

SYNOPSIS

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) (Deloitte report 2009). 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 [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.

Table 1.1: Standish CHAOS report on Software Project Failure

	1994	1996	1998	2000	2002	2004	2006	2009
Successful	16%	27%	26%	28%	34%	29%	35%	32%
Challenged	53%	33%	46%	49%	51%	53%	46%	44%
Failed	31%	40%	28%	23%	15%	18%	19%	24%

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 effect 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 risks have long been claimed to be a major cause of software 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]. 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 the 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 generation 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 cycle in Indian software industry is still missing. Though extensive literature has laid down the various affects of organizational climate on motivation of software developers, job satisfaction, performance and project outcome, but there is hardly any empirical evidence to suggest the affect of organizational climate factors on project specific risks. 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 and the three performance constructs. And also the need to study the moderating affect of organizational climate on project specific risk.

1.3 Conceptual Model of Research

The present research aims to explore the dimensions of organizational climate and project specific 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. 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. Since 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 need 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 shown in figure 1, clearly demonstrates the direct and indirect effect of organization on the success of the project.

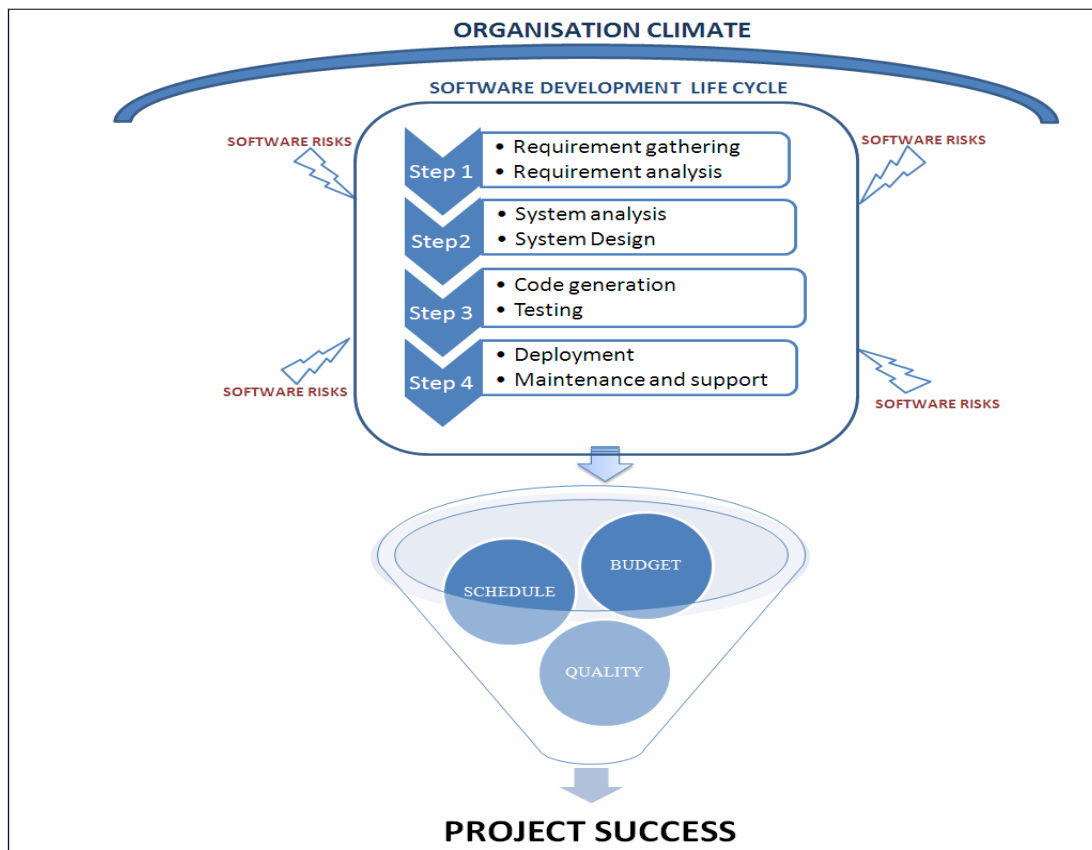


Figure 1: Conceptual Research Framework

1.4 Objectives of the Study

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 organizational climate factors present in the Indian software companies based on primary data.
4. To investigate the effect of the organizational climate dimensions and demographic characteristics on the software risk dimensions.
5. To investigate and propose a model for predicting the effect of the project specific 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 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 lifecycle 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 and was administered on the software professionals with a minimum experience of four years in handling software projects in India.

