CHAPTER 2

REVIEW OF LITERATURE

2.1 INTRODUCTION

Financial risks impacts the business in a very drastic way. Proper planning for management of the financial risks is thus essential. Risks occur in all fields, the probability of occurrence and the impact vary. In each industry there are specific ways to identify and manage the risks. The risks if not properly mitigated will have serious consequences which may be in terms of financial losses, not being able to achieve the milestones as per plan, delays in completion of the project itself and lost goodwill. It may also result in payment of penalties which drains the company of its profits. Financial risks are the ones that needs careful analysis due to its impact on the profitability of the business itself.

Bent Flyvbjerg & Alexander Budzier (2011) had conducted a study regarding budget overruns and financial risks in IT projects, it was found that in case of Information technology projects there was 27% chances of budget overruns, and hence high chances of failures. It was found that one out of six of the projects that was part of the study was a black swan, which had a 200% cost overrun and 70% schedule overrun. The term black swan was coined by
Nassim Nicholas Taleb to explain rare and unforeseeable events which may not be improbable, and can have a colossal impact on the project. A classic example is a $5 million project that may lead to $200 million loss and can impact the balance sheet of the organization itself.

In terms of an information technology project the unplanned conditions or events are called risks. Risks can have a negative or a positive effect on the success of the project. Every risk is not considered to be bad but they are given much importance as they are mostly looked at as a threat. Financial risks associated with a project seemed to be threatening the project managers. The risks in a project can mean increased costs, extended duration of the project and can also mean the failure of the entire project. It is said by (The Economic Times, 2014) that the risks are often a negative condition but the acceptance of the risks can also prove to offer a reward. In case of a project manager, the risks can even lead to project failure but duly accepting the same and taking appropriate steps can reward them in means of saving the costs, saving the time involved and many other similar benefits. Identifying the probable risks in advance and analyzing them to take precautionary steps in order to reduce the impacts of risks is referred to as the Risk management. The scope and priority of the project in the organization where it is performed and the effect on the delivery of the project are all related to the process of risk management.

The risk management process depends on the importance, complexity and type of the project. A low impact and a simple project might not have a risk management as a complex and a high priority project would have. To manage the risks, a pre-defined approach is often followed by the organizations. These pre-defined policies constitute the activities to plan,
initiate and respond to the risks encountered during the progress of a project. It is the duty of the project manager to map these policies to the project risk management in order to conform to the requirements of the organization. Based on the policies of risk management, the project manager is supposed to identify the components that hinder the progress of the project.

2.2 MEANING AND DEFINITION OF FINANCIAL RISK MANAGEMENT IN INFORMATION TECHNOLOGY PROJECTS

Financial Risk management in information Technology projects is defined as the complete set of processes put in place in order to plan, identify, mitigate, monitor and control the financial risks that arise while executing the information technology projects.

The financial risk management can be both quantitative and qualitative. The project team, key stakeholders and the project manager tend to determine the risks associated with the project and manage them. A schedule is needed by the process of risk management in order to determine when and how often the activities of risk management should be carried out throughout the project. The risk management for a project needs to be carried out at appropriate time, if not there could be a delay in the project because of the requirement of time to identify, evaluate and react to the risks. Thus, a reasonable schedule needs to be framed in the early phase of the project to analyze the risks, accommodate them and react accordingly.
2.3 NEED FOR FINANCIAL RISK MANAGEMENT IN INFORMATION TECHNOLOGY PROJECTS

Financial risk management leads to huge benefits realized in the form of projects running within budget and schedule, project closing successfully within the triple constraints and resulting in customer delight. It is possible to gain good financial benefits even from the uncertain projects if carried out in a proactive manner.

Chorafas (2007) in his study in the area of risk management in information technology projects have elucidated the results of a research done by the Standish Group, that brings out the annual evaluation of information technology projects, the conclusions were startling:

i. Only 29% of IT projects succeeded in the year 2004. This pointed to the high failure rates found in IT projects.

ii. In 2002 there was a 34% success record. It had come down to 29% in 2004. This highlighted the decline in the success rates.

Also it was found that on an average there were 56% budget overruns and it took 84% more time than the original schedule in the year 2004. This statistics pointed to the crumbling nature of the IT projects in terms of budget and schedule.

Further he cites the case of Swiss PTT, another IT project that was not properly risk managed and incurred huge losses. This project was badly defined, and managed without proper risk management in place. $49 million
was spent on the PTTs' post-check functions, but at the end, the project had to be scrapped. This led to huge loss and humiliation, which led to the director of PTT data processing organization to commit suicide.

He has pointed to the case of Project Star by the US Postal service which went totally out of control. At the time when Project Star failed completely and had to be dropped, the cost had touched $500 million, higher in magnitude than the failed IT Project at Swiss PTT. The reasons for Project Stars' failures are contributed to the senior postal management not reacting even as:

1) The budget was shooting up.
2) The goals had contracted.
3) The chances of success had dwindled.

A research was conducted by Calleam consulting (2015) on Geneca software company in the year 2010-2011. It was a interview based study of software projects, where around 600 people who were closely involved in software development projects were interviewed. The findings were surprising:

i. In the initial stage of a project itself many people expected the projects to fail. They were of the view that the unclear business goals, out of sync stakeholders and too much rework made 75% respondents lack confidence that their projects will succeed.

ii. 78% of respondents felt that the business was not in sync with the project requirements.
The Calleam consulting had studied a IT project Digital Media Initiative run by British Broadcasting Corporation (BBC) in May 2013. The total cost estimated for delivering the project was £100 Million pound and the project aimed to provide a single tool that could perform radio and video production from the initial input to the final edit. This would help in improved management and consolidation of archive materials. This tool was to be made accessible from the employees desktops and was supposed to provide better integration of the huge volumes of archive of media developed over the 90 odd years.

The contract was awarded to Siemens without the formal tender process in 2008. This was a fixed price contract with cost of £82 Million, and 18 months schedule for completion. Due to budget overruns and issues, the contract was terminated, and the project was back in-house. BBC planned to deliver the project by the internal team. As work progressed, many issues emerged, and project performance plummeted, and at the end the project was abandoned in May 2013.

