PLANNING IN SOFTWARE PROJECT MANAGEMENT

AN EMPIRICAL RESEARCH OF SOFTWARE COMPANIES IN VIETNAM

Thesis

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To my parents, and
To Phuong and Trung, my children

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ABSTRACT

The software industry has become a key industry in many developing countries because of the application of information technology in business, manufacturing and many other sectors. Software development produces higher value addition compared to other industries with more skilled human resources. Software project management is an interesting issue of both researchers and managers. Software projects have a notorious reputation of poor performance in terms of schedule, cost and quality assurance. There has been limited research on software project management, especially in a context of developing countries. Consequently, this study will concentrate on the role of planning for project success.

The conceptual framework in this study was developed to examine the critical role of planning in software projects. This framework includes three important elements: planning factors, planning performance and project outcomes. Planning factors are defined as human, management and technical factors that involved in project planning. Planning was assessed by the performance of four tasks, including defining requirements and specifications, estimating cost and time, scheduling and risk analysis. Project outcomes were evaluated by five criteria: overall success, qualitative benefits (such as improving project team ability, enhancing the company image financial benefits), financial benefits, time and costs. In the framework, planning performance is influenced by human, technical and management factors. Planning performance also related to project outcomes. This framework also proposed to analyze the influence of project characteristics on the relationships between the planning factors and planning performance.

Both quantitative and qualitative analysis were used to examine the relationships identified in the conceptual framework. 80 software projects in 65 software companies in Vietnam were analyzed. This data was collected mainly by survey. One case of the leading software company was chosen for in – depth analysis through interviews.

The research finding indicated that, there were not many significant differences between software projects based on size, type and ownership. Smaller projects had better scheduling, less budget excess, and better intangible benefits like improving project team capability, enhancing the company image, etc. than bigger projects. Considering the ownership differences between software projects, the significant differences mainly related to human factors. The project manager effort, team member ability and customer involvement of software projects in foreign companies were better than that in local companies. There were minor differences between software projects by type, such as commercial, made to order, and outsourcing.

These findings indicated the important role of human factors in planning. The role of the explanatory variable of planning to project success also confirmed. There were significant relationships between planning performing and all five project outcomes. The qualitative analysis of the project as shown the case study of the Financing and Promoting Technology Corporation (FPT Corp.) provided more explanations for these quantitative findings.

Table of Contents

List of Figures

List of Tables

1

INTRODUCTION

1.1 BACKGROUND OF THE VIETNAM SOFTWARE INDUSTRY

1.1.1 The Development of the Software Sector in Vietnam

Since the Doi moi policy with significant changes in policies and regulations, Vietnam economy has been growing very quickly. Market economy transformation has made Vietnam a country of high economic growth rate, stable macroeconomic environment and integration into the world economy. Along with country economic development, Information technology (IT) sector is growing and influencing other sectors of the economy. Software is an important segment in the IT sector. It has quickly become one of the most profitable and dynamic sectors in the world (Tran, 2001). Realizing the importance and benefits that software sectors and IT industry can contribute to the country economic development, Vietnam has had put emphasis on this industry as the lead sector to help Vietnam in achieving a knowledge – based economy (VNN - Vietnam News, 2000).

In the 90s, software industry in Vietnam was underdeveloped, but it then has a surge blooming due to relatively strong demand for IT and software products and services. Since then, the industry has had continuously growing with rapid increase in number of established software enterprises. This sector has an average growth rate of 22.7% (Hochiminh Computer Association – HCA, 2006). However, the overall value of this market is still relatively small in comparison to other Asian economies. In 2005, the total turnover of the Vietnamese Information Technology market, including hardware, software and services, was US$ 828 million, an increase of 20.9% over 2004 (HCA, 2006).

The IT industry in Vietnam has an imbalanced structure. In 2000, hardware accounted for 83.3%, services and software were 17.6%. This imbalance has changed overtime. In 2005, the market value of software and services was US$ 198 million, 23.9% of total market value and the value of hardware was 72.1% (HCA, 2006).

Export turnover for software is a main contribution to the software industry development as the export value can be much bigger compared to domestic market size. The year 2003 was a successful one for software outsourcing in Vietnam with exports revenue US$ 30 millions (HCA, 2004). In thee consecutive years from 2003 - 2005, the tunover of software oursourcing for export have had the growth rate of 50%. In 2005, this number reached US$ 70 millions (HCA, 2006). Japan is one of key markets for software outsourcing with support from Japanese software businesses in Vietnam. The Corporation for Financing and Promoting Technology (FPT) was the leader for software exports in 2004 of US$ 3.05 million (HCA, 2004). However, export revenue is mainly in outsourcing and sub-contracting activities while revenues from software package are limited.

In Vietnam there are few software development companies. Most software companies actually concentrate on hardware installation, computer training and services (Vietnam Chamber of Commerce and Industry – VCCI, 2000). According to the HCA (2004), there was 570 software companies with 12,000 software programmers. Most software companies in Vietnam are of small scale with less than 20 employees (VCCI, 2000). The survey also showed that most Vietnam local companies have less than 25 developers. According to HCA's criteria for classifying by size, the small business has from 10 – 30 employees, the medium size business has about 30 – 100 persons and a large company is with more than

100 employees. There are only some companies with more than 100 employees like FPT, a Vietnam's largest software producer, has 800 programmers, or TMA (Tuong Minh & Associates) – a largest outsourcing company – has about 600 engineers. The productivity of programmers in 2003 reached the level of US$ 10,000 per man – year (HCA, 2004).

Regarding the quality management system in software companies, at present, there are 3 companies in Vietnam with CMM certification and 33 services and software companies with ISO 9001 certification (HCA, 2004). Domestic software companies still have to struggle to survive in business. There are only a few local companies which can truly compete with foreign companies. The local software market is overwhelmingly dominated by foreign software suppliers who occupy 70% of the market (VCCI, 2000). The main obstacles hindering the potential of local software companies are their own weaknesses including the lack of infrastructure, and insufficient intellectual property rights. In Vietnam, the rate of copyright piracy continued to be high at 90% in 2005 (BSA & IDC, 2006)

1.1.2 Government Support Policies for Software Industry in Vietnam

Vietnam Government has aimed at building software industry the leading sector with high growth rate. Officially, the government has shown its commitment to develop Vietnam into a main software exporter in the region via significant investments in software promotion projects. A number of software parks have been built and put into operation by municipal, provincial authorities and relevant Government agencies. They offer tax exemptions and other incentives to software and related services firms. There are now around 10 software parks in the country (Nguyen Duong, 2004) such as Hoa Lac high-tech Park, 30km west of Hanoi City, established in 1999, Saigon Software Park and Quang Trung Software Park, established in July 2000 and March 2001, respectively in Hochiminh City, Dannang Software Park in Da Nang worth $1.7 million, established in 2000, Can Tho Software Park in 2002. In addition, the Virtual Software Village project valued at US$7 million is now being implemented to attract software customers and support domestic companies in marketing their software products. Moreover, the government has applied most preferential treatments to software enterprises, especially tax rates (Nguyen Duong, 2004), and many decrees related to the policy of developing Information technology have been issued. These decrees continue to strengthen the IT management of the government and to reduce the

telecommunication – Internet prices, diversify services and abolish monopoly in telecommunication sector (HCA, 2004). The protection of copyright can be achieved through enhancing the enforcement of the law.

In spite of government efforts in industry development, the sector development in Vietnam is still underdevelopment expectation. By 2000, the software industry was expected to generate an output worth of US$500 million, 25,000 high-level experts and professional programmers with good skill in English (Huynh, 2001). Three years later, the turnover of software and services was US$ 515 million and the number of programmers was only 12,000, about half of the expected target in 2003 (HCA, 2004).

The selection of software as a key industry for development with government support and commitment has created potential opportunities for investors in the software industry. Vietnam may be the next software industry success story in Asia, highlighting the growing competition in Asia in this knowledge-intensive sector (Asia Pacific Bullentin, 2002). While it is far too soon to suggest Vietnam poses a threat to the position of regional powerhouses like India and Singapore, its low wage costs for skilled software developers will help it to make inroads into the market. Following India's achievement history, Vietnam can believe on the success of software industry in the near future. However, this success is not guaranteed. Software companies nowadays have to increase productivity, flexibility and efficiency, the key competitive advantages to grow and success. This study, therefore, will focus on operational aspects which can help software companies manage their development process to achieve success.

1.2 OBJECTIVES OF THE STUDY

In software industry, many techniques of general project management are applicable to software development. However, the software industry has also achieved a notorious reputation of poor performance in terms of schedule, cost, and quality assurance. Estimating, planning, and quality control processes are so bad that the majority of large system projects run late or exceed their budgets. Many are canceled without ever reaching completion (Jones, 1998). This failure of software is often referred to as the "software crisis". This term refers to the fact that software projects are frequently delivered behind schedule, cost more than the original estimates, fail to meet user requirements, are

unreliable, and virtually impossible to maintain (Chatzoglou and Macaulay, 1996). A study in the USA found that 31 percent of software projects were canceled before completion, and more than half the projects cost an average of 189 percent more than their original estimates (Whittaker, 1999).

"Software crisis" can be attributed to the poor application of design approaches, but also to inadequate project management due to lack of recognition and understanding of the real problems in software development (Ratcliff, 1987). Many previous studies have indicated the role of project management for project success. The results of Blackburn *et al* (1996) indicated that the methods employed to manage the project and the people involved in the cross-functional process of software development tend to be more important than the tools and technology. Although new technologies have been developed to facilitate software development process, programmer's knowledge and experience is still the key to better software development. Therefore, managing the programmers and related stakeholders in software development, is more important than the technology itself. In recent studies, Aladwani (2002) found the positive significant relationship between project planning and project success. Procaccino *et al*. (2002) also indicated the significant role of customer involvement and support from top management to the success of a project. The more customer involvement and top management support, the higher chance of project success.

Project management is therefore a very important aspect that influences project results. This leads to the first research question in this study: What is the current status of project management practices in the software industry in Vietnam, a developing country?