The questionnaire was intricately designed to tap the demographic variables including age, designation and experience of the respondents. It also gathered details about the project such as name, team size, total duration and the value of the project executed by the respondents. The questionnaire was then divided into four parts. In Part A, the respondents were asked to rate the overall success of the project. They were also asked to rate the performance of their project on the basis of the three performance constructs namely

budget, schedule and quality. In Part B and C, the respondents were asked to rate the impact of risks (twenty three risk items) on the success of their last executed project. All the items were put on a five-point scale ranging from far too much effect to no effect on the success. In part D respondents were asked to rate organizational climate factors (seventeen variables) present during the last executed project. A five-point likert scale was designed to gauge the responses in part D. The scale ranged from never to always present.

Besides gathering data through questionnaire, in-person interviews were also conducted with the project managers and senior management to accentuate the data collected. Random sampling technique was used to gather data from software professionals with more than 4 years of experience in 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 32 companies in total. 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.

1.6 Hypotheses of the Study

Based on the objectives of the study the hypotheses were formulated which are as follows:

H1: The demographic characteristics and the organizational climate dimensions affect the project specific risk factors.

H2: The organizational climate dimensions and project specific risk factors affect the overall success of the software project.

H3. The organization's climate and project specific risk dimensions affect the budget performance of the software projects.

H4. The organization's climate and project specific risk dimensions affect the schedule performance of the software projects.

H5. The organization's climate and project specific risk dimensions affect the quality performance of the software projects.

In order to gauge requisite answers and test the hypotheses, various statistical tools were used to analyze data like descriptive statistics to quantitatively summarize the data; factor analysis to extract factors of project specific risks and organization climate; Duncan's mean test to compare means of the dimensions across various categories; correlations to find out the relationship between two variables; regression to find out the determinants of a dependent variable. With the help of these tests, the data was successfully analyzed.

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 risks in Indian software industry 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 software 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.

2. LITERATURE REVIEW

2.1 Introduction

Software development projects involves a creation of a product that has never been created, these have a dismal track-record of cost and schedule overruns and quality and usability problems [12]. Apparently, this implies that software project development is extremely risky and management of these risks is of primary importance in software project development [68]. The extant literature has produced a number of conceptual frameworks to explain different types of software development risk, risk management strategies, the preferred organizational climate and measures of software project performance [24] [35] [71]. This chapter aims to enlist and critically review the studies that have been conducted in the area of software risk, organizational climate, success of software projects and perceptions of the software professionals.

2.2 Basic Concepts

A **software project** is a project which encompasses a unique scope of work with given specifications which needs to be completed in a given time at a given cost [72]. The **success** of a software project in literature has been defined from two perspectives - efficiency and the effectiveness perspective [87]. One school of researchers defines success from the efficiency perspective, pinpointing the measures of efficient management of a project, such as adherence to time, budget, and quality requirements [74] [75] [76]. While, the other school, by contrast, places more emphasis on the effectiveness of projects, i.e. fruitful overall project outcomes for the organization as a whole, such as future profits or improved business process performance [87] [88].

Every software project involves a **Software development life cycle**, The Software Development Life Cycle (SDLC) is a framework that is used to understand and develop information systems and software successfully. It is a process used by almost all

developers and software development companies as the standard in the software process development. SDLC has many models and each model has its own strengths, weaknesses, advantages and disadvantages [90] [91].

The entire software development cycle is constantly exposed to both internal and external risks. **Risk** is any potential situation or event that could negatively affect the project's ability. A risk is an exposure to loss or injury or a factor, thing, element, or course that involves uncertain danger [25] [92] [93]. Risks specific to the software have been widely studied in the literature. An examination of the available literature reveals that software project risk has been conceptualized in several different ways [15] [26] [34] [46] [95] [96] [62] [97] [98] [99] [103]. However, the most common definition of risk in software projects is in terms of exposure to specific factors that present a threat in achieving the expected outcomes of a project [36].