The contributing factors for the failure was no proper financial risk management followed, the complexity was underestimated, and the project management governance was faulty, failure to conduct tendering process, the usage of fixed price contract acted as a blocker as BBC did not get deeply involved in the planning and design stage for fright of initiating change requests for increased budget. The studies that had been conducted highlighting the need for financial risk management in IT project has been summarized in Table 2.1. All these studies points to the need of a stringent financial risk management to be in place in information technology projects.
Table 2.1 Studies highlighting need for Financial risk management in IT projects

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Year of study</th>
<th>The consulting group /researcher who had undertaken the study</th>
<th>The Research subject studied</th>
<th>Methodology used for the study</th>
<th>Finding of the study</th>
</tr>
</thead>
</table>
| 1      | 2004          | Standish Group                                                | Annual evaluation of information technology projects. | Evaluation of IT project reports. | i. Only 29% of IT projects succeeded in the year 2004.  
   ii. On an average 56% budget over-runs and 84% additional schedule experienced. |
| 2      | 2007          | Dimitris N.Chorafas                                            | Swiss PTT, an IT project.       | Case study on Swiss PTT.        | i. Colossal losses.  
   ii. Costs $49 million, project had to be scrapped. |
| 3      | 2007          | Dimitris N.Chorafas                                            | Project Star by the US Postal service. | Case study on Project Star.     | i. Project failed completely.  
   ii. Cost touched, $500 million and project was dropped. |
| 4      | 2010 - 2011   | Calleam consulting group                                      | Geneca software company.       | Interview method - 600 people involved in Software development projects were interviewed as part of the study. | i. 75% respondents were not having confidence that their project will succeed.  
   ii. 78% respondents felt business not aligned with project requirements. |
| 5      | 2013          | Calleam consulting                                             | IT Project Digital Media Initiative by BBC. | Case study on the Media project by BBC. | i. Cost £100 M pound, project was abandoned due to poor financial risk management practices. |

Source: The secondary data collected as part of review of literature for the research.
2.4 VARIOUS PROJECT FINANCIAL RISK MANAGEMENT TECHNIQUES

Kelkar (2009) had discussed in length the various risk management techniques used in projects. As part of the risk management plan formulated, the Risk breakdown structure (RBS) is developed. The RBS is a hierarchical display of the risks that have been identified and organized by areas and the risk reasons. The probability and impact matrix is prepared and the risks are prioritized as per their probabilities and impact of occurrence on the project's objectives. Risk identification is an iterative process. Brainstorming is used as a key information gathering technique, where a complete list of project risks are developed by the subject matter experts in the area. It may be a free-form brainstorm or a structured brainstorming using interviewing techniques. Delphi technique is another information gathering technique which aims to arrive at a consensus of the experts. In Delphi technique, the project risk experts participate anonymously. The responses are summarized and circulated again to the experts for their views. This is done until a consensus is reached. Interviewing the key stakeholders is another form of information gathering. Root cause analysis helps to identify the problem, and discover the underlying causes, and arrive at a preventive action plan. As part of the SWOT analysis the strength, weakness, opportunities and threats analysis of the project and the organization is performed that helps identify both internal and external project risks. Cause and effect diagrams, Risk influence diagrams, risk checklist are also used for identifying the project risks. As part of Risk analysis, quantitative techniques like sensitivity analysis and simulation are used. Expert judgment and Delphi methods are used for qualitative risk analysis. For arriving at the risk response plans, usually a mix of strategies are found to be more effective. The risk response strategies used are risk avoidance, risk transfer and risk mitigation. Monitoring and control also includes the tasks of updating the organizational process assets such as the lessons learned databases and the templates used in risk management.
Baker et al (1999) had pointed out that the risk identification would be done by these techniques such as brainstorming, Delphi technique, expert or interview opinion, checklists and past experience. They stated that the brainstorming is one of the most famous techniques. This is used mainly for the generation of idea, it is also very significant for identifying the risk. Here the group or the team brainstorms for identifying the risk factors in projects.

Wang & Dulam (2004) have described that the Delphi technique would determine the risk factor without involving the other project members. Personnel or experts with sufficient experience in a project could assist in solving or avoiding similar issues again and again. Also referred that checklist comprise of risks list determined in the projects analyzed during the past and responses to such risks would be considered and start analyzing the issues.

Kim & Bejaj (2002) had mentioned that based on past experience from the similar kind of project, an analogy could be developed for identifying the risk factor. It is probable that similar kind of risks may arise on the same type of projects. This provides results by analyzing the project characteristics.

Patil (2008) pointed out that the probabilistic analysis is referred as the distribution of probability for each risk and then it identifies the impact of risks in the combination. This probability and impact value is an indication of the risk score. Also he mentioned that the decision trees are another method that is used for structuring graphical models. Decision tress combine the information required to take decisions for a project and indicate the current possible action courses and all future possible outcomes.

According to Ling & Hoi (2006) Influence diagrams are new risk analysis technique. Influence diagrams provide a powerful means of generating models of the risks in a project. They are used as the user interface
for information technology based risk modeling tool and enable the risk models to determine the time, cost and economic projects parameters.

Garvey (2008) says that RiskNav® is a tool developed by MITRE to facilitate risk management by helping the program managers to handle the risks. RiskNav was developed by US government to capture, design, analyze and figure out the risks in project or firm level. RiskNav® tool helps to gather, analyze, rank, monitor and visualize the risk information at a project or an enterprise level. It can be represented in both tabular and graphical forms. RiskNav® makes use of the weighted average method which arrives at a score for each risk that is identified. The risk priority is the weighted average of the time, probability and impact of occurrence. This score provides a high to low critical rank of the risks. Here the more critical risks get higher numbers followed by lower priority risks.