Project management includes four main activities: planning, monitoring, coordinating, and reviewing. Many previous studies have mentioned the important role of planning in software project management. Project planning can have a major influence in explaining the variation in the success of organizational projects including IT related activities (Pinto and Slevin, 1988). Chatzoglou *et al.* (1997) has proposed a model for determining the factors affecting the identification of the customer's requirements in planning. These factors are divided into three groups: human, management and technical. Chatzoglou

considered the influence of these factors on the number of interactions[1] in the Requirement Capture and Analysis (RCA) process, and then considered the level of resources that should be allocated for RCA. For more interaction, more time is needed and additional cost is involved. Chatzoglou's model produces the estimations for resources needed for the whole project as well as for the RCA stage. This model did not show the direct link between each factor (human, management and technical) to the specific project outcomes.

Regarding the factors influencing the project outcomes, Whittaker (1999) revealed three common reasons for project failures. The first reason is poor project planning in which risks were not addressed or the project plan was weak. Secondly, the business case for the project was weak. Lastly there was a lack of management, involvement and support. Aladwani (2002) also reported a positive relationship between IT project planning and performance. However, Callahan and Moretton (2001) could not determine the relationship between amounts of time spent for planning and the time for software development. Dvir, Raz and Shenhar (2003) have also studied the relationship between project planning effort and project success. Their results indicated there is a high correlation between the planning efforts for the development of functional requirements and the technical specifications of the product with the overall project success.

Although the previous studies have considered many factors that influence project outcomes, but planning was mentioned as an important factor for project success. It is necessary to focus more on the role of planning, including the factors of planning and the link between planning performance and specific outcomes. This study develops a conceptual model to assess these relationships.

Firstly, this model will be useful for Vietnamese software companies. There have been few research studies done in this field. Most research has been related to the macro policies for industry development rather than on how software projects are managed. Little attention has been given to the planning in project management and the main factors influencing project outcomes. These are the research gaps that this study seeks to fill. Secondly, the

[1] Number of interactions of the RCA process is number of repeated times of process: (a) gather information; (b) examine and assimilate the information (in order to identify requirements); (c) test whether enough information has been gathered and requirement identified.

results will contribute not only to project managers in the Vietnamese context but also to the emerging software industry in a transition economy.

This study will assess the planning process in a software project. Specifically, it has three objectives. The first objective is to investigate the factors that influence planning performance and develop a model that will identify the relationships between these factors, planning performance and project outcomes. In previous studies, planning was considered a factor that relates to project outcomes (Whittaker, 1999; Aladwani, 2002; Calahan and Moreton, 2001). It is usually treated as an independent variable. Only few studies considered planning as a dependent variable (Chatzoglou, 1997 and Dvir *et al.*, 2003). This study defines the factors that influence planning performance and its impact on project outcomes. By reviewing the literature on software project management, a set of factors that are hypothesized to affect planning performance will be derived. These factors are categorized as human, technical and management. The influence of planning is considered related to different aspects of project outcomes.

The second objective is to examine how planning is implemented in practice in the emerging Vietnamese software industry. Differences in planning related different project characteristics like size, type and ownership of software projects will be explored.

The final objective is to determine the causal relationships between the human, technical and management factors, planning performance and project outcomes. The strength of relationships help to define the key factors related to project success. Therefore, project managers can influence these factors to achieve better outcomes. The moderating effect of project characteristics on the relationship between planning factors and planning performance proposed in the conceptual model is also investigated in this analysis.

1.3 SIGNIFICANCE OF THE STUDY

This study makes a contribution to both the theoretical and practical dimensions of software project management. By reviewing and analyzing the previous studies on the critical success/ failure factors in software project management, focusing on the role of planning, the limited research concerning the critical factors for good planning performance or on the link between planning and project outcomes was found. A

theoretical model is specified to define the relationship between planning factors, planning performance and project outcomes. This model is needed to understand the components of planning and their impacts on project outcomes through planning performance in software project management, especially in the context of a newly emerging industry like software in a developing country. The results of this study help to understand the role of planning in software project and to know how to achieve a good planning performance. It contributes to the gaps in the theory of software project management which has considered the critical factors for project success, but not related to the planning process. This analysis also contributes to the knowledge of the characteristics of software project management as a new industry emerges.

The findings are also very useful to both managers and policy makers of the government related to the software industry of Vietnam. Firstly, this practical contribution will fill the gap in understanding of Vietnamese software project management. At the moment, most studies and market surveys were focused on macro aspects of the software industry like assessing or forecasting the IT market, human resource development issues, government policies and support policies. This initial empirical study will describe the current status of software project management in Vietnam software sector. The results will present a general evaluation of project team management, quality management and planning and indicate the common problems in software projects.

Secondly, this study investigates the practice of planning in software projects through human, management and technical factors. Project outcomes defined by different indicators are also presented. This information is very helpful to project managers and stakeholders to have a better understanding of planning and to improve the results of software projects in Vietnam.

Thirdly, this study investigates the relationships between different planning factors and planning performance and project outcomes. Understanding the role of planning to project outcomes helps project managers to be more effective. They will better understand the relationships between different aspects of planning performance and project outcomes, for example whether or not the relationship between defining requirements and specifications will influence project completion time and cost. This will help project managers to consider how to improve the specific planning performance actions be able to improve

specific project outcomes. Understanding the links between planning factors and planning performance will help project managers to select and control these factors in order to achieve better results. Then, they will be able to forecast the expected improvements in planning performance and project outcomes if these factors are changed. Improving the planning will solve the most common problems of poor planning in Vietnamese software projects today. Through these research findings, better guidelines for project managers to enhance, better preparation in planning will be identified.

Recognizing the current status of software project management will provide more information to the policy makers to understand the importance of support policies for the development of the software industry in Vietnam.

1.4 METHODOLOGY

To achieve the study's objectives, a two – stage research project was designed. In the first stage, an exploratory research will focus on two issues. The purpose of this research is to describe the current status of project management in Vietnamese software companies. In the second stage, the research will focus on defining factors influencing the software project outcomes. The results of the first exploratory study will be the foundation for the second stage study – an empirical analysis on the role of planning in software projects, and its influence on performance.

This two – stage approach is selected because that literature on software project management in the context of developing countries is not extensive. Theory (usually based on studies in the context of developed countries) may be not relevant in practice, especially in the context of an infant industry in which the project managers do not have much experience and knowledge of project management. The exploratory approach will focus on specific problems related to software and provide insights from the project manager's point of view.

The exploratory research is an empirical study. Methodology and results of this exploration will be presented in Chapter 4 of this thesis. The results indicated that poor planning is the most common problem in software project management. Based on this, the next stage survey will focus on planning activities of software project. Through reviewing and

analyzing previous research, a conceptual framework will be constructed. The analysis includes three models to test a comprehensive set of hypotheses. Correlation and regression analysis will be used to investigate the causal relationships in those models.

The first model analyzes the relationship between planning factors (11 factors) and planning performance. Planning performance was considered the dependent variable. Planning factors were identified as independent variables such as project manager' experience and efforts, team member capability, customer involvement, applied project management, system development and life cycle method, management support, project objectives, resource availability and management styles.

The second model explores the relationship between planning performance and 5 project outcomes. In this model, planning performance becomes an independent variable and project outcomes will be treated as dependent variables. In the overall framework of the study, planning performance plays the role of explanatory variable.

The third model examines the effect of project characteristics on relationship between planning factors and planning performance. The differences of behavior and performance between different software project size, type, and ownership are identified. The moderating effect of different project types is examined.

Data collection for the two stages is different. The sampling frame is based on the Information Technology Directory – Vietnam, 2003. This list included company name, address, year of establishment, number of employees, and their major products. First, a random sample was selected and sent by mail. The response rate was low. Then, a snow ball sampling approach was used. Through some software project managers - a respondent network was created by the nomination of initial respondents. This sampling method begins with few project managers and spreads out on the basic of links to the initial cases. The questionnaire will be distributed and collected mainly by this method. The exploratory research includes 55 questionnaires collected from Hochiminh City. Data for the in – depth survey will be collected from 80 software projects in both Hanoi and Hochiminh City. Additionally, 13 other project managers were interviewed in-depth for qualitative analysis.

For analysis of data, SPSS software will be used. Descriptive statistics, factor analysis, and regression techniques will be used for the analysis of the relationships and testing the hypotheses. The validity and reliability of variables will also be analyzed. Details of the research methodology will be presented in Chapter Four.

1.5 SCOPE OF THE STUDY

There are various approaches used in project management. According to the Institute of Electrical and Electronics Engineers (IEEE) (1993), "software project management is the process of planning, organizing, staffing, monitoring, controlling, and leading a software project". The Guide to the Project management Body of Knowledge (*PMBOK Guide*) (PMI, 1996) describes project management as including five types of management processes: initiating, planning, executing, controlling and closing. This study adopted the PMBOK definition for software project management. This definition separates project management into specific tasks to focus on a particular process of project management.

This study is conducted in the context of software industry in Vietnam, which is considered a very productive industry with high value added. The software industry has been a key industry in many Asia countries like India, Singapore or Taiwan.

This study focuses only on software development projects in commercial software companies rather than companies which develop software for their own use. In fact, software project development also is undertaken by companies themselves in different sectors, but they are not very extensive or professional because the level of information technology in Vietnamese companies is still low. This project therefore does not choose software development projects for own usage because of its lack of substance and suitability.

The study targets the entire population of Vietnamese software companies with about 600 companies (IT Directory in 2003). In fact, software companies are mainly located in two major centers: HoChiMinh City and Ha noi, for this reason the survey is conducted in these cities. A mailed survey was employed to collect data. In order to obtain the data of software projects, project managers were chosen as the appropriate respondents. They could provide all information related to their projects.

1.6 ORGANIZATION OF THE STUDY

This study contains 10 chapters. The first chapter is the Introduction. In this chapter, an overview of Vietnam software industry is presented. It identifies the role of the software industry in a developing country whose main advantage is human resources. This chapter also introduces the reasons to focus on project management in software development for this research. The objectives, scope and contributions of this study are described in following sections of chapter one.

Chapter Two presents the concepts and definitions related to software project management. The purpose of Chapter Two is to examine the theoretical background of software engineering and project management. Chapter Three reviews the related studies on software project management.The analysis of previous studies on the evaluation of project and critical factors for success are also presented in Chapter Three. This is the foundation for exploratory research (Chapter Six) and to develop the conceptual framework (Chapter Four).

Chapter Four describes the conceptual framework, hypotheses and research methodology. The model of relationship between planning factors, planning performance and project outcomes is specified. Based on this model, the hypotheses are developed. This chapter also discusses various methodological issues such as the operationalization and measurement of variables and the sampling method.