2.3 Studies Relating To Risks Affecting the Software Projects

Considerable amount of research has been conducted in the areas of risk identification, analysis and management of software projects. Investigators in this area have tried to identify various risk factors that affect the success of the software project and have also proposed various risk management models for better supervision of these threats [19] [22] [24] [26] [35] [36] [42] [108]. Researches like Zhou et al. [41], Dey et al. [42] and Anudhe and Mathew [22] have used case study data to discuss the key risks impacting the projects due to the non use of risk management principles while some empirical studies have used various statistical measures to identify the risks and propose their mitigation strategies [26] [43] [44] [45] [128]. 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.

2.4 Organization Climate

Organizational climate has been studied quite elaborately and various researchers have defined climate in numerous ways. According to Kopelman et al. [171] organizational members are active perceivers and interpreters of their work environments, and employees

tend to form their perceptions by observing how the daily operations of the organization are conducted and what goals the organization appears to be pursuing. Diverse literature is also available which points out the affect of organization's climate factors on the success of the project. Ein-Dor et al. [182] perhaps conducted the first study of climate in Information Technology. He examined the relationship between climate toward Management Information System and the quality of developer-user relationships, the degree of system use, and system integration in the organization. Thereafter, Doherty and King [27], Faraj and Sambamurthy [28], Mensah and Przasnyski [29], Warkentin et al. [30], Xu and He [31], Geethalaksmi and Shanmugam [32], Woodruff [48], McLean et al. [49], Rasch and Henry [50], Hoegl and Gemuenden [51] and Kendra and Taplin [52] have also 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. An extant literature also advocates on developing organizational citizenship behaviours, support technologies, management advocacy, clear goals, feedback and team autonomy as the key to software project success [53] [54] [55].

2.5 Perspectives of Software Professionals

The concept that different stakeholders can perceive software projects in different ways is also well established in the literature [46]. Keil et al. [141] have demonstrated that users and project managers differ in terms of their project risk perceptions. While, Warkentin [30] [86] and Stephen et al. [196] have exhaustively studied the perception of risk among various demographic characteristics of software professionals and have suggested that professionals with more experience in project leadership were more likely to view projects, and their associated risks, more holistically and assign and resolve risk as if they were organizational in nature. Besides this, studies have also been done on the perception of success of the software project among various stakeholders by [74] [80] [83] [84] [126]. These studies have concluded that there is a marked difference in the perception of the success of the software projects among various stakeholders of the project.

3. ANALYSIS AND FINDINGS

3.1 Introduction

The present section intends to accomplish the objectives of the study by holistically investigating the various dimensions of project specific risks and organization climate in

the software projects. The section is divided into four parts. The first part aims to identify the top ten risks affecting the software projects globally through an in-depth and exhaustive study of the secondary data and also identify and explore the various project specific risks affecting the software projects in India. The second part delineates the dimensions of organization climate present in the organization through factor analysis and compares these dimensions across various personal and project characteristics. The third part details out the descriptive statistics and correlations. The last part details out the regression analysis to test the various hypotheses of the study.

3.2 Identification and Exploration of the Software Projects

3.2.1 Secondary data analysis

In order to gain a deeper insight into the project specific risks affecting the projects, an in-depth assessment of the secondary data was conducted. Scoring model was developed and extensively used to analyze the various risks highlighted in the secondary data. Extensive literature on project specific risks was studied in detail. Finally, using the ranking method, a comprehensive and exhaustive list of the top ten risks affecting the software projects was developed. These risks were identified from the various researches conducted on identification and ranking of project specific risks. The list so developed is quite comprehensive and represent a global phenomenon as it encompasses a number of researches conducted in the past in various countries. The top most risk affecting the software projects globally is miscommunication of the requirements, followed by lack of top management support and then lack of technical knowledge. The correct set of requirements, top management support and technical knowledge are the pillars of software project, and without these the project is bound to get derailed. Therefore, these risks were identified as the top three most important risk factors affecting the success of the project. Thus, the first objective was effectively achieved as it resulted in the identification of top ten risks affecting the software projects globally. The next objective aimed at exploring the dimensions of project specific risks affecting the software projects in India based on the primary data collection.

