CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Information Technology (IT) plays an imperative role in almost every aspect of our lives. The world today has become one global village due to the widespread use of Information Technology. It has revolutionized the way businesses are conducted today by the government and private alike. The government and business have become so reliant on IT that it is hard to imagine how they would function without it. It has become an ever-increasing resource with which organizations have created and sustained their competitive advantages [1] [2] [3]. The IT sector basically consists of software and services, Information Technology Enabled Services (ITES) and the hardware segments. All these three have jointly contributed expansively towards the development and growth of all the countries in the world. Out of these, the software and services industry itself is a trillion dollar industry contributing tremendously towards the growth of the world economy [4]. It has not only helped in generating large scale employment in number of countries but has also helped a number of developing nations to take a step forward towards developed nations. According to Li and Gao [5] the world software industry is no longer predominantly controlled by the developed countries such as the United States and Japan. The success story of India has caught more and more attention of academia, policy makers, and businesses. It is widely believed that the software industry offers developing countries a unique opportunity to “break the shackles of economic under-development as a country”.

The major contribution of the growth of the Indian economy can also be attributed to the Indian software industry. It has been contributing substantially to increases in the GDP, urban employment and exports, to achieve the vision of a powerful and resilient India [4]. While the Indian economy was impacted by the global slowdown in 2009, the software industry displayed resilience and tenacity in combating the volatile conditions and posted a growth of 16.5% in the year 2009 with an estimated value of USD 26.9 billion [6]. The Indian software industry enjoy a very distinct advantage of a stable political environment, favourable government policies, a large base of English speaking graduates, healthy relationship with existing global clients, telecom infrastructure and NASSCOM - National Association of Software and Services Companies, a
strong industry lobbying body [7]. Besides this, the Indian software industry also boasts of low cost advantage, variety of service offerings from low-end application development to high-end integrated IT solutions, high quality of service offerings and maturity in processes (India hosts more than 55% of SEI CMM level five firms and the highest number of ISO certified companies). Today, the Indian software industry contributes to 5.8% towards GDP with 45% of incremental urban employment (both direct and indirect) and is expected to grow 16% and log revenues of USD 60 billion in 2010 [4] [8].

Thus, it appears that the software industry seems to be enjoying a bed of roses having all the positives. But as it is said that every coin has two faces, similarly on the flip side the software industry is marred with a number of project failures, cost overruns, late deliveries, poor reliability, and user dissatisfaction. According to Standish report [9] as shown in Table 1.1, world over 44% of projects were challenged (late, over budget and/or with less than the required features and functions) while 24% failed (cancelled prior to completion or delivered and never used). To sum up, a total of 68% of the projects were either failed or challenged, which is quite exponential. Boehm [10] found that 15-35% of all the software projects were cancelled outright while remaining projects suffered either from schedule slippage, cost overruns or failure to meet the project goals.

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This high failure rate of software projects can be attributed to the very basic characteristic of the software itself. The software projects are collections of large programmes with many interactions and functional dependencies. It involves a creation of a product that has never been created before. They are generally complex and their development takes place in a dynamic environment where business conditions and technologies change during the project. Users are often unsure of
their needs and frequently change requirements midway through the project. As a result, the software industry is plagued by cost overruns, late deliveries, poor reliability, and user dissatisfaction [11] [12]. A study conducted by Mensah and Przasnyski [13] showed that 35% of abandoned projects are not abandoned until the implementation stage of the project’s life cycle. This suggests that project managers are doing a poor job of identifying or terminating projects that are likely to fail. While there are many different modes of failure, one that has occurred very often is the project takes on ‘a life of its own’. It continues to absorb valuable resources without ever reaching its goal [14]. Eventually these projects are abandoned but the cost of having funded those results in a loss of organizational resources.