Chapter Five presents the qualitative analysis of software project management through a case of a software project in the leading software company in Vietnam – the Financing and Promoting Technology Corporation. This chapter will describe the actual project planning in the context of study.

Chapter Six presents the results of exploratory research on software project management and defines the main issues related to the in - depth empirical study. This chapter describes the current status and common problems of software project management in Vietnamese context through empirical research. The research results also contribute to the theoretical understanding of the evaluation criteria and successful factors for a software project in

practice. This is to supplement the *repertoire* of knowledge on software project management typically characteristic of the developed countries industry context.

Chapter Seven presents the results of the survey about software project planning. This chapter describes the characteristics of software companies and software projects in the survey sample. The planning process in software projects analyzes three groups of factors: human, technical and management. The last section of this chapter presents the assessment of project managers concerning planning, planning performance and project outcomes.

Chapter Eight presents the results of analysis of differences by project size (below and above average size group), project ownership (belonging to local or foreign companies) and project types (commercial, made-to-order or outsourcing). The analysis includes a comparison of project characteristics, planning factors, planning performance and project results of these groups. The statistical results, discussions and explanations are presented to support the findings.

Chapter Nine describes the hypothesis testing. Firstly, the analysis of validity and reliability and testing the assumptions for regression analysis are discussed. Secondly, each hypothesis is presented with supporting statistical results and discussion. In the final section, a short summary of the importance of hypotheses is presented.

Chapter Ten is an overview of the findings and the implications for theory of project management, planning and effective practices for project management.

1.7 SUMMARY

This chapter presents the introduction of this research. The background information of the Vietnamese software industry is introduced. Based on an analysis of the theory and practice, the rationale and purpose of this study are presented. The objectives for the research are specified. This section is followed by the significance and the scope of the study, and a short description of research methodology. This chapter ends by presenting an outline of the complete research study.

2

CONCEPTS AND DEFINITIONS

In this chapter, the terminology and concepts related to this study are presented. The first section presents the concepts related to software products and the design process. The second section includes the concepts, definitions and key areas of software project management. The last section describes the concepts and activities related to planning. This section also reviews the methods and techniques used in planning.

2.1 SOFTWARE PRODUCT AND PROCESS

2.1.1 Software Product

Software is defined as (1) instructions (computer programs) that when executed provide a desired function and performance, (2) data structures that enable the programs to adequately manipulate information, and (3) documents that describe the operation and use of the programs (Pressman, 1997).

Software is a logical rather than a physical system element. According to Pressman (1997) a software product has three characteristics. Firstly, software is developed or engineered. It is not manufactured in the classical sense. Secondly, software is not "worn out". It is not susceptible to the environmental condition which causes hardware to be worn out, but it may deteriorate. Finally, most software is custom – built, rather than being assembled from existing components. In fact, with a few exceptions, there are no catalogs of software components. It is possible to order off-the-shelf software, but only as a complete unit, not as components that can be reassembled into new program. Today, with the developments in software technology, the possibility to reuse software components is increasing. Reusability becomes an important characteristic of a high – quality software product. The last characteristic of Pressman (1997) therefore, is not relevant.

There are many ways to classify software products. For functionality it can be classified as application or system software. Because there are so many different uses for computers, there are correspondingly a large number of different application programs. Some of which are of special function or "packages" tailored for a specific purpose (e.g., inventory control or payroll). There are also general-purpose application programs that are not linked to any specific business task, but support instead general types of information processing. The most widely used general-purpose application packages include *spreadsheet, data management, word processing, desktop publishing, graphics, multimedia, and communications*. Some of these general-purpose tools are actually *development tools* that can be used for creating applications.

Many decision support and business applications are built with programming languages rather than with general-purpose application programs. This is especially true for complex,

unstructured problems. Information systems applications can also be built with a mix of general-purpose programs and/or with a large number of development tools ranging from editors to random number generators.

Systems software is a class of programs that controls and supports the computer hardware and its information processing activities. Systems software also facilitates the programming, testing, and debugging of computer programs. It is more generalized than applications software and is usually independent of any specific type of application.

According to Krishnan (1998) the software industry can be broadly classified into custom software, software service and packaged software. Custom software includes internal system development within an organization. Software service includes the systems integration and systems consulting services provided by a wide range of organizations, from an independent programming consultant to large consulting organizations. The packaged software domain includes all software sold as tradable products.

2.1.2 Software Process

There are some different definitions of the software development process. According to the Institute of Electrical and Electronics Engineers, software engineering is (1) the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software; that is, the application of engineering to software, and (2) the study of approaches to application (IEEE, 1993). A software process determines activities and organizational procedures to enhance collaboration in the development team so that a quality product is delivered to the customers (Leszek, 2001).

Pressman (1997) described the software process as an approach that includes framework activities and umbrella activities as shown in Figure 2.1. A Common Process Framework is established by defining a small number of framework activities that are applicable to all software projects, regardless of their size or complexity. A number of task sets – each collection of software engineering work tasks, project milestones, software work products and deliverables, and quality assurance points which enable the framework activities to be adapted to the characteristics of the software project and the requirements of the project team. Finally, umbrella activities, including software quality assurance, software

configuration management, and measurement overlay the process model. Umbrella activities are independent of the framework activity and occur throughout the process.

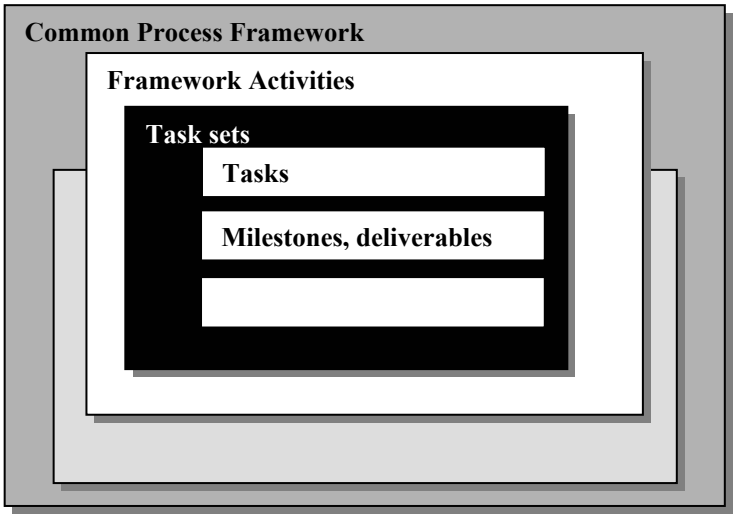

Figure 2.1 The software process (Pressman, 1997)

Software engineering occupies an intermediary position between the mathematical and physical disciplines of computer science and technology and the requirements of the particular application domains applying the findings of the former to solve problems of the application. The techniques for the engineering of software can be viewed, in part, as specializations of more general disciplines, such as project management, system engineering, and quality management (Moore, 2000). The relationship is shown in Figure 2.2.

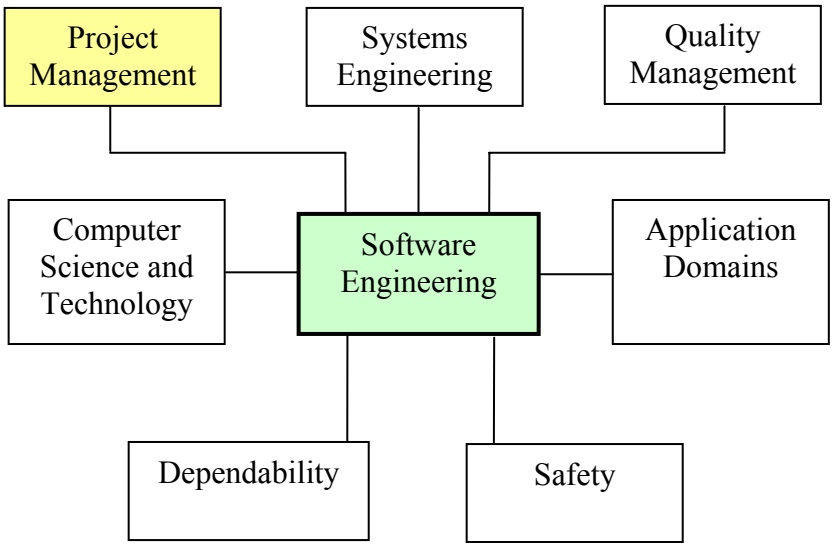

Figure 2.2 Relationship of software engineering to other disciplines (Moore, 2000).

This study will focus on a specific emphasis of software engineering that is project management. It will not consider technical aspects like computer science and technology or application domains.

Computer programmers write, test, and maintain the detailed instructions, called programs or software that computers must follow to perform their functions. They also conceive, design, and test logical structures for solving problems by computer. Many technical innovations in programming – advanced computing technological innovations in programming tools – have redefined the role of a programmer and elevated much of the programming work done today. In short, computer programmers refer to individuals whose main job function is programming. This group has a wide range of responsibilities and education backgrounds.

2.2 SOFTWARE PROJECT MANAGEMENT

2.2.1 Concepts of Software Project Management

The Institute of Electrical and Electronics Engineers (IEEE) (1987) defines "software project management is the process of planning, organizing, staffing, monitoring, controlling, and leading a software project". This is a common definition of project management. However, unlike hardware development or construction projects, there are three characteristics that make software project different from others. Firstly, it is not obvious until very late in the project whether or not the code meets the requirements. Secondly, the software development process is mainly implemented in the mind and it is virtually impossible to measure progress until it is completed. Lastly, testing the software product and integrating it are neither simple nor obvious (Parth, 1999).

Software project management can be defined as the process of making visible what is invisible. Specifically, the software engineering process is invisible because its progress is not immediately visible. Software products contain more complexity than other engineered artifacts. Software developers have to conform to the requirements of human clients. Clients sometimes are inconsistent and organizations have lapses in their collective memory, or in communication that developers have to cater for. Lastly, software systems are likely to be subject to a high degree of changes (Hughes and Cotterell, 2002). By this

definition, managing a software project is not an easy task. This is the reason why project management in the Information Technology area has had a poor success rate, an issue which will be examined in the next section.