Expected Monetary Value (EMV) within the decision tree is a measurable idea that computes the normal result when the future incorporates situations that might happen. This is one of the quantitative risk analysis methods used in the industry. Here the subject matter experts focus on determining the risks that may impact the cost of schedule of the project. The decision tree analysis helps to arrive at better decisions, and determine the most appropriate actions for both opportunities and threats and hence part of the plan risk responses process. Based on the decision tree, the monetary value associated with each outcome needs to be determined by multiplying risk probability times the monetary value of the outcome. The monetary value of the decision tree risk outcomes is added to arrive at the expected monetary value of the risk of decision.

The studies conducted on the financial risk management tools & techniques have been summarized in Table 2.2.
## Table 2.2 Studies on financial risk management tools & techniques

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Year of Study</th>
<th>The consulting group/researcher who had undertaken the study</th>
<th>Risk management tool &amp; techniques highlighted</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1999</td>
<td>Baker et al</td>
<td>Risk identification through brainstorming, Delphi technique, expert or interview opinion, checklists and past experience.</td>
</tr>
<tr>
<td>3</td>
<td>2004</td>
<td>Wang &amp; Dulam</td>
<td>Delphi technique, checklist method to arrive at the risk factors.</td>
</tr>
<tr>
<td>4</td>
<td>2002</td>
<td>Kim &amp; Bejaj</td>
<td>Use of historical information in determining the risk factors.</td>
</tr>
<tr>
<td>5</td>
<td>2008</td>
<td>Patil</td>
<td>Probabilistic analysis, decision trees method used for structuring graphical models.</td>
</tr>
<tr>
<td>6</td>
<td>2006</td>
<td>Ling &amp; Hoi</td>
<td>Influence diagrams as risk analysis technique.</td>
</tr>
<tr>
<td>7</td>
<td>2008</td>
<td>Garvey</td>
<td>RiskNav® is a tool for risk management at project and firm level. Developed by MITRE</td>
</tr>
</tbody>
</table>

Source: The secondary data collected as part of review of literature for the research.
There are many tools and software available in the market for performing Risk management like Risk radar and risk radar enterprise developed by the American systems. As described by Proconcepts LLC (2015), Risk Radar was initially released in the year 1996 is widely used by project managers throughout the world. It is easy to install, setup and use. It supports the project managers to classify, prioritize, and track risks and arrive at good management decisions before the risks turn into big issues in future. Risk Radar Enterprise was developed based on 15 years of experience in risk management services provided to US Government. This is a enterprise risk management solution and is scalable at a project, program or at a larger enterprise level.

As per Sword Active Risk (2015), Active Risk Manager (ARM) is a enterprise risk management software package, managing project and program risk and helps in strategic business planning. ARM supports organizations by identifying, analyzing, monitoring, controlling and reporting risk throughout the enterprise. ARM has in its offer complete ERM solutions for risk management at the enterprise level.

Modeling & simulation – A venture re-enactment, which utilizes a model that deciphers the particular itemized instabilities of the undertaking into their potential effect on task goals, typically iterative, is used for risk response planning. Monte Carlo is an example for an iterative product.

Many application and software tools are available in the market for risk management -

i. Project risk analysis project management tool used to arrive at a cost of a project and prevent the risks of underfunding.
ii. RiskyProject lite allows the project managers to plan, schedule, perform quantitative risk analysis and performance measurements of projects with many perceived risks.

iii. Primavera risk analysis software is risk solution which takes care of the cost and schedule risk management. It determines chances of project success along with easy risk response solutions. This product was developed by Oracle corporation.

iv. Risc Calc uses probability related analysis, fuzzy arithmetic and interval analysis with a flexible windows interface.

v. GS Risk is a useful risk management software, developed by IBM.

The risk management software and tools available in market has been summarized and depicted in table 2.3.

**Table 2.3 Risk Management Software and Tools available in market**

<table>
<thead>
<tr>
<th>Risk management software developer/products</th>
<th>Risk Management software package and tools for risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proconcepts LLC</td>
<td>Risk Radar and risk radar enterprise for risk management at project and Enterprise levels.</td>
</tr>
<tr>
<td>Sword Active Risk</td>
<td>Active Risk Manager (ARM) is a enterprise risk management software package.</td>
</tr>
<tr>
<td>Oracle, IBM, etc.</td>
<td>RiskyProject lite, Primavera risk analysis, Risc Calc, GS Risk for risk management.</td>
</tr>
</tbody>
</table>

Source: The secondary data collected as part of review of literature for the research.
2.5 IMPACT OF PROJECT FINANCIAL RISK MANAGEMENT
TECHNIQUES ON SUCCESS OF IT PROJECTS

Raz et al (2002) examined the risk management, success of the project and technological uncertainty. In the competitive world, success of the project become more crucial to the performance of business and most of the projects face challenges in the form of overruns, delays and sometimes fails due to these reasons. This study examined the various practices of risk management like identification of risk, planning for trade-off and uncertainty analysis, probabilistic risk analysis, the difference in applications of various projects and their effect on various dimensions in the success of the project. From the findings of the study it was noted that practices of risk management were not widely used. It was also noted that only a limited quantity of projects have used some kind of practices for managing risk and most of the them have utilized only some tools but not all the available management tools. It was also noted that when risk management techniques were implemented it showed a positive correlation with the success of the project. It was determined that the practices of risk management were more suitable to higher risk projects.

Junior & Carvalho (2013) had conducted a study to understand the impact of risk management on project outcomes. The survey was conducted on 415 projects in Brazil. These projects belonged to different industrial sectors. An attempt was made at understanding the risk management practices adopted in projects. In this study risk management is taken as the independent variable and project success is considered the dependent variable. The outcome of the study establish that risk management practices had a favorable impact on the project success. It is mentioned that each risk requires a different mitigation strategy to be applied. It has been recommended that the
specialized task of risk management needs to be performed on a regular basis by the project manager or a risk professional.