Numerous researches have been conducted on identifying the causes of failure or delay of the software projects and equal amount of time has been spent on recommending methods and models to combat these causes. Most of the researchers have named these causes as risks affecting the software projects. Keil et al. [15] assert that the high failure rate is due to managers not taking cautious measures to assess and manage the risks involved in the software projects. According to Boehm [10] and Phan et al. [16], most projects fail due to managerial issues and not technological issues. Mc. Farlan [17], Brooks [18], Boehm [19] are some of the pioneers in the area of software risk identification. They have identified a number of risks such as high level of attrition, lack of top management support, miscommunication for requirements, personnel shortfall, estimation errors etc that impacts the successful outcome of the project and leads to project delays and failures. Equal amount of research has been conducted in the area of software risk management and mitigation. Researchers have time and again focussed their attention in developing novel approaches towards mitigating the risks and ensuring project’s success [12] [15] [20] [21] [22] [23] [24] [25] [26].

During the literature review, one interesting aspect that came across was the provision of a resilient organizational climate to ensure the project’s success. Numerous studies have all pointed out the affect of organization’s climate on the motivation, job satisfaction and the overall performance of the software developers and the project’s outcome [27] [28] [29] [30] [31] [32]. In spite of so much study, managing the software project is still a daunting task because of the difficulties associated with it.
1.2 NEED FOR THE STUDY

Software project risk has long been claimed to be a major cause of project failure and empirical evidence exists to support it, with high levels of risk being associated with undesirable project outcomes such as low software quality, delays and budget overruns [10] [33] [34] [35] [36]. The extant literature has produced a number of conceptual frameworks to explain different types of software development risk, risk management strategies and measures of software project performance [24] [26] [33] [36] [37] [38] [39] [40]. Literature review has also shown how researchers have identified plethora of reasons behind the software project delay or failure. As a result, there have been various lists of risk factors with some similarities and some differences [40]. Researchers have used case study data to discuss the key risks impacting the projects due to the non use of risk management principles[22] [41] [42].While some empirical studies have used various statistical measures to identify the risks and propose their mitigation strategies [26] [43] [44] [45]. Overall, these studies provide illuminating insights into critical risks and their mitigation, but are weak in explaining the true impact of risk management principles so elaborated in practice. A few studies have even gone further to establish systematic models of risk management [46] [47]. They all conclude that risk management efforts reduce the exposure to software risk and can thereby increase software quality and improve software development. Diverse literature is also available which points out the affect of organization’s climate factors on the success of the project. A number of studies have pointed out the affect of organization’s climate on the motivation, job satisfaction and the overall performance of the software developers and the project’s outcome [27] [28] [29] [30] [31] [32] [49] [50] [51] [52] [53]. An extant literature advocates on developing organizational citizenship behaviours, support technologies, management advocacy, clear goals, feedback and team autonomy as the key to software project success [54] [55] [56].

In India, most of the studies conducted have focused on the outsourcing aspect of the Indian software industry, where various issues such as cross cultural issues, macroeconomic issues and project specific issues in outsourcing have been detailed out [22] [56] [57] [58] [59] [60] [61] [62] [63] [64]. However, not much work has been done on various dimensions relating to software development work in India. Software development is no doubt a part of outsourcing but still is one of the major revenue generating sources of most of the Indian software companies.
Arora et al. [65] and Athreye [66] have tried to identify various issues impacting the Indian software companies both at macro, micro and project specific level. However, a comprehensive list of risks affecting the Software Development Life Cycle in Indian software industry is still missing. Besides this, there are hardly any empirical studies that identify the key organizational climate factors that contribute towards the project’s success in the Indian context. Therefore, there is a dire need for a systematic and comprehensive work that studies the collaborative affect of the organization’s climate and the risk factors on the success of the software project.

It is a well known fact that an open, trusting and robust climate in an organization promotes freedom of expressions, mutual trust, team cohesiveness, team member proximity, team autonomy, domain-relevant and creative-thinking skills. These to a great extent affect the individual’s ability in perceiving the issues or risks affecting the software projects. However, not much work has been done to elicit out any relation between the organizational climate factors and the software risk factors. Therefore, a need for studying the impact of the organization’s climate on the risk factors emerges. Along with this, most of the studies have concentrated on the overall success aspect of the project, none of these keys out the specific organization’s climate factors and risk factors that help or prevent in meeting the three project constraints or success constructs (budget, schedule and quality). This understanding is important as it helps to identify the key factors that are individually responsible for affecting the three project constraints namely budget, schedule and quality. Therefore, a need arise to gauge the impact of the risk and organizational climate factors affecting the three success constructs. Thus, the need for this study can be clearly defined in two points. First, the need to study and analyze the collaborative affect of organization’s climate and risk factors on the success of the software projects and its three constructs. Second, to study the moderating affect of organization’s climate on the project specific risk factors.