2.2.2 Software Project Management Functions

The functions of project management include defining the requirements, establishing the extent of work, allocating the resources required, planning the execution of the work, monitoring the progress and adjusting deviations from the plan (Munns and Bjeimi, 1996). The Project Management Body of Knowledge Guide (*PMBOK Guide*) (Project Management Institute, 2000) describes five types of management processes: initiating, planning, executing, controlling and closing. This guide specializes in process types with 37 aspects of processes that are applied to nine program management knowledge areas, namely: project integration, scope, time, cost, quality, human resource, communications, risk and procurement (Moore, 2000).

For this exploratory research, the focus will be on key knowledge areas including human resource, quality, and time management.

2.2.2.1 Human Resource management

Human resource management includes all the processes that will be undertaken to identify, secure and maintain an effective project team. This may take place in a self-contained team management plan or it may be a section of the project plan. The team management plan may include staffing, team structure, team communication, conflict resolution, performance appraisal and training. A recent survey of leading software organizations in Europe identified that the quality of people in a software team is one of the most important factors in improving productivity and quality in software projects (Blackburn *et al.,* 1996*)*. To effectively manage the project team, the manager has to focus on training, motivating and evaluating the project personnel.

One important indicator of the quality of people is productivity, however reliable measures of software productivity have eluded researchers for years (Yu, Smith, and Huang, 1990).

Indicators which could be used for software productivity measurement include size – oriented and function – oriented metrics (Hughes and Cotterell, 2002).

Size – oriented metrics are derived by normalizing quality and/or productivity measures by considering the "size" of the software that has been produced. In order to develop metrics that can be assimilated to metrics from other projects, lines of code (LOC) is considered as a normalization value. A set of simple size-oriented metrics which could be developed for each project is presented in Table 2.1. Size-oriented metrics are not universally accepted as the best way to measure the process of software development (Jones, 1999). Most of the controversy is related to the use of lines of code (LOC) as a key measure. However, research in this area has often used LOC for measuring project productivity or size. Other research indicated that productivity measured by lines of code per man-month spent on the project area is different by types of project. For business application, the average was 1,040 LOC/ man-month or 1.04 KLOC/ man – month (Blackburn *et al,* 1996).

Table 2.1: Productivity indicators in software development

Size – oriented metrics	Function – oriented metrics
- errors per KLOC (thousand lines of code) - defects per KLOC - $ per LOC - pages of documentation per KLOC - errors/ person-month - LOC per person-month - $/ page of documentation	- errors per FP - defects per FP - $ per FP - page of documentation per FP - FP per person-month

Source: Pressman, 1997

The function point metric was created to measure the size, productivity, quality and other attributes of software applications. The function point (FP) metric is composed of the weighted totals of five external aspects of software application, namely inputs, outputs, logical files, inquiries and interfaces (Jones, 1998). The common indicators of productivity by the function – oriented measurement approach is presented in Table 2.1.

2.2.2.2 Quality management

Quality management includes the activities and techniques used to ensure that all project activities and work products comply with all relevant standards, procedures and requirements. The quality of the software product is considered to be a critical business success factor, and therefore quality management is important to the software development process.

Software quality refers to attributes as reliability, testability, modifiability, portability; usability and efficiency. Reliability is the degree to which the product meets its functionality over a measured period of time. Testability is the measure of difficulty in testing a product. Modifiability is the measure of effort required to modify and test a product to allow that a product to run in an environment other than the one for which it was developed. Usability is the measure of re-usability of code. Efficiency is a measure of the satisfaction of users regardless of their background, task performed, and needs (Yang, 2001; Gong, Yen and Chou, 1998). Software programmers and development teams rarely achieve their objectives for all of these attributes. Most base their estimates of a product's quality on its functionality and the appearance of the user interface (Yang, 2001).

Many quality management systems have been applied in software firms. Examples of quality systems are presented in Table 2.2.

Table 2.2: Examples of quality management systems

Quality system	Organization
ISO 9000	International Organization for Standardization
Capability Maturity Model (CMM)	Software Engineering Institute (SEI) – USA
TickIT	Department of Trade and Industry – UK
Software Process Improvement Capability Determination (SPICE)	SEI and SC7
Total Quality Management (TQM)	

Source: McAdam and Fulton, 2002; Yang, 2001, Gong, Yen and Chou, 1998; and Carroll, 1995.

In the following sections, three well – known quality management systems in software development in Vietnam, including ISO 9000, TQM and CMM are presented.

ISO 9000 has been effectively adapted for use in the software industry. From the ISO 9000 series, ISO 9001 is the most pertinent standard for software development and maintenance. It is applied to ensure that the supplier conforms to specified requirements during several stages of development – including design, development, production, installation, and servicing. ISO9000-3 provides guidelines for applying standard to the development, supply and maintenance of software (McAdam and Fulton, 2002; Yang, 2001).

TQM is a paradigm and a philosophy first adopted in Japan. TQM originated in the manufacturing sector but is increasingly applied to other sectors such as the service industries, health, government and education (Dean and Bowen, 1994).There is a growing trend of adopting the TQM philosophy to software development. Applying TQM to the software development process can control software quality and productivity (Gong, Yen and Chou, 1998). The key elements of TQM include: customer focus, attention to process, continuous improvement, measurement and analysis of data, and human factors, such as management and leadership.

The capacity maturity model (CMM) was created by the Software Engineering Institute in the late 1980s to help software organizations improving their software processes along an evolutionary path (Paulk, 1994). The CMM describes the principles and practices underlying software process maturity and assesses software process capability at five levels: initial, repeatable, defined, managed, and optimizing. Except for the first level, each level has a set of key process areas on which an organization should focus to improve its software process. Each level also is a well-defined evolutionary plateau directed toward achieving a more mature software process at the next level (McAdam and Fulton, 2002; Yang, 2001).

2.2.2.3 Time management

Time management includes the processes and techniques used to ensure the timely completion of the project. It involves the development and management of the project work activities and the project schedule. As part of the project planning specifically, the

definition phase, a detailed project schedule and work breakdown structure should be defined based on a project proposal. The project schedule must show the dates when each activity should start and finish and how much each resource will be required during the schedule (Hughes and Cotterell, 2002).

2.3 PLANNING IN SOFTWARE DEVELOPMENT PROJECTS

The concepts and definitions in this section concentrate on planning in software projects. This is the foundation for the in-depth analysis (second stage) of this study.

2.3.1 Planning

The literature on project planning may be divided into two streams. The first stream concerns the strategic aspects of project planning and focuses on the selection of projects that are congruent with organizational goals. The second stream of project planning research concerns the process of planning individual projects (Aladwani, 2002). Hughes and Cotterell (2002) offered an outline of main planning activities in a software development project. This outline includes both the strategic planning streams. The outline is displayed in Figure 2.3. In this study, the interest is on planning within individual projects. Project planning, with reference to the extent to which timetables, milestones, workforce, equipment, and budget are specified (Slevin and Pinto, 1986). According to Chatzoglou and Macaulay (1996), planning system development means determining what work must be done, who will accomplish it, and when it will be done. Specifically, project planning involves estimating the effort, time, cost and staff resources needed to execute the project.

According to Hughes and Cotterell (2002) planning includes seven steps as presented in Figure 2.3. Step One is to identify the project scope and objectives. The activities in this step ensure that all the parties to the project agree on the objectives and are committed to its success. A common problem is overlooking people who are affected by the project. Step Two is to identify the project infrastructure. There is usually an existing infrastructure into which the project can fit. Project leaders must identify the precise nature of this infrastructure. Step Three is to analyze the project characteristics. This is to ensure that the appropriate methods are used for the project. Step Four is to identify project products and

activities. A more detailed planning of individual activities is done. Step Five is to estimate the effort for each activity. Effort is the amount of work that needs to be done. The elapsed time – the time between the start and the end of a task – is estimated based on this effort. The individual activity estimates of effort should be summed to get an overall actual estimate which can be reconciled with the previous planned estimate. These estimates could reveal that some activities are going to take a longer time. Longer activities are more difficult to control. It would better to break this down into a series of smaller sub-tasks. Step Six is to identify activity risks. The project manager should identify and quantify the project risks through considering each activity. A risk reduction approach is produced. The risk analysis in this step should consider the last step and change the estimation of effort for each activity. Step Seven is to allocate resources. Based on the estimated efforts in step five, the staff available for the project is identified and is allocated to specific tasks. In Step Eight, the project manager will review the quality aspects of the project plan and then document this plan and obtain the agreements. Finally, in steps Nine and Ten, the project manager executes the plan and initiates lower level planning.

This step wise planning approach is used to construct a framework to identify and analyze activities in planning of specific software projects in the in – depth survey conducted in this research.

The selection of software development methodology and planning techniques do impact project results (Verner, Overmyer, McCain, 1999). Moreover, fast changing technology (such as new languages, new operating systems or increased hardware speed, etc.) and the higher requirements in the business environment (such as, increasingly complex applications, high development costs or time-to-market) have a strong influence on the management of software development projects (Parth, 1999).