3.2.2 Primary data analysis

The second objective was fulfilled with the help of a number of statistical analyses that included factor analysis, Duncan's mean test and descriptive statistics. In order to identify and evaluate the project specific risk factors based on the primary data, factor analysis was done. Principal component analysis was the method of extraction. The Kaiser rule was applied for extracting the factors. Four factors were extracted viz. SRS variability risk, team composition risk, control processes risk and dependability risk. A detailed analysis was done for each of these risk factors. The next step involved comparing these dimensions across the various background variables namely designation and experience, and project characteristics variables namely team size, total duration and the value of the project in terms of dollars. For this Duncan's post-hoc tests were conducted. All the four risk dimensions showed significant variances among the three **designation** levels. Among the **total experience variable**, significant difference was found in the mean values of SRS variability risk, team composition risk, control processes risk and dependability risk dimension. Similarly, the risk dimensions were also compared among the various project characteristics which resulted in quite interesting findings.

Identification and Exploration the Dimensions of Organization Climate Present in the Indian Software Companies.

For the fulfilment of the third objective, a series of statistical analyses were done. It began with factor analysis, followed by mean tests to compare the dimensions across various characteristics and ended with the descriptive statistics. In order to identify and evaluate the organization climate dimensions based on primary data, factor analysis was done. Principal component analysis was the method of extraction. The Kaiser rule for extracting the factors was applied. All total of 4 factors were extracted viz. high standards of work tasks, effective supervision, intrinsic supervision and role clarity.

The dimensions of organization climate so formulated after the factor analysis were then compared among the various personal characteristics of the respondents chosen for the study and also among the various characteristics of the project handled by the respondents. Duncan's post-hoc tests were conducted for this purpose which highlighted quite interesting findings.

3.4 Mean Standard Deviations and Correlates of the Software Risk Dimensions, Organizational Climate Dimensions and the Success of the Software Project and the Three Constructs

In order to gauge the top most risks affecting the software projects, the mean and standard deviation were computed. SRS variability risk was found to be the most important risk followed by dependability risk, team composition risk and finally control processes risk. The descriptive statistics was also computed for a better understanding of the four organizational climate dimensions. The intrinsic fulfilment showed the highest mean suggesting that the climate of intrinsic fulfilment was present in almost all the projects in the sample. This was closely followed by role clarity, effective supervision and finally high standards of work tasks. The descriptive analysis of the success and the three performance constructs revealed quite interesting findings. The quality performance of the project had the highest mean followed by schedule and budget performance respectively.

After evaluating the various risk and organizational climate dimensions and identifying the most important success construct, the next step involved computing correlation between risk dimensions, organizational climate dimensions and demographic characteristics. The correlation revealed a very significant relation between the demographic characteristics and the four risk dimensions. All the correlations were negative. While on the other hand, out of four organizational climate dimensions only few dimensions showed a significant relation with the four risk dimensions.

The correlations between the overall success and the four risk and four organizational climate dimensions was also computed. Out of the eight independent variables seven variables showed significant correlations with the dependent variable that is success of the project. All the correlations of the risk factors with the success of the project were negative, while all the correlations were positive between the three organizational climate factors and success of the project.

The correlation was also calculated between the three performance constructs, risk dimensions and the organizational climate dimensions. The dependent variables were the three performance constructs while the independent variables were the four risk dimensions and four climate dimensions. Here also all the risk dimensions showed significant negative correlations with all the dependent variables i.e. the budget, schedule and quality performance of the project. While on the other hand, out of the four

organizational climate dimensions only few dimensions showed a significant positive relation with the three success constructs.

3.5 Regression Model

For meeting the **fourth objective**, the stepwise regression analysis was done. The dependent variables were the four software risk dimensions viz. SRS variability risk, team composition risk, control processes risk and dependability risk, while the independent variables were the two background variables viz. designation and experience and the four organization climate dimensions viz. high standards of work tasks, effective supervision, intrinsic fulfilment and role clarity. The results of stepwise regression clearly revealed that the project specific risk dimensions can to a great extent be controlled and annihilated by open, free, trusting and effective organization climate.

