drawbacks existing in this method limits project managers use this method in most of the real time applications. Generally previous research dose not propose to use this method in most of the organizations with multiple activities involving various risk factors. This method is only used in exceptional cases where it is considered to be more essential for the organization with no other alternative. In the present research major IT projects are considered with large range of risk elements during real-time environment. According to Kwak and Ingall (2007) most of the software and hardware projects never used Monte Carlo simulation method due to its complex nature of dealing with problems as it used to contain most of the statistical data along with wide range of communication problems towards understanding the method. The usage of this method in a dynamic environment like in the present research scenario Monte Carlo method cannot handle the situation due to the nature of dynamic environment where, the risk parameters changes along with time and the simulation process using this method could not find the risk elements and factors in real-time in long run of the projects. Many organizations and their observations revealed that Monte Carlo method was treated as a burden for their operations rather being a fruitful tool (Kwak and Ingall, 2007). The steps involved in

Monte Carlo method according to GAIN Working Group (2003) are involving four major methods to analyze the risk factors in an organization. The first part involved with development of model, where it needs to define a problem or scenario in an excel spread sheet format. Second step involves identifying the uncertain variables within the spreadsheet and then possible values and probability distributions must be specified for analyzing the results. In the third step a detailed analysis of model with simulation to identify the range and possible risk probabilities from the results of worksheets. In the final step decision making will be based on results provided from analysis and personal opinions. At the same time to follow all these steps it sounds more useful in getting a detailed insight of different physical systems obtained from most of the theoretical understandings and requirements given where interpretation of results will directly represent particular material specifically. However, all these four steps need careful attention and accuracy along with experienced experts to make right choice while making a decision. However, the reliability of Monte Carlo method is always doubtful issue as the reliability estimations in this method are blindly undertaken (Al-Maati and Rekab 2003). Most of the times the reliabilities are unknown in advance and hence they are considered to be a nearest optimal value. If assumed probability p_i is known and the approaches for estimating the probabilities are more. However software reliability R is defined as (Al-Maati and Rekab 2003):

$$R = \sum_{i=1}^{K} p_i R_i \quad \ldots\ldots 1$$

From the equation –1 it can be seen that for a small software system the size of possible input domain would preclude from deriving reliability R_i. Hence overall reliability Monte Carlo method would be theoretical but not possible practically. Apart from this, in this method the intermediate results cannot be used once the test is in progress as the test will be conducted in different partitions for refining at different allocations. The same problem was highlighted by Kwak and Ingall (2007) towards the decisions of Management actions. The management cannot include their actions in the middle of the project. The accuracy of Monte Carlo method is largely based on the parameters selected to estimate the reliability for various test case allocations. An error in selecting a parameter can in turn result to produce a big problem in estimating the risk parameters in a dynamic environment.

Monte Carlo method uses random numbers for computing scientific applications (Raychaudhuri, 2008) (Goodman, 2006). It uses random numbers as tools for computing something which is not random (Zhou, Okamura, and Dohi, 2010). This method are also used for sampling the posterior distribution of hyper parameters of a regression model that needs to have a computational model of log likelihood according to Neal (1997). The derivative log is shown in following equation – 2.

$$\frac{\partial L}{\partial \theta} = \frac{1}{2} tr\left(C^{-1}\frac{\partial C}{\partial \theta}\right) + \frac{1}{2} t^T C^{-1} \frac{\partial C}{\partial \theta}\, C^{-1} t \quad \ldots\ldots \quad 2$$

This method is though looks more complex in nature but can solve most of the complex problems in a static environment. However, the sampling methods in this method are independent with respect to the scale of data. Hence in a dynamic system of an organization the computation of risk levels will be more difficult using this method. Apart from that Raychaudhuri (2008) emphasizes important problems using Monte Carlo methods towards performance issues that are related with coding. The software's with naive coding with texts are tend to give a poor performance and two significant factors were identified are frequent branching and frequent producer calls. According to Zhou, Okamura, and Dohi (2010) Monte Carlo Random Testing (MCRT) is only limited to test the parameters that are based on statistical parameters estimation but not for dynamic environment and hence the fault detection depend on various models of the software testing models that are built. The applications of Monte Carlo are even extended to measure and test the RF components also but only with static environment (Tongbong, Mir, and Carbonero, 2007).