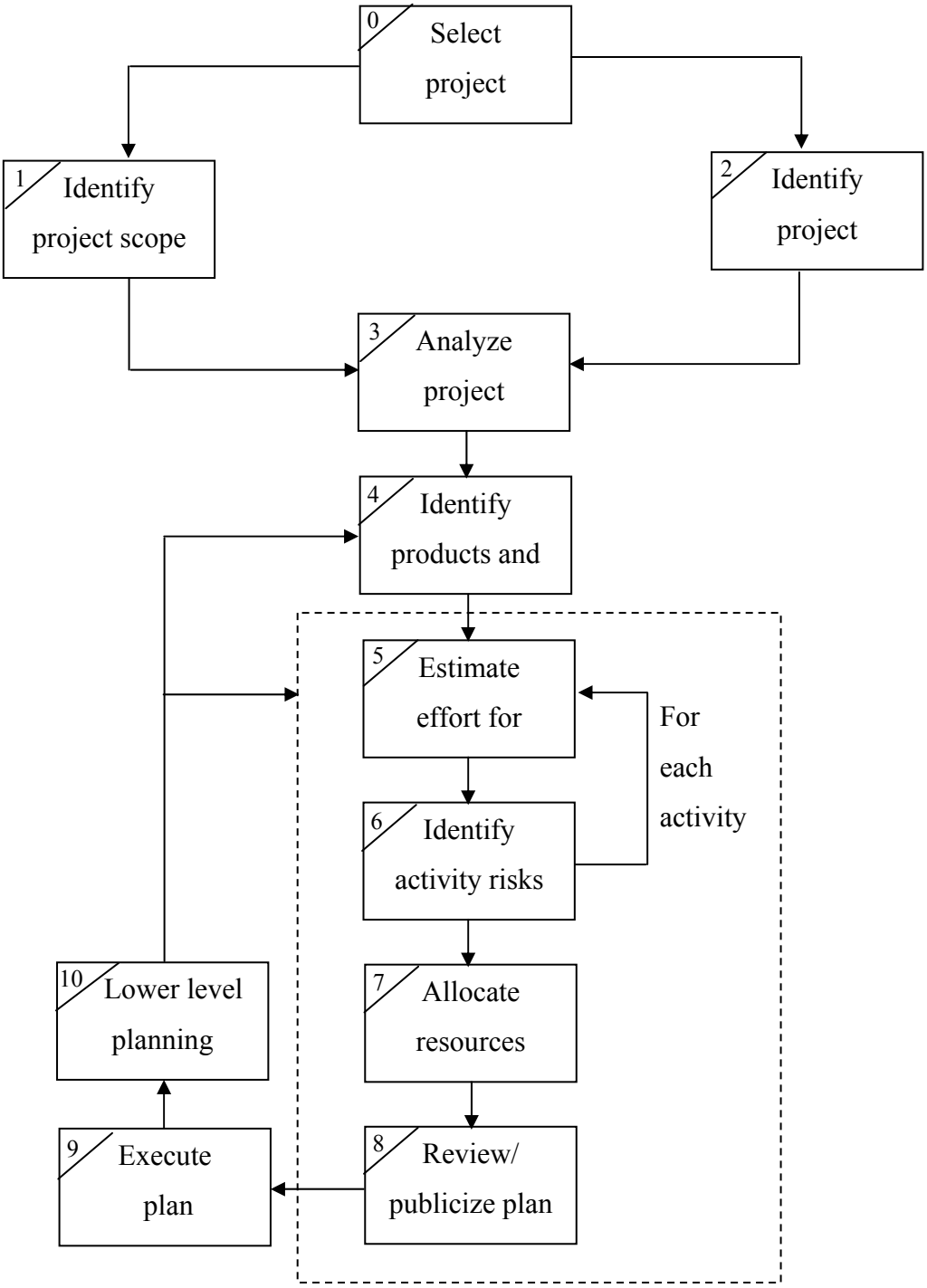

Figure 2.3 Step wise planning activities (Hughes and Cotterell, 2002)

The methodology and techniques which are applied in software development project could be categorized into three groups, including Life – cycle models, system development methods and planning techniques.

2.3.2 Life-cycle Models

The life – cycle model (or process model) is a development strategy that encompasses the process, methods, and tools layers that are used to build software. The research of Verner, Overmyer, McCain (1999) indicated that the choice of the right life – cycle methodology is a key factor in the successful projects.

There are many views on how to develop information systems. Some of these perspectives have been captured in particular methodologies, for example: ad hoc (Jones, 1990), waterfall (Royce, 1970), participative (Mumford and Weir, 1979), soft systems (Checkland, 1981), prototyping (Naumann and Jenkins, 1982), incremental (Gilb, 1988), spiral (Boehm et al., 1984), reuse (Matsumoto and Ohno, 1989), formal (Andrews and Ince, 1991), rapid application development (Martin, 1991; Morton, 2004), object-oriented (Humphrey, 1990) and software capability (Jones, 1986).

In this section, the popular life-cycle models are described, namely the waterfall, V-process, spiral, software prototyping and incremental delivery approach. The details of these approaches are suggested by Hughes and Cotterell (2002).

2.3.2.1 The Waterfall model

This is the "classical" model of system development. Figure 2.4 describes this model as a sequence of activities working from top to bottom. The diagram shows some arrows pointing upwards and backwards. This indicates that a later stage may reveal the need for some extra work at an earlier stage, but this should definitely be the exception rather than the rule. The limited scope for interaction is in fact one of the strengths of this process model. With a large project it is necessary to avoid reworking tasks previously completed. Reopening completed activities changes the promised completion dates.

Hughes and Cotterell (2002) indicate there is nothing intrinsically wrong with the waterfall approach, even though alternative models are advocated. It is the ideal process for which the project manager strives. If the software to be developed is familiar to the project team (in terms of application domains and technology), the waterfall approach allows project

completion times to be forecast with more confidence than more iterative approaches, allowing projects to be controlled effectively.

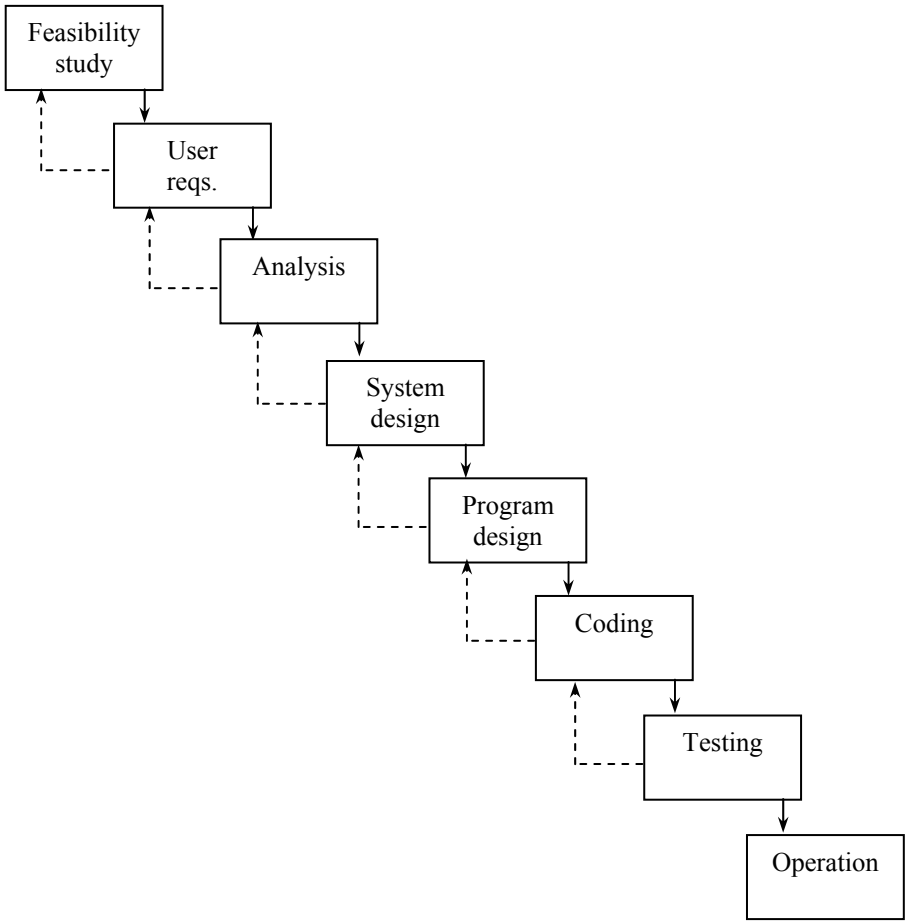

Figure 2.4 The Waterfall model

2.3.2.2 The V-process model

Figure 2.5 gives a diagrammatic representation of this model. This is an elaboration of the waterfall model and stresses the necessity for validation that will match the activities that create the products of the project.

The V-process model can be seen as expanding the activity *testing* in the waterfall model. Each step has a matching validation process which can, where defects are found, cause a loop back to the corresponding development stage and a reworking of the following steps. Ideally, this feedback should only occur where a discrepancy has been found between what was specified by a particular activity and what was actually implemented in the lower level of activity.

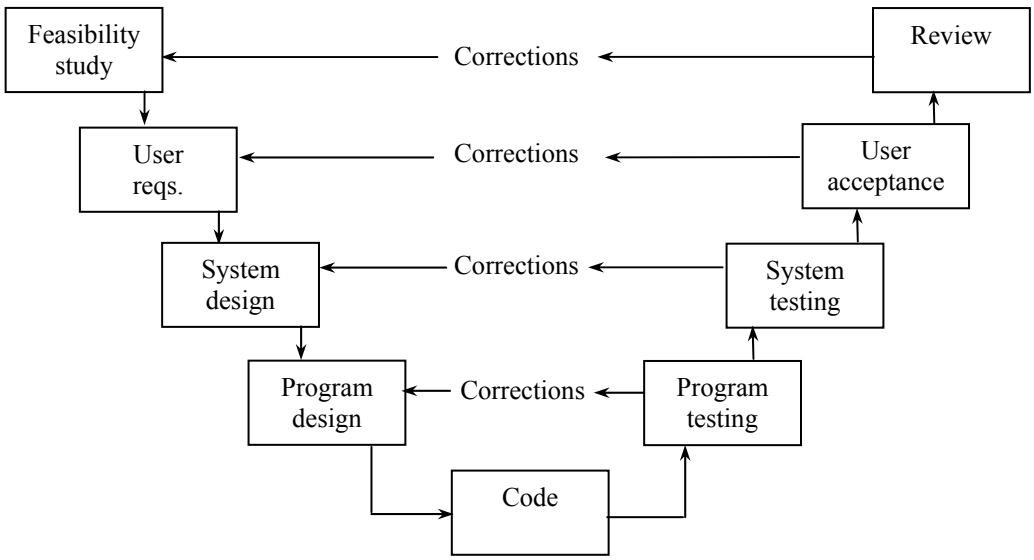

Figure 2.5 The V-process model

2.3.2.3 The Spiral model

This is another way of looking at the waterfall model. In the waterfall model, it is possible to escape at the end of any activity in the sequence. A feasibility study might decide that the implementation of a proposed system would be beneficial. Management authorizes the detailed analysis of user requirements. Some analysis might already have taken place at the feasibility stage, but a more thorough investigation is launched. This could reveal that the costs of implementing the system would be higher than the projected benefits and lead to a decision to abandon the project.

The greater level of detail considered at each stage of the project leads to a higher degree of confidence about the success of the project. This can be portrayed in a loop or a spiral where the system to be implemented is considered in more detail in each application. Each stage terminates with an evaluation before the next interaction is taken.

2.3.2.4 Software prototyping

A prototype is a working model of one or more aspects of the projected system. It is constructed and tested quickly and inexpensively in order to test assumptions. Prototypes can be classified as throw-away or evolutionary.