To meet the **fifth objective** of the study, the stepwise regression analysis was conducted wherein; the dependent variables included the overall success of the project, the budget performance, the schedule performance and the quality performance of the software project. While the independent variables included four software risk dimensions viz. SRS variability risk, team composition risk, control processes risk and dependability risk and four organizational climate dimensions viz. high standards of work tasks, effective supervision, intrinsic fulfillment and role clarity. The regression revealed very interesting findings. With the **overall success** as dependent variable, it was found that all the four risk factors affect the success of the project and only one climate dimension showed to have a positive influence on the success of the project.

The regression analysis was also conducted for strengthening the findings of correlation and for identifying the factors that affect the three performance constructs. The regression between **budget performance** as a dependent variable and software risk and organization climate dimensions as independent variables revealed, that the budget performance gets affected by three organizational climate dimensions and one software risk dimension. While the **schedule performance** gets affected by two software risk dimension and one organization climate dimension as revealed by the regression analysis and the **quality performance** of the software project gets affected by one software risk dimension and one organizational climate dimension.

Thus, on the basis of regression model it can be concluded that both the organizational climate dimensions and demographics play a very positive role in controlling and reducing the impact of risk on the software projects. Furthermore, the project specific risk dimensions and the organizational climate dimensions together, influence the overall success of the software projects and the three performance constructs of the project. Therefore, to ensure the success it is imperative to develop a healthy, open, trusting and free environment in the organization that will not only repress the various project specific risks impacting the success but will also ensure a successful completion and deployment of the project.

4. MODEL VALIDATION

For the final validation of the regression models the case studies were developed based on the real life software projects. Two cases were developed on the failed projects while the other two represented the success stories. The detailed analysis of the four case studies revealed a number of lessons. The main causes of the failure of the projects as identified from the cases I and II were; lack of experience in handling the similar projects, inaccurate cost and timelines estimation, lack of top management support, an ineffective and poor supervisor, low morale and lack of commitment of the team towards the project. All these risks can be attributed to SRS variability and team composition risk which were found to be of immense importance in our findings related to the overall success of the projects. While the main factors that lead to the success of the project as identified from case III and IV were; complete ownership of top management and client, involvement of technically qualified and synchronized team, well laid out documentation and work breakdown structure and timely feedback and the freedom to the team. Most of these factors belong to effective supervision, role clarity and high standards of work tasks. In our findings, these factors have emerged as significant factors affecting the success of the project.

5. CONCLUSION

5.1 Comparison with the Previous Studies

The identification of the project specific risk that affects the success of the software project along with the three performance constructs can be compared with the list of the top ten risks identified through secondary data analysis. As is quite clear from the regression analysis, the most important risk that affects the success of the project is SRS variability risk. This factor includes conflicting and continuous requirement changes, inaccurate requirement analysis, miscommunication of requirements, estimation errors, less or no experience in similar projects, inaccurate cost measurement, language and regional differences with client, delay in recruitment and resourcing and lack of client ownership and responsibility [15] [19] [22] [24] [25] [26] [42] [43] [125] [140]. Out of these risks, miscommunication of requirements (ranked 1), less or no experience in similar projects (ranked 3), changing requirements (ranked 9), estimation errors (ranked 6), lack of client ownership and responsibility (ranked 7), inaccurate cost measurement (ranked 8) feature in the list of top ten risks affecting the software projects globally.

The second important risk that the software projects in India face is control processes risk followed by team composition and finally dependability risk. The control processes risk which includes poor documentation, poor code and maintenance procedures, insufficient testing and poor configuration control [51] [58] [140] [207] [208], does not feature in the list of the top ten risks identified through secondary data analysis. This means, that these risks may be more prominent in the Indian software projects than in the other countries. The third risk that impacted the success of the software projects in India was team composition risk which included lack of availability of domain expert, working with inexperienced team, team diversity, lack of commitment from the project team, low morale of the team, high level of attrition and lack of top management support [15] [24] [25] [26] [33] [34] [43] [45] [125] [128] [140]. Out of these, lack of top management support (ranked 2) appeared as one of the top ten risks affecting the software projects globally.