As stated by Durkovic & Rakovic (2009), considering that competition is omnipresent, it becomes all the more important to define the risk factors that can impact the project success, and that can cause slippage of budget and schedules. Also it is critical to select the appropriate risk management methodology. The process of risk management starts at the start of the project and lasts throughout the project development, implementation till its end. The main focus of risk management is to identify the big risks and concentrate on its mitigation plans. This is possible through risk prioritization process. The risk management comprises the risk assessment, risk identification, risk analysis, risk mitigation and risk monitoring and control stages. A more focused approach towards risk management can impact project success.

Carbone & Tippett (2004) examined project risk management using project risk failure mode and effects analysis (RFMEA) technique. An research had been undertaken on the project risk management and a new technique proposed for managing project risks called the project risk failure mode and effects analysis (RFMEA). This new tool is based on the risk failure mode and effects analysis(RFMEA), which is used extensively as a planning tool. While using the FMEA, the RPN(risk priority number) is calculated. In case of RFMEA, the risk events are identified, followed by assigning the probability of occurrence, impact and the detection values. The risk priority number(RPN) & critical value is calculated and reviewed through pareto analysis, and this is plotted on scatter diagram of the RPN vs. risk score. The risk response are developed for the high risks and the response plan is re-assessed based on the response plan. Case study method was used for showing the effectiveness of use of this new model in the area of risk
management. This new method or technique would be beneficial in numerous ways. They prioritize risk contingency planning, enhance participation of team in the process of risk management and develop and enhance the risk controls.

2.6 TYPES OF RISK FACTORS THAT AFFECTS INFORMATION TECHNOLOGY PROJECTS

There has been studies undertaken to understand the risk factors that affect the information technology projects.

It is stated by Robert (2009) that the high technology projects may be exposed to many risk factors which can impede project success, such as:

i. Technological - The project team or company may not have any experience working with the new technology. Similarly in case of rapidly changing technologies, the current design, version may not be current and out of support after may be six months. These risks needs to be factored.

ii. Interpersonal - There needs to be a working relationship established among the team members. Sound relationships among the project members are very essential for project success. Serious interpersonal relation issues can spoil the working atmosphere and hamper project success and hence should be brought to the notice of the senior management.

iii. Environmental - The environment of the project is a very significant contributor to the project success. Stability in management structure, project priority, views of the sponsor, staff turnover are all key risk factors in the project.
iv. Cultural - The enterprise culture in which the project operates may be a risk factor. If the project is consistent with the way the organization functions, or does it necessitate huge changes to be successful? These risk factors need to be carefully factored. For instance, if the project deliverable is a new process which pulls away the decision-taking powers from the employees who were used to making decisions on their own, the project is likely to face development, implementation and support issues.

v. Causal relationships - The dependencies pose as a risk factor, the cause and effect situation needs to be studied and stated clearly.

It has been found by (John 2012) that based on the information technology life cycle the risk factors identified are as follows:

i. Environmental risks - The environment in which the project is implemented pose risk, a classic example is an unfavorable legislation which does not allow to develop the project.

ii. Management risks - This pose as a severe risk factor. In case the management does not understand clearly the vision, objectives and performs unrealistic schedule and budget estimates, poor planning and poor communication due to lack of experience and expertise. All these risk factors can seriously impede project success.

iii. Financial risks - Over budget risks caused by resource, technical, vendor, procurement, technological, planning,
organizational, information security, project complexity risk factors are to be carefully observed and mitigated.

iv. Production & technology risks - These include poor testing, quality, performance and architectural design risks which can lead to an unsatisfied client and inhibit project success.

James (2009) had written in length about the risk factors that must be carefully evaluated and managed to ensure project success. He speaks about the following risks:

i. Customer risks - This includes changes to the projects scope, and project cancellations, and other actions that may impact the project budget, scope and deliverables. This can be mitigated by working closely and having regular communication with the customer in order to understand their requirements. But in many cases still these tend to impact the project and disrupt its financials.

ii. Key stakeholder risks - These involves the resources in terms of material inputs, information and the people required to support the work. Regular communication between the team and its key stakeholders is very important.

iii. Regulatory risks - This includes modifications in laws and regulations that may render a product or a project obsolete. This differs in different countries, and even in a particular region within a country. This makes it important for the project managers to be aware of the local laws and regulations. This may impact the project success significantly.
iv. Technology risks - Obsolescence of technology or heavy reliance on a new technology that is not tested, or that is not available in market. This can cause delays and impact the project financial and also the success rates.

v. Availability of supply - This includes the timely availability of critical resources like equipments, people, software, and facilities. Supply risks can cause impact to the product cost and may impact the project success. He further says that there may be many additional types of risk factors based on the project application and the customer industry.

Albert & Petros (2009) had conducted a research and speaks about the technical risks, project management risks, application risks and organizational risks that are commonly found in information technology projects. He further says that the risk factors vary as per the projects, customers, application and infrastructure. The application risk factors include the risks related to application downtime and risks of low adoption and use.

Drake & Byrd (2006), examined and amalgamated the risk factors encountered in the area of information technology project management, software product development, information technology administration framework, strategies IS planning and financial portfolio management. Due to the tremendous increase in the information technology field, the complexity of the IT department and the projects they manage too increases. This increased complexity brings with it higher risk levels. Risks from the individual projects and the overall portfolio risks are carefully examined. Five categories of risks had been studied in detail.
i. Portfolio Financial risks - The value of each project was calculated by ROI (return on investment), cost/benefit ratio, rate of return, net present value (NPV). But these fail to take into account the complexity, and the interlink ages between the projects and the deliverables of the projects. In order to close the gap several multi-criteria strategies have been proposed for use such as analytic hierarchical process (AHP), balanced scorecard, risk management matrix, advanced programmatic risk analysis method (APRAM) (Dillon & Cornell 2001).

ii. Organizational risks - Many projects had failed in the past due to ineffective resource allocation by the management or the project management office (PMO). The bureaucratic style of management, red-tapism, and internal politics can significantly harm the project. Proper risk response plans in the form of better process and control mechanisms needs to be formulated based on the organizational and management risks.

iii. Cultural risks - The business culture can significantly impact the risk of the portfolio. The cultural aspects and acceptance of changes in terms of new technology, organizational changes and process changes have a bearing on the risk perception. A rigid business culture that is not receptive to changes is a major risk factor. Regular communication of the management with the teams will help reduce the risk.

iv. Strategic risks - The projects in the portfolio needs to be aligned to the overall strategic goals of the organization. The
business intend should be clear and the projects needs to be aligned to business goals. This necessitates investigation into the capabilities, core competence and the technologies that can be crucial for strategic success. The risk in the overall portfolio is minimized if there is alignment among the projects to be delivered and the business strategy.

ev. Project dependencies and correlation risks - The complex interlinkages and the dependencies among the projects needs to be managed properly. The key project decisions of resource allocation should be performed considering these relationships. This will tremendously reduce the risk of the overall portfolio.