In throw-away prototypes, the prototype is used only to test ideas and is then discarded when the actual development of the operational system begins. The prototype could be developed using a different software environment or even a different hardware platform. In evolutionary prototypes, the prototype is developed and modified until it can become the operational system. In this case the standards that are used to develop the software have to be carefully considered (Hughes and Cotterell, 2002).

According to developers, using the prototype approach helps both software project team and customer develop are understanding of the customer's expectations. Often, a customer defines a set of general objectives for software but does not identify detailed input, processing, or output requirements. In other cases, the developer may be unsure of the efficiency of an algorithm, the adaptability of an operating system, or the form that human – machine interaction should take. In this situation, a prototyping solution may offer the best approach. (Presman, 1997).

2.3.2.5 Incremental delivery

The incremental model combines the elements of the linear sequential model with the interactive philosophy of prototyping. But unlike prototyping, the incremental model focuses on the delivery of an operational product with each increment. Early increments are "stripped down" versions of the final product, but they do provide capability that serves the user and also provide a platform for the evaluation by the user (Pressman, 1997). The application of this approach is word-processing software.

This approach involves breaking the application down into small components which are then implemented and delivered in sequence. Each component delivered must give some benefit to the user (Pressman, 1997). Figure 2.6 gives a general outline of the approach. Time boxing is often associated with an incremental approach. Here the scope of the

deliverables for an increment is rigidly constrained by an agreed deadline. This deadline has to be met, even at the expense of dropping some planned functionality. Omitted features can be transferred to later increments (Hughes and Cotterell, 2002).

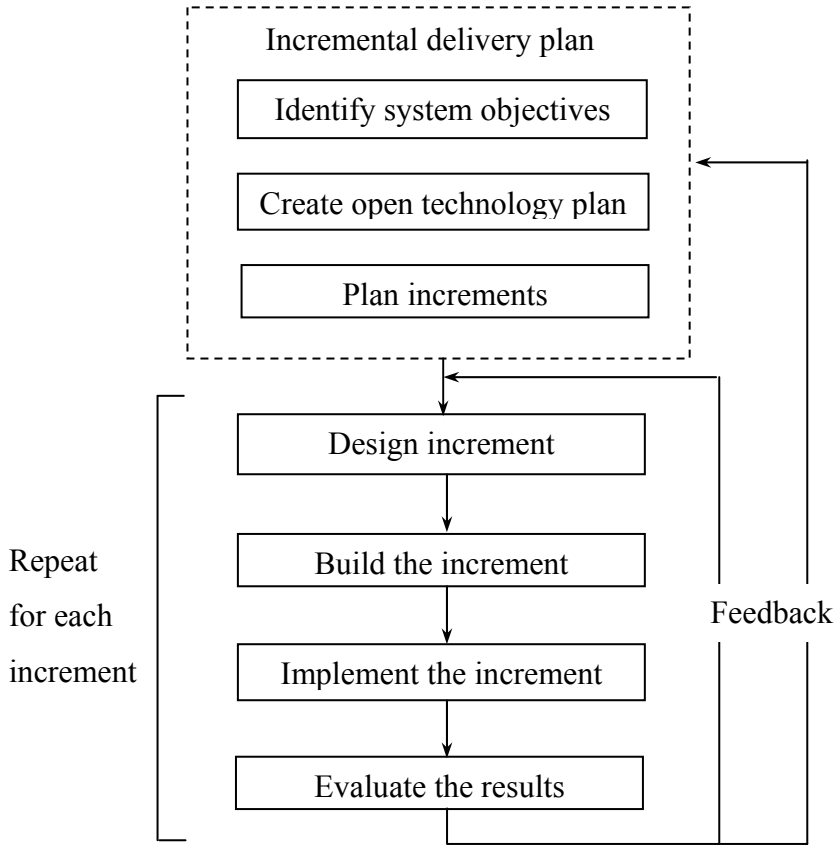

Figure 2.6 Intentional incremental delivery (Hughes and Cotterell, 2002).

2.3.3 System Development Methodologies

System development methodologies are promoted as a means of improving the management and control of the software development process, structuring and simplifying the process, and standardizing the development process and product by specifying activities to be done and techniques to be used (Russo and Walz, 1995).

System development methods are rapidly changing with the development of new technology in software engineering. Russo and Walz (1995) conducted a survey on how system development methods are used. They found that the Structured approach was most used. Currently, the trend of system development has changed to the object – oriented

methodology. This is very popular in software engineering today. Some popular system methodologies will be reviewed in this section.

The Structured approach or modeling is a kind of conceptual modeling paradigm related to models (Pressman, 1997).

Object orientation is the most common principle in software research and development at present. It covers various stages of the software life cycle, from implementation, through design to system analysis. Object-oriented programming, which emphasizes implementation issues rather than the underlying designs and requirements of the system, is well known and well established. The object orientation is more than just a programming paradigm, the emphasis in object-oriented technology has shifted to the earlier stages of the software development process (Pressman, 1997).

Rapid application development (RAD) is the methodology or choice of architecture and tools, requirements and design analysis, selection of personnel and management, construction, and implementation and support. The goals of RAD are to be faster, better and cheaper (Hirschberg, 1999)

Rational Unified Process (RUP) is a software engineering process that was created by Rational, a software development company, bought and developed by IBM. It provides a disciplined approach to assigning tasks and responsibilities within a development organization. Its goal is to ensure the production of high-quality software that meets the needs of its end-users, within a predictable schedule and budget (Jacobson, Booch and Rumbaugh, 1999 and Kruchten, P. 1999)

2.3.4 Planning Techniques

One of the most important phases of project management is the “Planning phase”, in which all work to be done is determined and defined. Planning is the most time consuming set of activities but valuable if done properly. In this phase, many different techniques are used, such as tables, work breakdown structure (WBS), charts and networks. Tables are used to present the project activities and relevant information such as the duration, dependency, cost, starting, ending, and required resources. Tables are used during the planning and

controlling phase and can be used for implementation and monitoring. WBS (Work Breakdown Structure) is an organizational chart that breaks the project into subsystems, components and tasks that can be readily accomplished. It is used for scheduling, pricing and resource planning. WBS simplifies summarizing and reporting progress and costs. Organization Breakdown Structure (OBS) is a model that organize resources into groups for better management. It can be used to keep track of resource allocation and specific work assignments. There is a strong interdependency between OBS and WBS (Badiru and Pulat, 1995).

The Gantt Chart is one of the oldest and most useful techniques planning. It is clear, simple and easy to use and understand. The interdependency between activities is not easily represented, especially in large projects, hence networks are used. Networks are a graphical display of the project activities showing their interdependency. Several network techniques have been introduced and used over the years. Mainly two types of networks can be used, depending on the type of project under consideration: deterministic and probabilistic methods. For representation, either activity-on-arrow (AOA) or activity-on-node (AON) are used to model the project. The probabilistic method is known as the program evaluation and review technique (PERT), while the deterministic method is called either the precedence diagramming method (PDM) which uses the AON method for representation, or the arrow diagramming method (ADM) which uses AOA method. All of the methods use what is known as the critical path method for determining the project duration, critical path(s), floats and other relevant data.

The empirical research of Abbasi and Al-Maharmah (2000) indicated that Project management software is used most frequently for project management (70%). Other applications in planning and managing the project are reporting progress (53%), time cost analysis (50%), bar chart (53%), critical path method (CPM) (34%), organization breakdown structure (OBS). Similar results were found in the empirical study of White and Fortune (2002). Project management software is the most commonly used application (77%), next is the Gantt chart (64%) and Cost benefit analysis (37%). However, this study also shows that the application of project management software had the most the limitations. These included inadequate coverage for complex projects, difficult to model the “real world”, too heavy documentation, or too time consuming.

Both of these studies examined project management in various industries. In software projects, planning and managing a project still depends on a method of estimating the resources required in terms of cost, effort and timescale (Chatzoglou and Macaulay, 1998). There are many available methods and software packages (such as COCOMO, SOFTCOST, ESTIMACS, PRICE S, PRINCE etc.) that support the various estimations for software development projects. The most commonly used planning techniques in software projects and their impacts on the final project outcomes is one of objectives that will be examined by this study.

2.4 SUMMARY

This chapter provides the background for both the exploratory and in – depth research. The software product and process were defined. The definition of software project management functions were followed PMBOK Guide (2000). The emphasized was on the team, quality and time management functions. The planning approach is followed Hughes and Cotterell (2002) that planning activities were separated into ten steps. The remaining sections described common methods in software project management, including system development, life – cycle methods and planning techniques.

The current status of software project management is analyzed through three main areas of project management, including team management, quality management and time management. The step wise approach of planning provides the framework for conducting in – depth interviews with project managers about their software projects. Besides, the concepts of life – cycle models, system development methods and planning techniques in software project were presented.

3

REVIEW OF EMPIRICAL STUDIES

There has been little research on project management in the software industry in transition economies. Most studies have usually focused on advanced economies. The literature that is reviewed here mainly relates to this context. Research on project management for other types of projects is also considered. In this chapter, the results of previous studies are considered to establish a theoretical base for this study. In the first section, the indicators used to evaluate project outcomes will be discussed. Next, the critical factors influencing software projects will be analyzed. The last section concentrates on the role of planning to project outcomes.

3.1 SOFTWARE PROJECT PROBLEMS

Considerable research has been focused on problems in software development projects. The main purpose of this research is to understand the common problems and why they happened. The results of these studies are very rich and detailed. In this section, software project problems are categorized into 3 groups: performance of the project, people, and project management issues.

3.1.1 Performance of the Software Project

Performance is defined as the fulfillment of the management and technical requirements of the software, including its functions, cost and schedule. Performance problems were related to the inability to deliver the product within budget and/or on schedule and to develop a high-quality product that was acceptable to the customer (Duvall, 1995). Many software projects have problems with meeting deadlines and cost targets. Gibbs (1994) indicated that for every six new large-scale software systems put into operation, two others were cancelled. Another study in the USA found that 31 percent of software projects were canceled before completion and more than half the projects will cost more than 189 percent of the original estimates (The Standish Group, 1995). A study which focused on meeting deadlines in software projects in Germany revealed that in 60 percent of the projects investigated, more than 20 percent were behind time, while only 5 percent were completed on time (Eversheim *et al.,* 1997).

This poor performance stems from other problems that happen during the software development process. The following discussion will reveal the problems related to people issues, and project management issues.