1.3 CONCEPTUAL MODEL OF RESEARCH

This research aims to explore the dimensions of organizational climate and software risks holistically and produce a model for predicting the success of the project. For this, a conceptual model of research has been proposed which incorporates the organizational climate dimensions, the software risk dimensions, the overall success of the project and its three performance constructs namely budget, schedule and quality. Every software project has a development cycle
and various models and methodology are available and practiced for successfully completing the project. Whether it is spiral, waterfall or agile methodology, the first step in any software project is requirement gathering and analysis followed by system analysis and design, code generation, testing and finally deployment and maintenance. This typically followed Software Development Life Cycle (SDLC) is exposed to a number of risks at both technical and managerial levels. The various types of risks affecting the software projects have been examined in the literature review. As the risks surface so does the risk management strategies to mitigate these risks. Some of these strategies are quite effective and can control the risks if administered on the right time. But there are also equal number of risks which may or may not be controlled by these short term strategies and therefore such risks must be controlled at the grass root level. The grass root level here refers to the organization’s climate under which this entire process of software development takes place. Stating that organization’s climate has no affect on either the success of the project or the software risks would be blatantly wrong. Therefore, the model shown in figure 1.1 has been designed keeping in mind the moderating and collaborative effect of the organization’s climate on the risks and success of the project.

![Conceptual Research Framework](image_url)

**Figure 1.1:** Conceptual Research Framework

*Ph.D. Thesis*
As is clear from the figure 1.1, the organization’s climate plays a very crucial role in the execution of the project. It is like an umbrella under which the entire process of software development takes place. As already pointed out, every single step in the development process can be marred by anticipated or unanticipated risks such as high level of attrition, lack of domain expert, miscommunication of requirements, continuous requirement changes, estimation errors, insufficient testing, poor code and documentation etc; that needs to be tackled for a successful implementation of the project. If the organization has an open and consultative climate where the team members have a clear idea of their roles and responsibilities, are given timely and adequate feedback and are provided with adequate tools and techniques to effectively perform their tasks many of these risk factors can be annihilated. Thus, the model clearly demonstrates the direct and indirect effect of organization on the success of the project.

1.4 OBJECTIVES OF THE STUDY

Past three decades have witnessed a number of studies and researches in the area of software risk identification and their mitigation and even today software risk management is one of the most talked and written about areas of risk management. One of the primary reasons for this is that the risk factors change overtime due to the development of technology and organizations. That is why researchers should from time to time conduct rigorous risk studies [40]. Moreover with the failure rates of software projects increasing as shown in the Standish report [9], this area is still open to lot of research and empirical analysis. With this motivation, an attempt has been in the present study to recommend a model which identifies the major dimensions of risks and organization’s climate that impacts the success of the software project and provide concrete recommendations which will eventually be valuable to the organizations to increase the rate of success of the software projects. The specific objectives of this thesis are:

1. To identify and rank the risks in software development projects based on secondary data.
2. To explore and analyze the dimensions of project specific risks based on primary data collected from field survey.
3. To identify and explore the dimensions of organization climate factors present in the Indian software companies based on primary data
4. To investigate the affect of the organizational climate dimensions and demographic characteristics on the project specific risk dimensions.

5. To investigate and propose a model for predicting the affect of the software risks and organizational climate dimensions on the overall success and the three performance constructs namely budget, schedule and quality of the software projects in India.

6. To validate the models by critically evaluating the causes of failure and success of real life software projects through case studies.