2.7 STRATEGIES TO REDUCE FINANCIAL RISKS IN INFORMATION TECHNOLOGY PROJECTS

Stephen (2008) had performed extensive research in the area of actionable strategies where he speaks about an integrated approach covering performance, process, project and risk management. He speaks about identifying and reporting the process and financial risks, scrutinizing the metrics for analyzing the risks, and consolidating the project risks that can have impact on the budget and hence hit the success rates. He points to the maturity levels of the companies in its treatment of risks. A company having lower maturity model have a single, standard method of managing risks whereas a company following a higher maturity model follow a much more complicated risk management procedure. A company following robust strategic planning focuses on proactive risk management processes. Risks are mitigated by understanding potential conflicts early on, accommodating regulatory changes earlier than their due time, replacing equipments or
technology before the recommended lifetime to avoid risks and failures. He advocates that a company should reach concurrence around the long term goals and develop structures and processes around the resulting risks, processes, metrics, business plans. The goal is to work on promoting proactive mitigation of risks and minimize reactive risk management techniques. Risk identification through scenario analysis and understanding risk consequences through option analysis had been recommended. Also as companies get bigger, innovation helps to mitigate risks in a better way. As part of the study the risk factors has been classified as process risks, people risks, systems risk and external risks. Monte Carlo analysis and real options analysis has been highlighted as methods of financial risk analysis. Funding mitigation plan has been found as another effective way of reducing financial risks. All these steps goes a long way in reducing financial risks in information technology projects.

Kelkar (2011) in his study has given a detailed description about the different strategies that needs to be employed to minimize risks in information technology projects. These include avoidance of the risk, transferring the risk and reducing the occurrence of the risk. This has been illustrated with a example - In case of a IT project, schedule slippage risk caused by the intangibility of the software is mitigated by improving the visibility of the software product. This can be accomplished by creating documents throughout the development phase, and getting it reviewed by the teams, and keeping milestones at regular intervals. The project team needs to maintain the risk register up to date, and have a risk management plan in place. The required strategies for negative risks[threats], positive risks[opportunities], contingent response strategies, and expert judgment are used for accomplishing this. Each plan for risk response is assigned a response owner to take up responsibility for each risk response.
Jack (2014) in his research has expressed that the following are essential for successful risk management:

i. Commitment by the stakeholders - For the risk management to be effective, commitment and support is required from the project sponsor, technical teams, management, the project teams and all stakeholders is essential.

ii. Risk ownership - Each risk should have a person owning it and responsible for managing and mitigating it.

iii. Different strategies/plans for different types of projects - It has been observed that the IT risks differs across different types of projects and different companies. So based on the specific project the risk management strategies needs to be framed. A common risk management strategy cannot be used for all projects.

Neo & Leong (1994) have described that the information technology projects are afflicted with budget and schedule slippages, technical issues, and failures to achieve the customer deliverables. The types of risks identified as part of this study are:

i. Unrealistic budget and schedule deadlines - The main reason for failure of projects is the unattainable and unrealistic cost and time estimates specified as part of the contract. This puts tremendous pressure on the resources, and in most cases leads to failed projects. In many cases the quality of the deliverables is severely impacted. So having a optimal cost and schedule estimate will reduce this type of risk.
ii. Organizational factors - These include organizational structure, culture, the knowledge and skill level of its resources, the mindsets and behaviors of the staff and resistance to change. The internal camaraderie and working relationships among the teams also play a key role in reducing this kind of risk.

iii. Technological risks - Acceptance of new technology, the presence of the necessary skill level required to implement a new technology identified decreases the risk profile of the project.

The major risk management strategies recommended as part of the study are:

i. Risk anticipation - A proactive system in place for anticipating the probable risks and applying the appropriate strategy to reduce the impact.

ii. Separation of risks - The risks are isolated, analyzed, prioritized and ownership assigned to individual risk to ensure effective risk mitigation.

iii. Reducing risks - Setting up effective project management and risk management governance, strengthening its knowledge management and having expert teams.

iv. Sharing risks - This includes collaborating with other departments/organizations, and establish positive relationships with other systems.
2.8 EXISTING STUDIES