3.1.2 People Issues

There are many people involved in or related to a software project. In general, they can be categorized into two groups: project personnel and stakeholders (including the customer or user, subcontractor and the personnel of the parent company). The main problem for project personnel (including project manager, designer, programmer, etc.) is the lack of skillful and talented people (Duvall, 1995) or a shortage of programmers (Yang, 2001).

This problem becomes more serious because of the poor training given in software companies. Many software project managers are either untrained or poorly trained for their work. They are also severely under equipped. The Software Productivity Research Company (USA) has indicated that less than 25% of US software project managers received any formal training in software cost estimating, planning, or risk analysis (Jones, 1999).

The customer is defined as the end user(s) of the software and/ or the one who pays for the development. The customer doesn't know what they want but know what they like (Duvall, 1995). This problem occurs because programmers have so much more experience with computers than their users. They find it very difficult to understand a user who does not have similar capabilities and familiarly with software (Parth, 1999). The customer can be inconsistent. Organizations, because of no memory, poor internal communication or ineffective decision-making can exhibit remarkable "organization stupidity" that developers have to recognize (Hughes and Cotterell, 2002). Therefore, software project managers always encounter problems in defining the customer's requirements. Users cannot adequately define the requirements because the application they want has never been done. Moreover, the requirements change, such as the need to adjust the level of functionality incorporated into the final product (Duvall, 1995).

3.1.3 Project Management Issues

Project management issues refer to the problems which usually happen in the software development process in performance or enabling technologies. Enabling technologies are the methods and tools used to develop the software.

Managers often feel that the processes they used did not address their needs. The problem of defining the requirements was the most difficult part of the software development process and was inefficient. There are also inherent problems with the software process. Managers complained about dissatisfaction they felt in dealing with tools for software development –that did not meet their needs and/ or were difficult to learn (Duvall, 1995).

A survey conducted by Thayer, Pyster and Wood (1981) identified the common problems in software project management. They include poor estimates and plans, lack of quality

standards and measures, lack of guidance about decisions, lack of techniques to make progress visible, poor role definition and incorrect success criteria. Although this study was conducted more than 20 years ago, the problems found still exist in software projects today. An assessment by the Software Engineering Institute (SEI) in 1991 indicated that 93% of the companies assessed did not have a well-defined software development process. 81% did not have a quality management system. The software process has a poorer reputation than most other product development functions. The problems in managing the development process often leads to quality lapses.

Software projects have a high level of change. Change was the replacement of one thing with another, implying movement. Everything can be changed, people, situations, needs or specifications (Duvall, 1995). Hence, managing a software project always has the risk of changes.

In short, these problems in the software development process lead to the high rate of failure of software projects and they still are the concern of managers and researchers. The common problems in software projects will be examined in the context of software industry in Vietnam – a developing country.

3.2 PROJECT PERFORMANCE EVALUATION CRITERIA

The criteria for evaluating success or failure in projects have a rich literature with a variety of points of view. This section will summarize the results of different studies on specifying criteria for project evaluation.

Poor software project performance is based on the criteria of completion on time and within budget. These criteria are very important in determining the project results. However, in the literature the definition of project success has changed over the years. In the 1960s, project success was measured entirely from the technical viewpoint that is the product worked. In the 1980s, the definition for project success required meeting three objectives completed on time, within budget and at a desired level of quality (Kerzner, 1998). The quality of a project was commonly defined as meeting technical specifications. All these measures were internal to a project. After the introduction of TQM, a project was considered to be a success by meeting the internal performance measures of time, cost and

technical specification but also is acceptance by customer and the customer's satisfaction (Kerzner, 1998).

Focusing on customer satisfaction is reflected in considerable research in project management. The related studies on evaluation criteria for software and other kinds of project are presented in Table 3.1. This summary is developed from the research of Westerveld (2003). The previous studies related to project evaluation are divided into two groups. First is software and IT projects and second is on other types. According to Westerveld (2003), the evaluation criteria could be categorized as project results and stakeholders satisfaction. The project results include outcomes related to project time, cost and quality. Stakeholders include project personnel, clients, users, contacting partners and others. The analysis and classification in Table 3.1 are to identify the criteria most commonly used.

As Table 3.1 indicated, there are many criteria for evaluating project performance, but the most common evaluation criteria are project results (in terms of cost, time and quality). Only the research of Seen, Beaumont and Mingins (2001) did not consider this criterion. Their research emphasized more on the benefits for the parent company, not for an individual project. Satisfaction of customers (including both clients and end-users) is another criterion that many researches used. Although Westerveld (2003) distinguished between clients and end-users for his analysis, most studies on software or IT projects rarely do this. Additionally, the satisfaction of project personnel and parent company are also an objective that many projects consider. This analysis also showed that contracting partners were considered in only few studies. Because of many researches in this summary missed this criterion, the satisfaction of contracting partners, therefore, is not important. Comparing between software/ IT projects and other project types, the criteria for evaluating software or IT projects are quite similar to that of other type of projects.

In brief, the most common criterion for project evaluation is project results in terms of time, cost and quality. Satisfaction of customer is next important. The projects rarely considered the satisfaction of contracting partners.

Table 3.1 Project evaluation criteria – summary of previous studies

	Result areas / Authors	Project results Time Cost Quality/ Scope	Satisfaction of stakeholders				
			Project personnel	Client	End-users	Contracting partners	Sponsors/ parent company
Software/ IT projects	Wateridge (1998)	- Meets timescale - Meets budget - Meets quality	- Satisfied project team	The project achieves its business purpose	- Meets user requirements - Satisfied users	Commercial success	Satisfied sponsor
	Abdel-Hamid, Sengupta and Swett (1999)	Evaluate based on cost, schedule and quality					
	Seen, Beaumont and Mingins (2001)		- Committed, professional staff	Customer satisfaction (for new and repeat business)			- Profitability for long-term survival - A harmonious culture - Research and development - Improvement in processes - Commercialization of new products, concepts and ideas

	Result areas / Authors	Project results Time Cost Quality/ Scope	Satisfaction of stakeholders				
			Project personnel	Client	End-users	Contracting partners	Sponsors/ parent company
Software/ IT projects	Aladwani (2002)	- adherence to schedules - quality of work	- overall efficiency of operations - extent to which the project solved the right problems				- effectiveness of interaction with non – members - effectiveness of interaction with consultants
	Dvir, Raz and Shenhar (2003)	- meeting functional requirements. as defined during design phase - meeting technical specification as defined during design phase - meeting schedule - meeting budget goals - meeting procurement goals		- satisfying end-user operation need - project end-product is in use - system delivered to end-user on time - system has significant usable life expectancy - performance level superior to previous release - end-user capabilities significantly improved - end-user satisfied from project end-product		- profit exceeds plans - profit exceeds similar projects - new market penetration - created new market - created new product line - developed new technologies and infrastructures - developed new knowledge and expertise - generated positive reputation - responded to business or competitive threat	

	Result areas / Authors	Project results Time Cost Quality/ Scope	Satisfaction of stakeholders				
			Project personnel	Client	End-users	Contracting partners	Sponsors/ parent company
Other kinds of project	Tuner (1997)	The facility is produced to specification within budget and on time.	The project satisfied the needs of project team and supporters	- The project provides a satisfactory benefit to the owner - The project achieves its stated business purpose - The project meets pre-stated objectives	The project satisfied the needs of users		The project satisfied the needs of stakeholders
	Dvir, Lipovetsky, Shenhar and Tishler (1998)	Meeting design goals: - Functional specification - Technical specification - Schedule goals - Budget goals		- Reached end-user on time - Product used over a substantial period of time - Product yields substantial improvement in user's operational level - User is satisfied with product			Meeting acquisition goals: - Meeting the operational requirements - Product entered into service
	Lim and Mohammed (1999)	Micro success (short-term): - On time	Micro success (short term) appreciation of the project team	Macro success (long term) "does the original (business) concept tick?"		Micro success (short term): - Profitability of the	

3.3 CLASSIFICATION OF CRITICAL FACTORS FOR PROJECT SUCCESS OR FAILURE

The high failure rate of software project leads to a consideration of causes. This issue is of interest to many researchers in the project management field. Reviewing previous studies on critical factors for project success (or failure) provides the theoretical foundation for this research. The summary of related studies is presented in Table 3.2. In this review, the critical factors will be categorized as people factor, process factor, technical or methodology factors. The analysis mainly focuses on software projects rather than on other types of projects.

People factors include the characteristics of individuals and groups that affect the development of a software product (including project managers, project team members, customers, marketers, related personnel in the parent company). The process factors represent a series of action or operations used to produce a software product that are related to the results of the project. Technical and methodology factors are tools, methods and techniques used to develop the software that will affect the performance of the project.

Table 3.2 Critical factors for project success/ failure

	Factors / Authors	People factors	Process factors	Technical/ methodology factors	Project characteristics/ resources
Software/ IT projects	Chatzoglou (1997)	- Team members - User	- Management style	- Techniques and tools employed	- Available resources - Project characteristics
	Krishnan (1998)	- Personnel capability of team - Domain and language experiences			- Product size
	Whittaker (1999)		- Top management involvement and support - Project planning		- Weak business case

Software/ IT projects			(inadequate risk mgt. and weak project plan)		
	Verner, Overmyer and McCain (1999)	- Customer and user - Project manager	- Management support - Requirement and specification defining - Estimation and schedule - Staffing	- Life cycle methodology - Risk mgt. techniques - Planning, monitoring and control techniques	
	Abdel-Hamid Sengupta, Swett (1999)		- Project goals: cost/ schedule or quality/ schedule		
	Callahan and Moretton (2001)	- Project leader power	- Supplier involvement - Sale and marketing involvement - Time spent for planning - Frequency of load build - Financial rewards	- Testing methods	
	Yeo (2002)	- User involvement	- Management style - Internal communication - Estimate of timeline - Definitions of requirements and scope - Project risk analysis - Vision/ Goal	- Choice of software - Degree of customization in application	- Change in design specifications
	Aladwani (2002)	- Project diversity of project team members (difference in	- Planning	- Technical complexity	- Project size

		backgrounds, experiences and skills among team members)			
	Procaccino, Verner, Overmyer and Darter (2002)	- Customer/ users involvement	- Management support - Project scope defining	- Method of requirements gathering	
	Dvir, Raz and Shenhar (2003)	- End-user involvement	- Requirements defining - Technical specifications defining - Project management implementation		
	Nguyen M. (2003)	- Project manager - Team members - Knowledge in related field - Knowledge in decision making	- Planning & estimating - Communication with customer - Quality standards & measure	-Planning software	
Other project kinds	Jang and Lee (1998)	- Clients' participation - Top management support - Functional experience of team members	- Goal defined	- Compatibility of the methodology used - Standardization of procedures	
	White and Fortune (2002)	- Senior manager support - End-user commitment	- Goal/ Objectives defined - Scheduling		- Adequate funds/ resource
	Hameri and Heikkila (2002)	- Understand of project team about project objectives	- Project planning and scheduling - React to sudden changes in the project management	- Discipline in design change control - Technological difficulty	