Lastly, in dependability risk which includes third party dependencies, inability to meet specifications and inadequate measurement tools for reliability [24] [26] [33] [125], none of the items appeared in the list of the top ten risks affecting the software projects identified through secondary data analysis. One of the probable reasons may be that these risks might not be present or may be present but at higher ranks. This is also in analogy with the findings done in the present study as it appears to have with lesser impact on the success of the project. Also it does not affect any of the three performance constructs of the

success, thus further strengthening the above statement. Figure 1.2 elucidates the above findings in a diagrammatic representation.

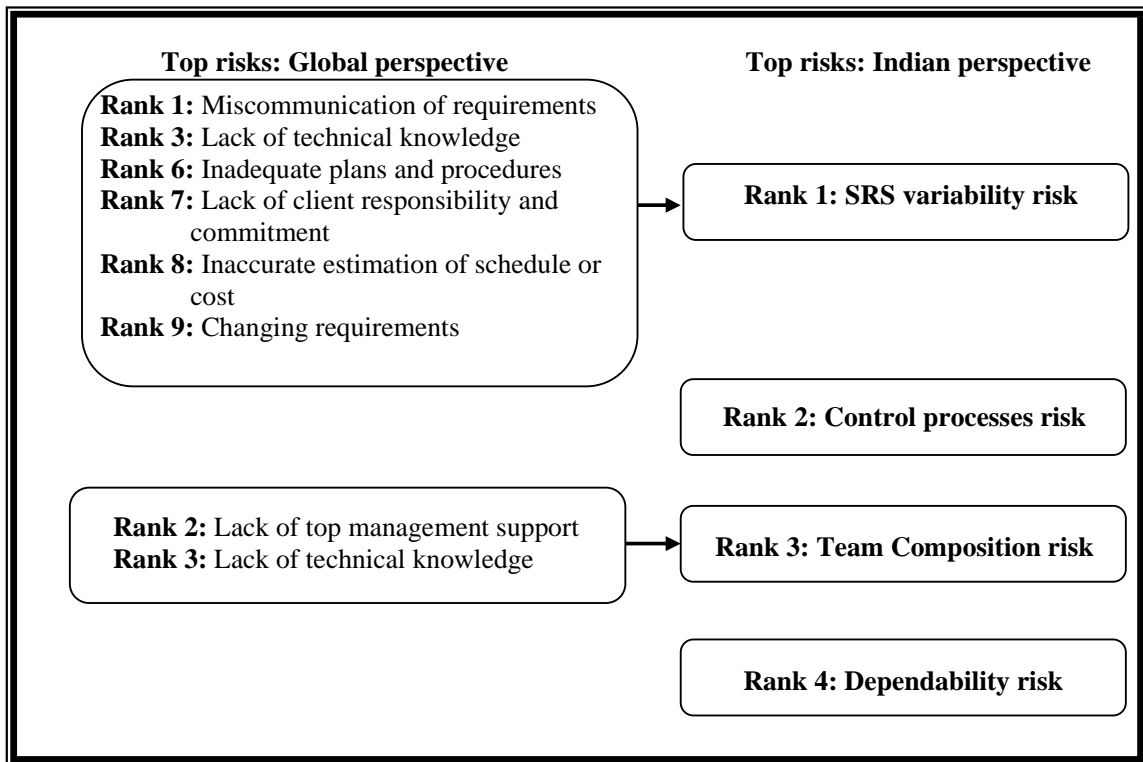


Figure 1.2: Analogy with the top ten risks identified through literature review

5.2 Implications of the Study

Based on the conclusions derived after the in-depth and comprehensive study, few implications can be made about minimizing software risk thereby ensuring the success of the software projects in India. Risk is basically any potential situation or event that could negatively affect a project's ability to succeed and meet the three broadly acceptable parameters of success namely budget, schedule and quality. The organizations have been constantly working to mitigate these risks and provide quality software without affecting the budget and the schedule performances of the project. CMM level 5, PCMM level 5, TL9000 and ISO 9001-2000 certifications are some of the steps taken by Indian software companies in this direction. Most of these certifications pertain to the process improvement and overall quality aspect of the project. These accreditations in the company formalize the overall Software Development Life Cycle. Therefore the usage of the correct methods can control the software risk to a great extent. However, the correct procedure depends on the project manager and the team handling the projects.