Walewski & Gibson (2003) examined the international project risk assessment, risk procedures, methods and critical factors. The authors have recommended the following steps to be taken in order to develop and implement tools for both risk analysis and management. Risk analysis and management have to be deployed earlier. A properly structured identification of risk, risk analysis and process of risk mitigation could moderate the risks associated with the project, so this have to be properly managed. It has to be noted that risk assessment and management cannot be used as a substitute for adequate project controls, pre-project planning or other technical and management needs. The most efficient and effective process of risk management is coordinated with all concepts of project management and development. Traditional relationships between contractors, investors and owners in international settings make it tough to assess and control the risks. It was also noticed that project with few characteristics such as new technology, people and processes would raise the level of the risk. It was concluded that the risk management is essential in the IT projects in order to manage and control the risks associated with the projects. The study develops a process for the project risk management. First is the risk management planning. It will decide the approach and plan of the risk management activities. Second is the risk identification. It will determine the risks that are likely to influence the project and recording. Next is the qualitative risk analysis that will prioritize the risks on the basis of probability and impact of happening. Next is the quantitative risk analysis. It will numerically state the effects and risks. Next is the risk response planning that enhances the opportunities and reduces the threats in order to meet the project aims. Next is the risk monitoring and control. It will follow and find the risks and evaluate the effectiveness of the risk strategies in the project.
Stern & Arias (2011) examined the methods of risk management in IT projects. Development of project particularly in the IT field because of its complex nature could face numerous unanticipated risks and thus results in project failure due to exceeding budgets, deadlines and so on. Even though these risks cannot be totally removed, it could be managed or controlled by implementing methods for risk management. This could assist to deal with issues prior they occur. It was noticed that organizations who adopt procedures and techniques of risk management would have greater control over the project management. This study analyzed five methods of risk management. Boehm method uses a model of software risk management which concentrates on the approach of exposure of risk. The major benefits of this method are that they are simplistic and has the potential to cover all the software development phases. The RISKIT method could be implemented in large scale organization since it fails to cover small and medium sized enterprises. Benefit of RISKIT is its flexibility. This method was initially developed for projects of software development but it could be applied in other areas also like marketing, business planning and in technology related fields. Drawback of this method is that it failed to bridge the gap between risk metrics and risk estimation, this indicates it is very tough to determine the potential reliability of the risk. SEI-SRE method was developed for the management of project and risk management element was later incorporated to the equation. SEI-SRE method uses familiar, established and well-tested tools. Thus this method is efficient for software development enterprises. SERUM focus on implicit management of risk, thus the common risk across all the projects could not be handled explicitly. Because of this reason, quantities of risk to be dealt explicitly is minimized and make management of risk easier and handle majority of the risk adequately. This method is applied within software projects since it is appropriate for projects that have different release versions and consistently updates and lends itself to the development
of software. SERUM method has major benefits when compared to other methods like Boehm as it handles both explicit and implicit risks. SERIM enables risk assessment factors in the development of software from unique perspective and development would be concentrated on the action plans for managing risks prior they become realities. This method does not concentrate on explicit guidelines. After analyzing the five risk management methods it was clear that the most appropriate method relies totally upon the specific aspect or criteria of any project.

Berg (2010) conducted a study to analyze the risk management, risk procedures, methods and experiences. Risk management identifies the risk, assess the risk and develops a strategy to control it and mitigate the risks through the resources of management. Generally, management of financial risk concentrate on financial related concerns. Risk management would mitigate certain risks relative to pre-selected domain. It is significant to perceive the risk concept that is dynamic and requires formal and periodic review. It was recommended that risk management have to be implemented in all kinds of small and medium enterprises. It was also noted that research institutes, governmental organizations and hospitals are also implementing risk management. It was concluded that the risk management also focused on the financial related concerns and they have to be dealt with periodic and formal review. In his study, the various risk management steps involved has been explored in detail, they are:

i. Risk planning - The external environment, the complex interlinkages and dependencies are thoroughly studied to arrive as part of the risk planning. It involves review of the historical risk documents, regulatory documents, standards, risk management and business plans. The financial implications of the risks that had occurred in the past are also analyzed.
ii. Risk identification - Using the information gained as part of the risk planning phase the risk pertaining to the project are initially identified. Again this may involve expert judgment and the other risk identification techniques to arrive at the risks that are likely to occur at the various milestones, the stakeholders who may contribute to increasing the risk profile of the project like suppliers, contractors etc.

iii. Risk Analysis - The risks identified are analyzed by qualitative, semi-quantitative or quantitative means to arrive at the risk matrix where the probability of occurrence and the impact are assessed. The risk levels are analyzed carefully to understand the financial impact on the project.

iv. Risk responses - Based on the risk assessment the appropriate risk response strategy is chosen. It may be in the form of risk avoidance, risk mitigation, risk transference, and risk acceptance.

v. Monitoring and control of risks - constant monitoring and control is required on a periodic basis to effectively manage the project risks in information technology projects.

Bakker (2011) conducted a research to examine the impacts of project risk management on project success. Projects are influential, widespread, and significant and are identified in large number of organization. It was stated that in order to enhance the success rates of IT projects, they have to concentrate on intensive usage of risk management and assessment. It was identified that practice of project risk management had increased success rate in terms of timely delivery needs within the budget limits. Thus it was clear, for successful implementation of IT project intensive use of risk management is necessary.
Taylor et al (2012) performed a detailed investigation into the risk management approached followed in the IT industry, the gaps that are evident, the risks factors that impact the project success rates and the mitigation strategies that can be followed for increasing success rates. The risks identified can be classified as:

i. Project management risks - These relate to the failures of the project management teams, PMO. It can be due to the poor planning, estimating, budgeting, resource estimations that were performed in a shoddy way. This increases the risk of the project.

ii. Relationship risks - The interdependence of the teams, and the underlying working relationships have a bearing on the risk profile of the project. In case the teams are close-knit, this risk reduces significantly.

iii. Scope and solution ambiguity risk - In many cases the scope of work is not defined properly, this creates a confusion, which can have disastrous impacts. The project management is responsible for effective communication in order to eliminate any sort of ambiguity.

iv. Environmental risk - The external environment in which the project is implemented, also introduces certain risk factors.

The strategies recommended as part of the study for reducing the risks are as followed:
i. Effective Communication - among all teams to ensure that all stakeholders are involved which will reduce the risks.

ii. Project management maturity - ensure that highly experienced project managers are assigned for managing the large complex and critical projects.

iii. Complexity - the complexities in the form of application interfaces, process and project dependencies, multiple technologies employed needs to be carefully examined and well understood to reduce the risk actors.

iv. Project Criticality - The highly critical, visible projects with high management focus needs to be monitored on a weekly basis for ensuring that there are no slippages.

v. Technology - Emphasis on understanding the implications of implementing new technology. This requires consulting the technology experts and IT architects.

vi. External factors - Collaborative approach to be adopted to ensure a cordial working atmosphere with the external bodies.

As part of the study a risk spider chart have been established as a effective tool for identifying risk at an early stage and mitigating it appropriately.