*5.3. Scenario One: Monte Carlo Negative Impacts in a Dynamic Environment*

There are many drawbacks of Monte Carlo method while using in a dynamic system. Based on the steps involved in Monte Carlo method a state diagram is shown in figure – 4. To explain the problems involved in IT industry to find risk parameters with a detail description. Monte Carlo simulation will be an intuitive (spontaneous) interface (Sugiyama, 2008) works effectively for a static system with limited inputs. However, in a dynamic environment the sensitive interfacing is not going to work out due to random inputs from different resources. Decision making using Monte Carlo in most of the software projects are resulting into possible uncertainties at outputs due to possible variables at the input (Madani and Lund, 2011). For example, the gaming software's are now – a – day have great market across the world and they are having worst decision making problems at different sections of the software development projects. Since most of

the decisions in Monte Carlo method are taken blindly, the decision making will be an uncertain thing to be considered in a software industry. On the other hand the software project developments need multi – criteria with multi decision making problems for dissimilar alternatives and these are generally complex in nature. Apart from this statistical distribution of data or project inputs (like task distributions must be able to obtain from reliable data from previous history) are available in many cases if the job task is within 2 – 3 days. However, if the same considered with research and development projects in big software companies the information will not be available for the improvising the estimations using Monte Carlo Method (Intaver, 2006). Another major disadvantage discussed in Intaver (2006) during quantitative risk analysis for Microsoft projects is about losing the grip of project managers in case of missing or delayed projects. The task to perform certain actions will get much difficult and to define the risks in near future will become a big issue.

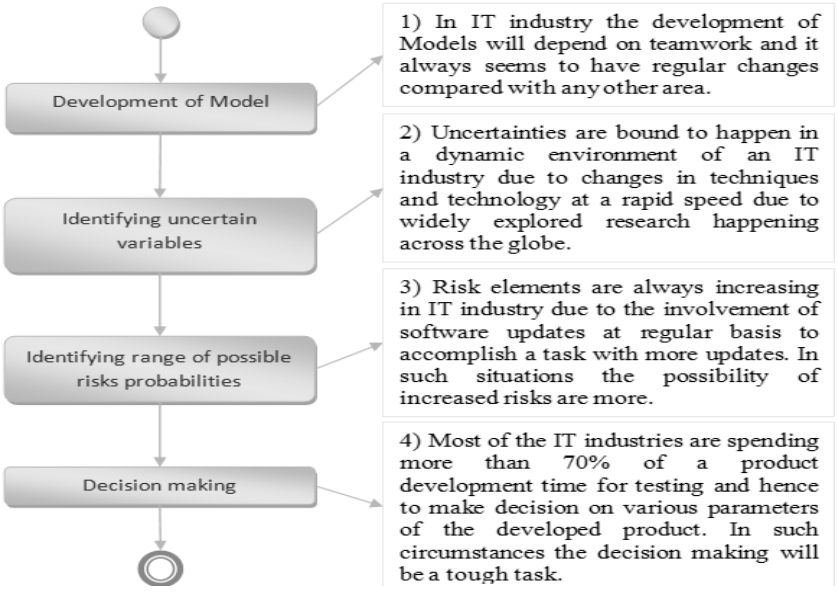


Figure 4. Problems Involved in IT Industry to Find Risk Parameters Using Monte Carlo Method

*5.4. SysML Simulation Method*

SysML method is having wide range of advantages and is considered to be an extension of UML for application in system engineering domains. It is having wide range of capabilities to develop embedded systems, to integrate heterogeneous elements, expressing continuous data flow, parametric constraints and it is used in wide range of modeling applications as well (Kawahara, et al 2009). Apart from that SysML in an organization can supports modeling various requirements, behaviors, structures and etc. It can aid the verification, validate and simulate the software projects. In simple it is capable of providing a practical approach for integrating and testing the risk parameters (Hause and Holt, 2010). Generally the behavior of a system is described as a mixture of event driven and continuous time model. However SysML cannot define the continuous – time behavior practically. But in present architecture the nature of being dynamic model it needs to explain the risk parameters along with time – to – time activities. Using the DRiMaP model an extension of SysML can be developed and it will be able to describe continuous – time behavior.