1.5 RESEARCH QUESTIONS

Based on the objectives set for the research, a set of research questions were formulated. These questions are nothing but translation of objectives into questions, so as to gather the required data from the respondents. The study was done in four components. First was precisely the identification and exploration of the risks affecting the software projects in India. This involved an exhaustive study of the personal profile of the respondents, profile of the projects handled by the respondents, exploring the risk factors impacting the success of the software projects and then comparing these factors across the various personal and project characteristics. Second was the identification and exploration of the organization’s climate factors in the Indian software companies. This involved detecting the factors through field survey and comparing them across the personal and project characteristics. Third was i) the identification of organizational climate factors and demographic characteristics that impact the project specific risk dimensions and ii) assessment of the impact of project specific risk and organizational climate dimensions on the success and its three performance constructs of the software projects using regression analysis. Fourth was the model validation by developing case studies involving the post-mortem analysis of the four real life software projects from the Indian software companies.

With the four dimensional purpose of the study, the following research questions were addressed:

PART I: Exploring the software risk dimensions in Indian software industry

1. What are the risk factors that impact the success and the three performance constructs (budget, schedule and quality) of the project?

2. How much do these risk dimensions vary across the demographics and project characteristics?
PART II: Exploring organizational climate dimension present in the Indian software companies

3. What are the organizational climate dimensions that contribute towards the success and the three performance constructs (budget, schedule and quality) of the software projects?
4. How much do the climate dimensions vary across the demographics and project characteristics?

PART III: Proposition of a regression model

5. How much do the organizational climate factors and demographic characteristics affect the project specific risk factors of the software project?
6. How much do the organizational climate and project specific risk dimensions together affect the success and the three performance constructs (budget, schedule and quality) of the software projects?

PART IV: Validation of the proposed model

7. How do the risk dimensions and the organizational climate dimensions affect the success of the software projects in real life?

1.6 RESEARCH METHODOLOGY

A systematic and organized methodology was obtained for the research study. First and foremost, based on an in-depth discussion and exhaustive literature review, the objectives of the study were chalked out. This was followed by in-depth interviews and discussions with 40 software project managers to gauge the risk factors and organizational climate factors that affect the success of their last executed project. The project managers in the interview were specially asked to identify the critical risk factors affecting the Software Development Life Cycle and also key out the organizational climate factors which they perceive were present extensively in their organizations during the execution of the software projects. Based on the perception of the project managers in the interview and in-depth secondary data analysis, 23 risk items and 17 organizational climate items were identified. A questionnaire was prepared using the risk and organizational climate items.
A questionnaire was intricately designed to tap not only the demographic variables including age, total experience and designation of the respondents and but also the project variables including total team size, total duration and total value of the last executed project. It also gathered information about the risk factors impacting the success of the last executed project and the organizational climate factors that were present during the last executed project. Random sampling technique was used to gather data from software professionals with more than 4 years of experience of handling software projects. For the survey, 4 major IT hubs viz. NCR (Gurgaon, Noida, Delhi, Faridabad), Hyderabad, Bangalore and Chennai were selected. From each IT hub 8 companies were selected making a total of 32 companies. A total of 900 questionnaires were sent to these 32 companies out of which only 340 responses were received. For the study, only 300 completely filled questionnaires were considered and the rest were discarded due to incomplete data. Main data collection began in the month of July 2008. Statistical Package for the Social Sciences (SPSS) version 17.0 was religiously used for statistical analyses.

1.7 SIGNIFICANCE OF THE STUDY

The significance of the research lies in the detonation of the software industry in the recent years. Where on one hand the sector is growing with leaps and bounds giving employment to more than 2 million people with a contribution of 5.8% towards the GDP of India, on the other hand, the poor software quality, failed projects, increasing employee cost and high level of attrition is tarnishing the rosy picture of the Indian software industry. The study is an attempt to assess the dimensions of project specific risks present in the software projects in India and analyze the relationship between the organization’s climate and risks so as to ensure the success of the software projects by controlling the impact of risks on the project. This is not only significant for academicians as it adds to the existing body of knowledge but also for the organizations which are battling to control the failure or delay of the software projects.