The project risks start from the requirement gathering and analysis, how these risks are addressed is what really matters in the project. It's a well known fact that the project manager along with his team is responsible for collecting the correct set of requirements and executing them. In between whatever threats or issues come they are handled by the manager. Therefore, the onus of the success of the project actually lies with the team handling the project. Even though everyone is aware of this, yet the organizations fail to address this key point. Most of the organizations treat their employees as replaceable assets. It is often observed that the link that connects the team, the organization and the client is project based rather than relationship based. Thus, the sense of ownership and commitment, which is the pedestal for a project's success, gets diluted with attrition and discouragement. The present study clearly recognized the moderating effect of organizational climate on the software risks. The issues of attrition and discouragement in the project team can be annihilated with the establishment of clear roles and responsibilities, timely and adequate feedback and adopting excellence in work tasks. This dedicated study on software risk and success with respect to organizational climate unearthed a number of insightful and enriching findings that widened and supplemented the existing knowledge base. Based on these findings a number of recommendations have been drafted:

The success of the project can be ensured when the project specific risks are annihilated and the team develops the ownership towards the project. **Training and mentoring** is a one of the steps in this direction. Training and mentoring is important for unlocking the hidden potential, maximizing the performances and developing intellectual capital. Senior managers mentoring the leads and software engineers, top management mingling with the fresh recruits and sharing their experiences informally, organizations sponsoring the courses of project management for future managers are few steps in this direction. Besides this, **investment in research** – which is one of the most crucial yet highly ignored aspects in the organization, also helps the organizations in foreseeing the changes and in devising strategies and processes for adapting or influencing the change. Investment in R & D also enables the companies in maintaining scalability, sustainability and mitigating project risks by finding innovative solutions. Incessant **audit reviews** at every stage of the project and **alignment of performance appraisals with training and presentations** can also help in ensuring the development of intellectual capital and maintaining sustainability by the organizations.

High level of attrition, low morale and lack of commitment from the team are some of the burning issues that the Indian software organizations are facing. Besides the work and supervisor, one of the major causes of this is the lack of well developed career path for the employees. To overcome these issues one of the most effective ways is to develop **leadership programs** and programs outlining the **career path** of the employees. Finally, open communication, facilitative leader and comprehensible roles and responsibilities in the organizations go a long way in promoting innovation and creating an atmosphere of certainty and predictability. All these will help in ensuring the loyalty and sense of ownership of the team towards the project and the organization.

5.3 Limitations and Scope for Further Research

The research study is limited to a few aspects. Firstly, the study has considered only the project specific risks and while assessing the risk factors and its impact on the success of the software projects. Secondly, only the seventeen organization's climate attributes that emerged out after the discussion with 40 project managers during pilot study were considered while evaluating the various risk dimensions and the success. Thirdly, measuring attitudes of respondents is quite subjective. Although great care was taken for precision, yet there may be certain gaps which need to be rectified. Thirdly, the model needs to be tested on a larger dataset. With more than 500 software service companies of various specializations, sizes and turnover in India spread across the Indian sub-continent, dataset can be further increased to garner better results.

Further research can be conducted by adding a couple of facets to it. The study can be replicated by taking into account macro, micro and project specific risks affecting the Indian software industry in totality. A comparative study on organization's climate and its impact on risks and success can also be conducted between the large and small/medium sized software companies. It must be noted here that Indian software industry as a whole has been taken as a population irrespective of the area of expertise of the company. Therefore, future research can be conducted on identification of risks and its impact based on the specialization. Further research can also be conducted by taking both the organizational climate and culture into account and studying their impact on risk factors and success of the software projects. Finally, impact of organization's climate and risk on success constructs based on the perception of practitioners can also be gauged. Research must also be conducted to discover ways of integrating the perspectives of less

experienced, lower level software engineers with those of senior, upper level IT professionals, and study how these views can be synergized so as foster a more cohesive approach towards managing risks and ensuring project success.

6. 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.