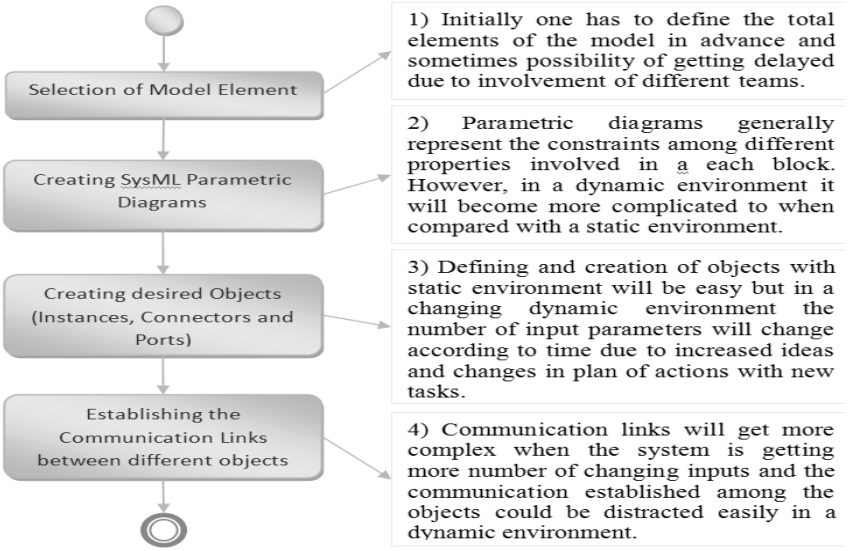


Figure 5. Problems Involved in IT Industry to Find risk Parameters
Using SysML Method

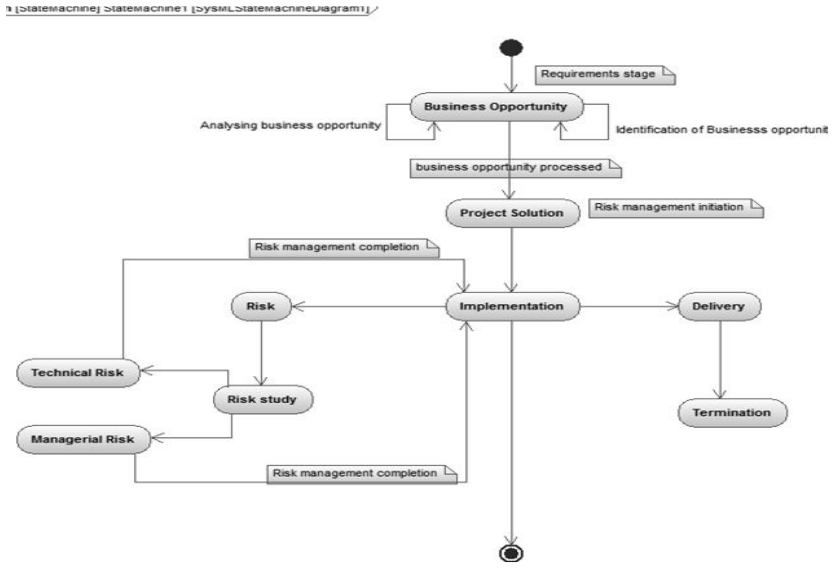


Figure 6. The DRiMaP Model
Using the SysML

The DRiMaP case study was used to run the experiment, illustrated in the figure – 6. This provided an overview of the critical analysis of the distributed risk management activities. The DRiMaP case study was an example and the software development life cycle (SDLC) of the large IT systems has been designed and proper risk management activities have been identified. The loss distribution calculation helped to understand the unexpected losses incurred to the IT systems. In the second experiment, the threshold, time variance and the unexpected risk factors will be explained and an own system will be designed to modify the DRiMaP model in order to introduce a distributed risk management model. In the research conducted by Schonherr and Rose (2009) reveals that the SysML method will be able to identify and structure significant properties of various processes in different production systems only on theoretical basis.