Talet et al (2014) carried out an investigation to analyze the risk management and IT projects. IT project management mostly suffer from risks that are generated from different environment sources. Therefore comprehensive understandings of such probable risks have to develop strategic policies in order to confront them as the basic need for successful
implementation of information technology projects. This study examines the effects of KM (knowledge management) on risk management in IT process of project implementation. It was recommended that in order to prevent and reduce the potential issues escalating or arising into bigger magnitude, rapt attention have to be provided prior implementing any IT project. Thus it was concluded that comprehensive understanding must be needed for developing strategic solutions and policies for implementing in IT projects.

Hosniehsadat (2011) had undertaken a study in the area of risk management in information technology projects by means of a exploratory research. It is evident that support from the project sponsor for carrying out risk management helps the project achieve its schedule. It is found that implementing the risk management practices increases the number of projects closing within budget, schedule and scope requirements.

Kutsch & Hall (2009) had conducted a research to understand the barriers that inhibit the information technology project managers from using the risk management practices. The research was undertaken by means of interviews and survey on IT project managers. The results were astounding, it was concluded that in one-third of cases, due to problems around cost justification, project risk management process was not applied.

Gholami (2012) had found that the critical risk factors in information technology project management are financial risks, managerial risks, technical risks, behavioral risks and the political risks. It has been observed that in many cases there is low awareness on the risk management practices to be practiced.

Sanchez et al (2009) had undertaken a study with the intend of comprehending the current risk management practices that are applied to
projects, programs and portfolios with the objective of identifying the opportunities to explore and develop better tools, processes and techniques. It has been found that project risk management has reached a higher level of maturity when compared to the program and portfolio risk management domains. It has also been highlighted that more sophisticated tools are required for performing continuous monitoring and control of the projects. The study concludes that the project risk management processes, tools and techniques can be further refined to evolve in the direction of superior management framework.

Marle (2014) had studied in detail the complexity related risk factors. The research proposed a new structured model in the form of project risk interactions management process (PRIM) which helps in decision making regarding the risk response plans. As part of the proposed model simulation analysis is used to get a deeper understanding of the potential impacts of risks, derive the simulated risk probability and risk criticality values. Using this data as input the risks can be prioritized. The risks are further grouped into clusters and the ownership of each of these cluster is assigned to a project team member for managing the risks occurring in that cluster. This study has many limitations, it is taking into account only the complexity related risks. In the future scope of the study, investigation into the financial risks occurring in the information technology projects studies have been recommended.

Olsson (2014) had described the use of assumption surfacing as a underlying principle for project risk management. The study has brought out the different facets of use of assumption analysis as a beneficial tool to be used as part of project risk management. The procedure for performing assumption surfacing analysis is to determine a reduced set of assumptions and to exhibit these assumptions in a manner amenable for comparison to the baseline. This method can be applied to projects in most industries. In the
future assumptions around the financial risks in particular can be baseline
and studied.

Zhang (2009) used case studies to establish that the concept of
project risks management can be used in many types of projects and care
needs to be taken to ensure that the appropriate analysis methods are used and
suitable plan formulated. Case studies for information technology project,
construction project, development project have been presented to stress this
point. Further it has been concluded that the innovative projects, large
investment projects and projects with stiff requirements will benefit more
from the usage of principles of risk management.

Khraiwesh (2012) had explained the steps for inclusion of risks
management process area in the capability maturity model integration
(CMMI) framework. This study is focused on the risk management domain.
Methods for analyzing and controlling the IT projects have been mentioned.
The usage of these principles differs based on the process maturity of the
organization.

Chapman (2003) brought out an interesting aspect of risk
management where it has been suggested to focus on 'uncertainty' instead of
risks. The researcher had highlighted the difference between risk and
uncertainty, in terms of enhanced focus on opportunity in case of uncertainty.
A complete study in terms of uncertainty management has recommended the
revision of the term "risk" to uncertainty and using the phrase project
uncertainty management in place of project risk management. This change
will shift the focus from a threat oriented approach to a opportunity based
approach.
Wet & Vissar (2013) had examined the project management processes followed on the information technology projects in South Africa. It has been found that most of these projects applied internally developed risks management methods, and there was only very few projects that used the standard risk management processes. It was evident the usage of risk management processes improved the success rates of projects.

Kutsch (2008) had undertaken a study to understand if there exists a gap between how the project risks are being currently managed and in what way should they be actually managed. Interviews were conducted and survey done through distribution of questionnaire. It was found from the research that project managers usually ignored and avoided risks, which resulted in delays in mitigating the risks. Project managers had a feel of discomfort towards risk, and many times considered risks beyond their sphere of influence. They did not proactively perform risk management and favored the risks getting resolved on their own. A combination of all these factors had a terrible impact on the IT project results.

Sundararajan et al (2013) conducted an empirical study on the software development risks and their management. The study had employed survey method through distribution of questionnaires to the project team members of software development projects. The study analysed the difference in the risks and ranking of the in-house projects and offshore projects. The risk factors has been identified as resource related, clarity in requirements, cultural factors, quality management, knowledge management. A risk management model has been proposed for the outsourced projects.
Saleem (2011) had undertaken a study for understanding the risk management practices followed in software development field in Pakistan. It was observed that many organizations did not follow properly documented risk management policies and processes. So these companies were not in a prepared state to deal with the risks. It was seen that there were very few software companies that implemented risk management techniques, and these companies were performing well. The risks were categorized into financial, technical, management, contractual and personnel risks. It has been recommended that all the software companies practice risk management for managing their projects.

Samadi et al (2014) described the risk management being followed in the information technology outsourcing projects. Literature review is done to understand the risk factors. Fuzzy analytic method is used to prioritize risk factors. Here sensitivity analysis is used for validating the results. It has been concluded that suppliers lack of knowledge in the area is a significant risk.