1.8 SCOPE OF THE STUDY

The research gauges the dynamics of organizational climate dimensions on project specific risk and success of the project along with the three success constructs based on the primary and
secondary data analysis. However, the study is limited on number of grounds. Firstly, as already mentioned the IT industry is classified into three sub-industries and out of this only software industry in India has been studied. Secondly, the sample of the study consists of the software projects executed by the Indian software companies. Again, software projects have a number of aspects technological, managerial, economic, political, social etc, out of this only the managerial aspect of the software projects has been looked into. It is also important to note that the study is limited to a sample size of 300 projects executed in one of the four major IT hubs of India. Moreover, the software projects have been taken in general and have not been classified into various categories like application development, ERP, SAP etc. thus limiting the scope of the study. Furthermore, the success of the software projects has been defined on the traditional basis that is meeting time, cost and quality while ignoring the other parameters of success. In addition, only the project specific risks have been considered. The project specific risks emerge due to the factors affecting the project delivery. Therefore, the scope of the study is limited to the sample size and also to the selected dimensions of success, risk and organizational climate factors.

1.9 ORGANIZATION OF THE THESIS

The work presented in this thesis focuses on the assessment of the impact of the risk factors and the organizational climate factors on the success of the software projects, how the risks in software projects can be abrogated, how organization’s climate be used as a strengthening factor for ensuring project’s success by subjugating the impact of risks. While the risk factors reduces the chances of success of the project, the organizational climate factors not only help in improving the success of the project but can also be used effectively to reduce or remove the effects of project specific on the project and this has been statistically proven in the work done. The results obtained are encouraging. The study has been organized in five chapters. A brief outline of the various chapters is as follows:

Chapter 1 is a prologue to the thesis. It establishes the foreword about the Indian software industry, the risk factors and the organizational climate factors affecting the success of the software projects in India, It underlines the significance of the study and also emphasizes on the source of motivation for the present work. The chapter throws light on the various research questions that have been addressed in the thesis and clearly delineates the objectives.
Chapter 2 is enriched with an exhaustive and comprehensive literature review of the subject. It illustrates about the research work taking place globally with reference to the risk factors and the organizational climate factors. It begins with the concepts of risk, success of the project and the software development lifecycle. The chapter then discusses the research work done in the area of risk identification and management. It then brings out a comprehensive and a complete list of risk factors that affect the software projects. Finally, it discusses the concept of organizational climate and the various works done in the area of organizational climate, team performance, team motivation and overall success of the project.

Chapter 3 deals with the overall methodology of the research work. The chapter commences with the details of the pilot study and its findings. It then moves on to the research methodology of the main study. In order to validate the findings of literature review, a survey was conducted among the IT professionals having a minimum of four years of experience in handling software projects in India. An instrument was developed to facilitate systematic data collection in this study. The chapter elucidates the instrumentation adopted and the participants chosen for the study. It describes the variables that form the skeleton of the research questions and vividly explains the questionnaire designed for data collection. It then also hits on the validity of the instrument and talks about the statistical analyses done for each of the research question.

Chapter 4 deals with the detailed findings and analysis of the objectives. It begins with a description of the identification of risk factors from the global perspective using scoring model for ranking the risks. The top ten risks have been identified after reviewing the earlier researches. It then moves to revealing the personal profile and the project profile handled by the respondents of the field survey and then talks about the identification of risk dimensions clubbed through factor analysis. It then compares the dimensions of risk across the various personal and project characteristics. The chapter also details out the dimensions of organizational climate clubbed through factor analysis and compares these dimensions across the various personal and project characteristics. It then explains the relation between the organizational climate and risk dimensions and shows how each organizational climate dimension contributes in reducing the software risk factors. It also explains an individual assessment of the impact of organizational climate dimensions on the risk factors. Finally, it conducts a regression analysis and show how
much does the risks and climate factors affect the success and the three success performance constructs namely: budget, schedule and quality of the software project.

**Chapter 5** details out the model validation through real life case studies. Post-mortem analysis of four live-projects has been undertaken and presented in form of the case studies. Two of the cases belonged to the failed projects while the other two brings out the success stories. It shows the details of the projects and identifies the reasons of success and failure of the projects. The chapter ends with the lessons learned from these cases.

**Chapter 6** is devoted to conclusions and implications. This chapter also discusses the limitations and scope for further research in the area of software risk and organizational perspective.

**1.10 CONCLUDING REMARKS**

In this chapter, a brief overview of the Indian software industry, the various risks affecting the software projects, need of the study, conceptual model of the research, objectives of the study, significance and scope of the study, and a brief outline of the research methodology, followed by an outline of the organization of the thesis is presented.