*5.5. Scenario Tow: SysML Negative Impacts in a Dynamic Environment*

SysML is only suitable for building models that are related with concepts. It can be used for structure modeling for designing all behavior patterns. However, the biggest problem of SysML is towards the inability of representing distributed systems. Generally the state modeling using SysML method will be of complex in nature along with various system elements. These modeling areas will be based on conditional behavior and will be able to allow only low level behavioral modeling of systems in a static environment. According to Matei and Bock (2012) SysML cannot represent behavior of dynamic systems that are continuously working. Mostly these interaction models are having certain limits to discrete and finite flows among the components as each flow is having its own element in the model representing graphically as lines. The applications of Monte Carlo and SysML method are meeting most of the requirements of solving the problems involved with risk parameters in IT industry. However, in a dynamic environment they are giving limited outcomes (in case of SysML) or they are creating complex situations (in case of Monte Carlo) to identify risk parameters as the input values are increasing. Such scenarios are demanding a flexible model like DRiMaP that mitigates risk and establish wide range of organizational relationships even when the input parameters are increasing extensively.

## 6. Proposed Method

The DRiMaP Extension model will complement the actual DRiMaP risk management system with provision of collaborative platform across multi-organizational terrains. It utilizes information stored about projects from all the phases designed to manage and to notify the users about the mitigation process used to prioritize the identified risk during development. The defined language currently in use is English language. Following the steps, the DRiMaP Extension uses the data generated from these states: create, delete, and update to identify the associated related risk which are evaluated within the predefined rules for mitigation process with the output presented through alert systems (i.e. automatic email generation). The DRiMaP Extension system is written in web services (.Net 4.0 framework c#), class libraries for data transaction, and client-side which is provided to test the functionality of DRiMaP extension.

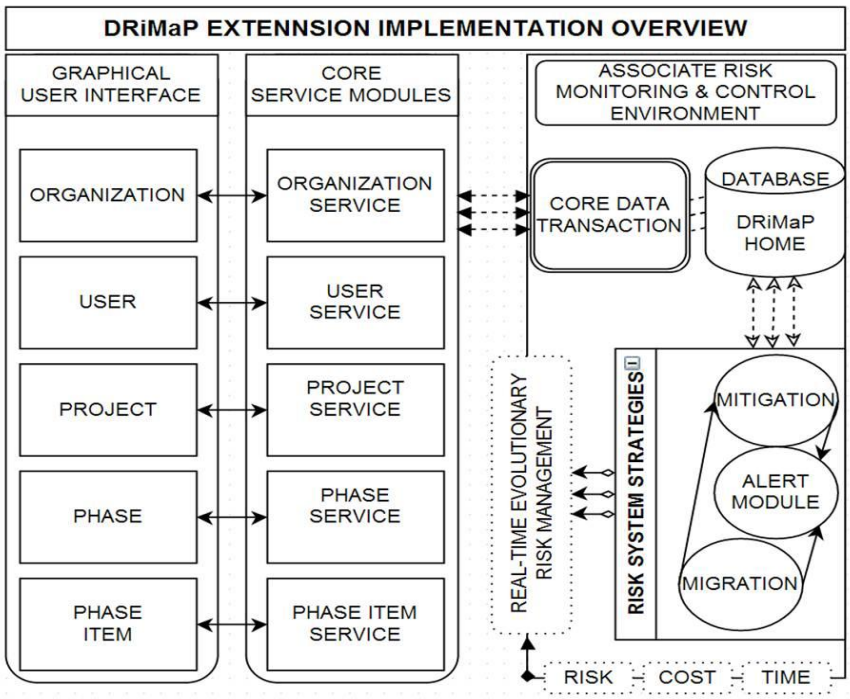


Figure 7. DRiMaP Extension Implementation

## 7. Outcome from DRiMaP Extension and Simulation

DRiMaP Reporting View: In respect to the above, the GUI below represents view of activities for each of the entities mentioned above for deadlines (i.e. Time) versus Cost on Project, phase, and Phase Item or items of the requirement phase.