Bannerman (2008) had analyzed the risk practices followed in various companies. It was found that the software projects do not conform to a distinct structure. Usage of project risk management is necessary for ensuring successful outcomes. In many cases ad-hoc methods were being used for managing project risks. Standard risk management practices were used only in large companies whereas the smaller software firms were not having a structured risk management process and many times in-house risk management practices were being employed by the project managers.
Baccarini et al (2004) had undertaken a detailed study through interviews with information technology practitioners to understand how the risks were being managed during the delivery of projects. The respondents came up with the risks that had high probability of happening and causing maximum impact on the project outcome. There were 27 key risks that were ranked by the respondents and human resource pitfalls & errors, unrealistic budget and schedule, unattainable expectations, ambiguity in requirements and delays happened to hold the top ranks. The importance of risk management for the successful delivery of projects has been emphasized. An interesting finding is that it is the use of project management processes and not the technical procedures that was key for managing risks. The scope, resource, vendor and quality management solutions were used to mitigate risks. Managing stakeholders’ expectations is a key focus area and helped in reducing several IT risks.

Patil et al (2012) had described an approach to managing the information technology projects using the earned value management[EVM] technique. The earned value[EV] acts as a performance indicator for any deviations in the project budget and project schedule. Performance review meetings, where EV values are analyzed on a periodic basis, had been proven as means for controlling the project cost and also as an important tool for people to perform better. The key values examined as part of the earned value management are - the planned value[PV], actual cost[AC], earned value[EV], estimate at completion[EAC], rate of performance[RP], schedule variance[SV], cost variance[CV], schedule performance index[SPI], cost performance index[CPI] and level of effort[LOE]. Also weighing the milestone with percent complete helps to determine the overall project performance, hence proving to be a useful tool for the project managers.
These performance indicators can be used as inputs to the risk management process, thus helping project managers in critical decision making.

Anbari (2003) had performed a study on the earned value project management method and brought out interesting insights into the use of Cost performance index\([\text{CPI}]\), schedule performance index\([\text{SPI}]\) and critical ratio \([\text{CR}=\text{SPI}*\text{CPI}]\) for assessing project performance. It supports management of the project triple constraints of time, scope and cost. It indicates early on in case of budget and schedule related slippages and allows the project manager and the project team to adjust project strategy. When applied in combination of risk management, proves to be an extremely useful tool for understanding the state of the project. The paper had simplified the EVM concept and demonstrated its applicability to different kinds of projects. Using the current state of the project, the future forecasts can be developed for better decision making purposes. In parallel, the risk probability and impact assessments and its financial implications are analyzed. This can be used as early warning signals by project managers to take timely actions as a response to declining project performance or to capitalize on a opportunity which may increase revenue and enhance project success rates.

The existing studies in the area of risk management has been summarized and shown in Table 2.4.
<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Year of study</th>
<th>Researcher</th>
<th>Objective</th>
<th>Major finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2003</td>
<td>Walewski &amp; Gibson</td>
<td>The research examined project risk assessment, risk procedures, methods and critical factors. The study aimed to develop a process for the project risk management.</td>
<td>Risk analysis and management have to be deployed at the start of the project. A properly structured identification of risk, risk analysis and process of risk mitigation could moderate the risks associated with the project, so this have to be properly managed.</td>
</tr>
<tr>
<td>2</td>
<td>2011</td>
<td>Stern &amp; Arias</td>
<td>The study analyzed the methods of risks management.</td>
<td>The organizations who adopt procedures and techniques of risk management would have greater control over the project management and more successful project outcomes.</td>
</tr>
<tr>
<td>3</td>
<td>2010</td>
<td>Berg</td>
<td>Study undertaken to analyze the risk management, risk procedures, methods and experiences followed in organization</td>
<td>It was recommended that risk management have to be implemented in all kinds enterprises. Risk planning, risk identification, risk analysis, risk response planning and monitoring and control constitute the risk management process.</td>
</tr>
<tr>
<td>4</td>
<td>2011</td>
<td>Bakker</td>
<td>Study examined the impact of project risk management on project success.</td>
<td>It was identified that practice of project risk management had increased success rate in terms of timely delivery needs within the budget limits. Thus it was clear, for successful implementation of IT project intensive use of risk management is necessary.</td>
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Table 2.4 (Continued)

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<td>5</td>
<td>2012</td>
<td>Taylor</td>
<td>Detailed investigation into the risk management approach followed in the IT industry, the gaps, the risks factors and the mitigation strategies.</td>
<td>Classified mitigation strategies into effective communication, project management maturity, complexity, technology, project criticality, external factors,</td>
</tr>
<tr>
<td>6</td>
<td>2014</td>
<td>Talet</td>
<td>An investigation to analyze the risk management in IT projects.</td>
<td>The researcher found the use of KM tools helped to complement the risk management process.</td>
</tr>
<tr>
<td>7</td>
<td>2011</td>
<td>Hosniehsadat</td>
<td>A study in the area of risk management in information technology projects to know the impact of risk management in IT projects.</td>
<td>It was found that implementing the risk management practices increased the number of projects closing within budget, schedule and scope requirements.</td>
</tr>
<tr>
<td>8</td>
<td>2009</td>
<td>Kutsch &amp; Hall</td>
<td>To understand the barriers that inhibit the information technology project managers from using the risk management practices</td>
<td>It was concluded that in one-third of cases, due to problems around cost justification, project risk management practices were not applied.</td>
</tr>
<tr>
<td>9</td>
<td>2012</td>
<td>Gholami</td>
<td>To study the project risk management practices followed.</td>
<td>It had been found that in many cases there was low awareness on the risk management processes to be practiced.</td>
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<td>It has been highlighted that more sophisticated tools are required for performing continuous monitoring and control of the projects.</td>
</tr>
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<td>11</td>
<td>2014</td>
<td>Marle</td>
<td>Study on the risk factors and impacts on projects.</td>
<td>Model simulation analysis were used to get a deeper understanding of the potential impacts of risks.</td>
</tr>
<tr>
<td>12</td>
<td>2009</td>
<td>Zhang</td>
<td>Study use of IT risk management in different organizations.</td>
<td>Case studies were used to establish that the concept of project risks management can be used in many types of projects and care needs to be taken to ensure that the appropriate analysis methods are used and suitable plan formulated.</td>
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</table>

Source: Review of literature undertaken for this study.