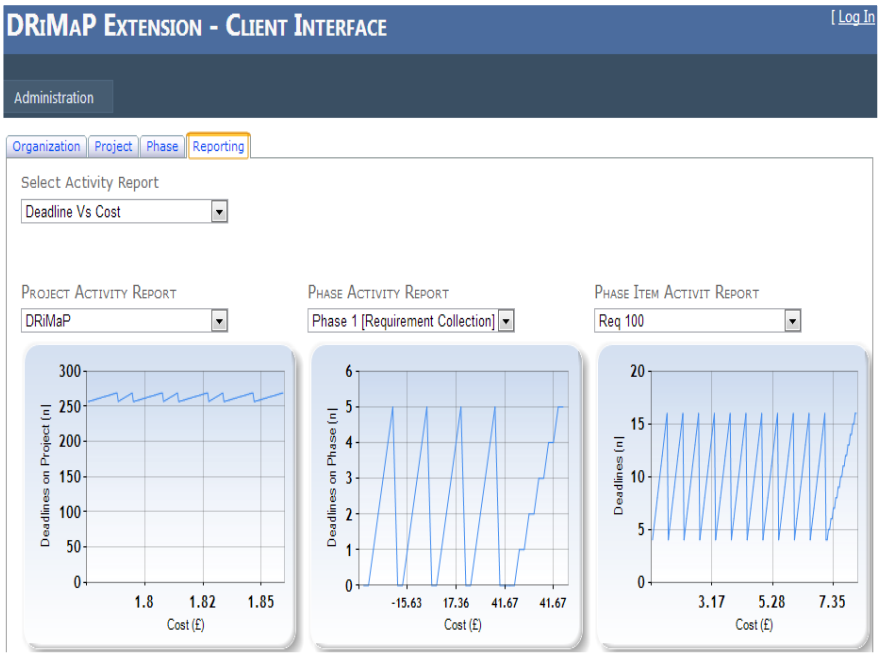


Figure 8. DRiMaP Reporting Activity:

Deadline vs. Cost (on Project, Phase and Phase Item)

The level of the risk is determined if the percentage calculated fall in any of the range above. As we can see here, the estimate at this point indicates that at a Low risk the expected risk cost would be £13.89. Equally, as the deadline is approaching risk tends to increase as the cost.

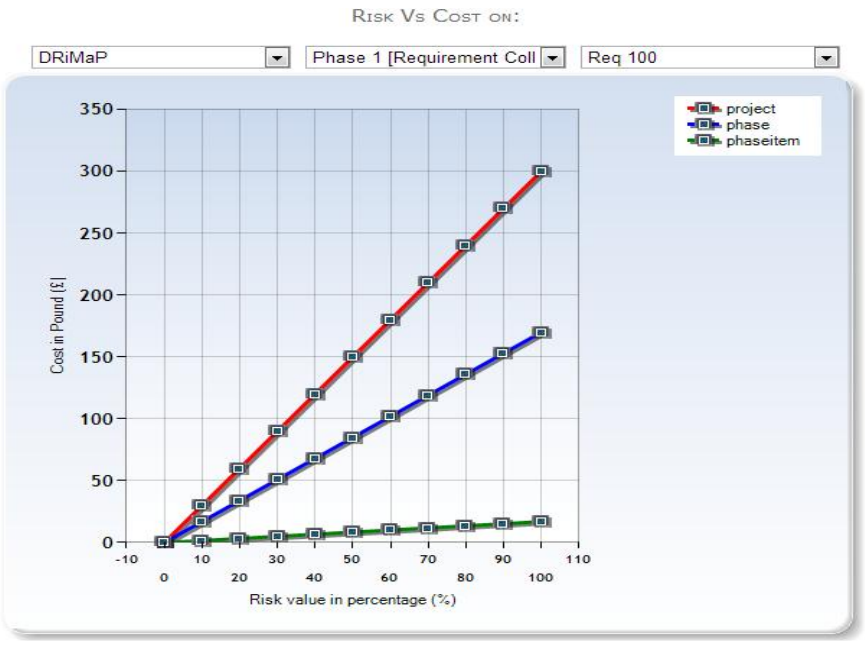


Figure 9. Executive Reporting

Activities

## 8. Conclusions

This research gives a detailed critical analysis of the distributed risk management activities. The DRiMaP case study has been taken as an example and the software development life cycle (SDLC) of the large IT systems has been designed and proper risk management activities have been identified. The loss distribution calculation helps to understand the unexpected losses incurred to the IT systems. In the second experiment, the threshold, time variance and the unexpected risk factors will be explained and an own system will be designed to modify the DRiMaP model in order to introduce a distributed risk management model. The Monte Carlo simulation method was well applicable in finding the distributed risk in management processing but due to heavy involvement of statistical analysis and sampling of data it cannot be used in the present research. In the perspective of the current research one can observe that this research cannot use Monte Carlo method as it needs to select the information randomly and need to test the samplings of data at different levels from IBM mainframe, which is very difficult to get accessed with larger quantity of material from there. Hence in this research it is considered to use SysML for the modification of the existing risk management model. For designing a customized model to mitigate the risk and distribute the same among different organizations it is necessary to use SysML to design the further models.

**References**

Al-Maati, S. A., and Rekab, K. (2003, November). Dynamic test allocation model for software reliability. In Quality Software, 2003. Proceedings. Third International Conference on (pp. 26-31). IEEE.

APM (2008) APM White Paper on Soft Skill in Risk Management, version 3, APM Risk Specific Interest Group.

Bakker (2008) Traditional Risk Management Does not work. [Online] available at URL:
< http://www.noop.nl/2008/03/traditional-ris.html>, [January 19, 2010].

CAS (2003) Overview of Enterprise Risk Management. [Online] available at URL: <http://www.casact.org/research/erm/overview.pdf>, [January 19, 2012].

Caywood, C.L. (2004) The Handbook of Strategic Public Relations and Integrated Communications. India: Tata McGraw – Hill.

Coombs, W. T. and Holladay, S. J. (2011) The Handbook of Crisis Communication: Volume 22 of Handbooks in Communication and Media. USA: John Wiley & Sons.

Culp, C. L., (2001) The Risk Management Process: Business Strategy and Process. Volume: 81, John Wiley & Sons, Inc.

Dury, J.L., Beaton, E. and Boiney, L (2010) Collaboration Research for Crisis Management Teams. USA: Now Publishers Inc.

GAIN Working Group (2003) Guide to Methods and Tools for Airlines Flight Safety Analysis. 2nd edition. Abacus technology Corporation, NW, USA.

Goodman, J. (2006). Principles of Scientific Computing. *Courant Institute of Mathematical Sciences, NY University, New York*.

Gordon, P. (1999) To err is human, to estimate, divine. *"Information week"*, pp. 65-72.

Haselkorn, M. P. (2007) Strategic Management of Information and Communication Technology: The United States Air Force Experience with Y2K. Washington, DC, USA: National Academic Press.

Hause, M., & Holt, J. (2010). Testing solutions with UML/SysML.

Higuera, R. P. and Haimes, Y. Y. (1996) Software Risk Management: Technical Report, Pittsburgh, Pennsylvania: Carnegie Mellon University.

Intaver (2006) Quantitative Risk Analysis with Microsoft Project: Monte Carlo Simulation with Microsoft Project. [Online] available from URL: <http://www.intaver.com/Articles/RP_Art_MSProjectRiskAnalysis2.html>, [April 21, 2013].

IRM (2002) A Risk Management Standard. Available at: http://www.theirm.org/publications/documents/Risk_Management_Standard_030820.pdf [Accessed: 05/05/2011].

Kawahara, R., Nakamura, H., Dotan, D., Kirshin, A., Sakairi, T., Hirose, S., Ono, K., & Ishikawa, H. (2009, March). Verification of embedded system's specification using collaborative simulation of SysML and simulink models. In *Model-Based Systems Engineering, 2009. MBSE'09. International Conference on* (pp. 21-28). IEEE.

Kwak, Y. H., and Ingall, L. (2007). Exploring Monte Carlo simulation applications for project management.

*Risk Management*, *9*(1), 44-57.

Madani, K., & Lund, J. R. (2011). A Monte-Carlo game theoretic approach for multi-criteria decision making under uncertainty. *Advances in water resources*, *34*(5), 607-616.

Matei, I., & Bock, C. (2012). *SysML Extension for Dynamical System Simulation Tools*. US Department of Commerce, National Institute of Standards and Technology.

Mattsson K. and Nyfjord J., (2008), State of Software Risk Management Practice, *"IAENG International Journal of Computer Science"*, Vol. 35, No. 20.

Mattsson, M.K., Sjokvist, K. and Krogdahl, D. (2011) Outlining a Distributed Risk Management Process Model, *International Journal of Information Processing and Management.* Vol. 20, No: 1, issue: 1.3, pp. 22 – 33.

Mills, K. and Walle, B. V. D. (2007) IT for Corporate Crisis Management: Findings from a Survey in 6 different Industries on Management Attention, Intention and Actual Use. *Proceedings of the 40th Hawaii International Conference on System Sciences – 2007*.Pages 24, January, Hawaii.

Molenaar, K. R., Anderson, S. D., Schexnayder, C. J. and National Research Council (U.S.) (2010) NCHR Report 658: Guide book on Risk Analysis Tools and Management Practices to control Transportation Project Costs. Washington, DC, USA: Transportation Research Board.

Muhlbauer, W. K. (2004) Pipeline Risk Management Manual: Ideas, Techniques and Resources. 3rd Edition, Oxford, UK: Elsevier Inc.

Neal, R. M. (1997). Monte Carlo implementation of Gaussian process models for Bayesian regression and classification. *arXiv preprint physics/9701026*.

Olsson, R. (2008) "Risk management in a multi-project environment: An approach to manage portfolio risks", International Journal of Quality & Reliability Management, Vol. 25 No. 1, 2008 pp. 60-71.

Raychaudhuri, S. (2008, December). Introduction to monte carlo simulation. In *Simulation Conference, 2008. WSC 2008. Winter* (pp. 91-100). IEEE.

Saunders, M., Thornhill, A., and Lewis, P. (2009) Research Methods for Business Students. 4th Edition, Harlow, England: Printice Hall – Pearson Edition.

Schonherr, O., & Rose, O. (2009, December). First steps towards a general SysML model for discrete processes in production systems. In *Simulation Conference (WSC), Proceedings of the 2009 Winter* (pp. 1711-1718). IEEE.

Škrlj, S. (2008) Monte Carlo Analysis for MS Project. [Online] available from URL: <http://rule-of-thumb.net/monte-carlo-simulation-for-ms-project/>, [May 02, 2013].

Škrlj, S. (2013) Monte Carlo Analysis for MS Project. [Online] available from URL: <http://sourceforge.net/projects/montecarloprj/?source=dlp>, [May 02, 2013].

Sugandhi, R. K. (2003) Customer Relationship Management. New Delhi, India: New Age Internationals (P) Ltd.

Sugiyama, S. (2008). Monte Carlo simulation/risk analysis on a spreadsheet: review of three software packages. *Foresight, Spring*, *9*(2008), 6-42.

Tongbong, J., Mir, S., and Carbonero, J. L. (2007, April). Interactive presentation: Evaluation of test measures for LNA production testing using a multinormal statistical model. In *Proceedings of the conference on Design, automation and test in Europe* (pp. 731-736). EDA Consortium.

Wallace, L., Keil, M., and Rai, A. (2004) How Software Project Risk affects Project Performance: An Investigation of the Dimensions of Risk and Exploratory Model. *"Dimension Science"*, Volume 35, N0.2, United States: Spring Publishers.

Wallis, M.R., (2005), Corporate risk taking and performance. [Online] available on URL:

<http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/strategicrisk.pdf>, [January 15, 2011].

Zhou, B., Okamura, H., and Dohi, T. (2010). Markov chain Monte Carlo random testing. In *Advances in Computer Science and Information Technology* (pp. 447-456). Springer Berlin Heidelberg.