	Westerveld (2003)	- Project manager and team members (skills, background)	- Management support		- Project characteristics (size, uniqueness, urgency) - External environment (political, technological)
	Belout and Gauvreau (2003)	- Project personnel	- Management support - Project mission defining - Project scheduling - Communication - Monitoring and control - Trouble-shooting solving	- Technical tasks	

Table 3.2 categorized all factors influencing the success of a project from previous studies. The first group is personnel factors. This group was considered by most studies. Although there are many stakeholders related to a project, the analysis indicated that typically only the project team and customers influence the success or failure of a project. Regarding the project team, the role of the project manager and the knowledge and experience of the project team are critical. Customers are evaluated based on their knowledge, experience and involvement in the project. The second group is management factors. This factors group was also studied by many researches. The most prevalent group relates to management support, planning and the definition of project goals. The third group is technical factors involved in the software project. Previous studies considered the importance of applying methods and tools related to project results. The summary in Table 3.2 shows that the technical factors were not considered in many studies. Software projects, however usually related to technical methods like system development, life cycle methods and project management. The lack of technical factors in the previous studies shows the gap in literature of software project management. The importance of this factor group should be studied further. The last group is characteristics and resources of a project. The

most frequent factor in this group is the project size. The influences of these factors on project results are presented in the next sections.

3.4 THE RELATIONSHIPS BETWEEN CRITICAL FACTORS AND PROJECT OUTCOMES

The influence of the critical factors that classified in Table 3.2 on the project outcomes will be described in more detail. In this analysis, the relationships between personnel, technical, management and project characteristics will be identified.

3.4.1 Relationship Between Personnel And Project Success

Krishnan (1998) indicates that a higher capability of personnel in the software development team is significantly associated with both the improved productivity and quality software products. Aladwani (2002) supposed that a diversified membership may adversely affect the planning process. However, the empirical evidence in his study did not support this assumption. Chatzoglou & Macaulay (1996b) indicated that Project team member's experience, commitment, user knowledge and interpersonal communication are ranked as very important factors related to planning performance. Regarding the role of project manager, Verner, Overmyer and MacCain (1999) through interviews with the software managers, found that the capability of project managers plays an important role in project performance, especially project failure.

However, Callahan and Moretton (2001) did not find a relationship between project leader power and software development time. Regarding the role of customers, Procaccino *et al*. (2002) found that the higher the level of confidence that customers have in the project manager and development team, the more likely the project will be successful. However, the involvement of the customer in scheduling estimates does not increase the success of a project. Previous research by Dvir *et al.* (2003) concluded that user involvement should start at the first stage of the project and continue until its successful end.

Previous studies have indicated that the higher capability of project managers and team members, the better project results. The involvement of customers in the project also influences the project outcomes. Therefore in this study, the role of project manager, team

members and customer in planning are considered simultaneously in the conceptual model, so the relationships between project managers, team members and customers and project results will be examined related to project results.

3.4.2 Relationship Between Applying Methods, Techniques And Project Success

There is not much research on the application of the methods and techniques in project management. Verner, Overmyer and McCain (1999) indicated that applying appropriate and efficient techniques in the software development process would increase the chance for project success. Chatzoglou *et al.* (1997) considered the methods and techniques used in software projects influence the software development process. Their results showed that just 53% of projects apply some methodology in the development process. The application of project management methods was surveyed in the study of White and Fortune (2002). They investigated the current practice of project management in many kinds of projects. The most used techniques were the Gannt chart and project management software. The lack of research on this aspect is also evident related to the complexity and diversity in applying the types of methods and techniques.

In short, the influence of the application of methods and techniques on project results was not clarified in previous studies. In this study, this relationship is studied concerning software projects. The methods or techniques used in software projects are categorized as project management, system development and life-cycle methods.

3.4.3 Relationship Between Management Approach And Project Success

The analysis presented in Table 3.2 indicated that management approach and process factors were considered in many studies. Chatzoulog *et al.* (1996, 1997) identified management styles and available resources as important to planning and influencing performance. Kasser and William (1998) identified a list of 34 risk – indicators of an IT project. In which, poor plans was ranked a high risk factor. This was followed by "resources are not allocated well", "failure to communicate with the customer" and "lack of management support". According to Whittaker (1999), two common reasons for project failure were poor project planning and the lack of management involvement and support. Abdel-Hamid *et al.* (1999) found the positive relationship between different project goals,

software project planning and resource allocation. The difference in project goals focused on the "cost and schedule" or "quality and schedule" influenced the project outcomes. With the given specific software project goals, managers do planning and make resource allocation choices in such a way that they will meet those goals. Callahan and Moreton (2001) found the negative relationship between the involvement of supplier and sales and marketing in the early stages of design and software development time. More involvement indicated less development time. The involvement of sales and marketing is considered as a part of management support. Yeo (2002) identified the top five failure factors of a project. These include "lack of user involvement", "top-down management style", and "poor internal communication". Procaccino *et al.* (2003) considered the role of management support to project success. They did not find a significant relationship between "project manager with full authority" and "project success". However, there was a significant correlation between "project with committed sponsor" and "project success". In recent research, Belout and Gauvreau (2003) found a significant link between project mission, and management support in planning with the success of the project.

In brief, the management factors influencing project results include management support including the role of top management, involvement of the sales and marketing department, and suppliers. The availability or allocation of resources for the project is the second factor influencing project outcomes. Other aspects include project planning, project objectives and scope, management styles and communication. The results of previous studies were very consistent. The relationships between management factors in planning and project outcomes in software projects will be examine in this study.

3.4.4 Relationship Between Project Characteristics And Project Success

The remaining factors are diversified but they are related to project characteristics. In this section, the influence of project characteristics and project success is examined.

In identifying the factors that influence project outcomes, researchers usually consider the effect of characteristics of the project. The common project characteristics used in previous studies were project size, project sectors and project types. Overall the evidence suggests that project size has a negative effect on IT project success (Aladwani *et al.*, 1999). Krisnan (1998) investigated the impact of various team factors in packaged software

development. His findings indicated that the effect of product size on the field defects of software product is positive and significant. This means that the bigger product size was related to lower quality because of increased software defects. Aladwani (2002) found a negative relationship between project size (measured by number of people involved in the project) and project planning. But there is no link between project size and project success. Nguyen M. (2003) also did not find any evidence for the relationship between project size (measured by duration and number of people involved in the project) and project results.

The study of Belout and Gauvreau (2003) examined the moderating effects of project sectors and the organization structure on project success. For three types of project organization (project-based, matrix and functional structures), the correlations between variables of project mission, management support, project schedule, client acceptance, personnel, technical tasks and communication and project success were different. In the case of the matrix structure, there were significant correlations between only three of these seven factors, including project mission, management support and project schedule and project success. For the project – based structure, there were significant correlations between almost all seven factors (except personnel) and project success. Finally, in the case of the functional structure, the management support, client acceptance and communication were significant correlated with success. In short, these variables have a different impact on performance depending on the organizational structure.

In summary, previous studies considered the influence of project characteristics including project size, project sector and organization structure on project success.

3.4.5 Relationship Between Planning And Project Success

Project planning, in this study, refers to the extent to which timetables, milestones, workforce, equipment, and budget are specified (Slevin and Pinto, 1986). In Table 3.2, planning belongs to the group of management factors. According to Whittaker (1999) the most common reason for project failure is poor project planning, specifically, risks were not addressed or the project plan was weak. The empirical study of Aladwani (2002) also confirmed that there is relationship between project planning and project success.

Many factors presented in Table 3.2 are related to planning or appear only in the planning stage. Various studies demonstrate the important role of planning to project outcomes (Whittaker, 1999; Aladwani, 2002; Belout and Gauvreau, 2003; Nguyen M., 2003). Other research explores more specific aspects such as human resource, management or applied tools or techniques throughout the project life-cycle. There are two studies that examined planning in detail. First, the studies of Chatzoglou and Macaulay (1996 – 1998) considered the role of input factors such as people, management and technical methods in the requirements capturing and analysis (RCA) stage – an important task in planning. Their approach provides a comprehensive view of factors in planning that can affect the efforts during the RCA stage and throughout the whole development process. Second, the empirical study of Dvir *et al.* (2003) considered planning as composed of three major tasks: development of functional requirements; development of technical specifications and the implementation of project management. They examined the relationship between the performance of these tasks and the project results. In the following sections, these studies will be described.

3.4.5.1 MARCS model

Chatzoglou and Macaulay (1996) proposed a new approach for project planning and estimation, described as MARCS (MAnagement of the Requirements Capture Stage). The main objective of MARCS model is to provide project managers accurate predictions of time, cost and requirements of the project development process, the RCA process as a whole, as well as each interaction of the RCA separately. This should be done as early in the system development life-cycle as possible, and be based on the factors readily identifiable and measured from the beginning of the RCA process. The inputs for this model include the project, manager, development method, personnel and user characteristics. The model's output consists of two sets:

- The general MARCS model: refers to the resources of the whole project development process and to the resources of the RCA process
- The expanded MARCS model: refers to the resources of each interaction of the RCA process

From this model, Chatzoglou (1997) conducted a survey to consider the factors affecting the completion of the requirements capturing stages of projects with different

characteristics. In this model, they are described as moderating variables. The project characteristics include:

- Developing Organization (Software houses, Industry, Consultants, Academics)
- Developers (Project managers, system analyst, consultants)
- Project type (Software, System)
- The type of problem (structured, average, unstructured)
- Its applicability (tailored, generic)
- The target user (own company, external)

In the next stage of development, Chatzoglou and Macaulay (1998) modified this model. The changes were mainly centered on output variables. The modified model is displayed in Figure 3.1. In this model, the input factors include human, management, and technical factors. The outputs of this model are the allocation of resources for the development process, the RCA process and for each interaction of the RCA process.

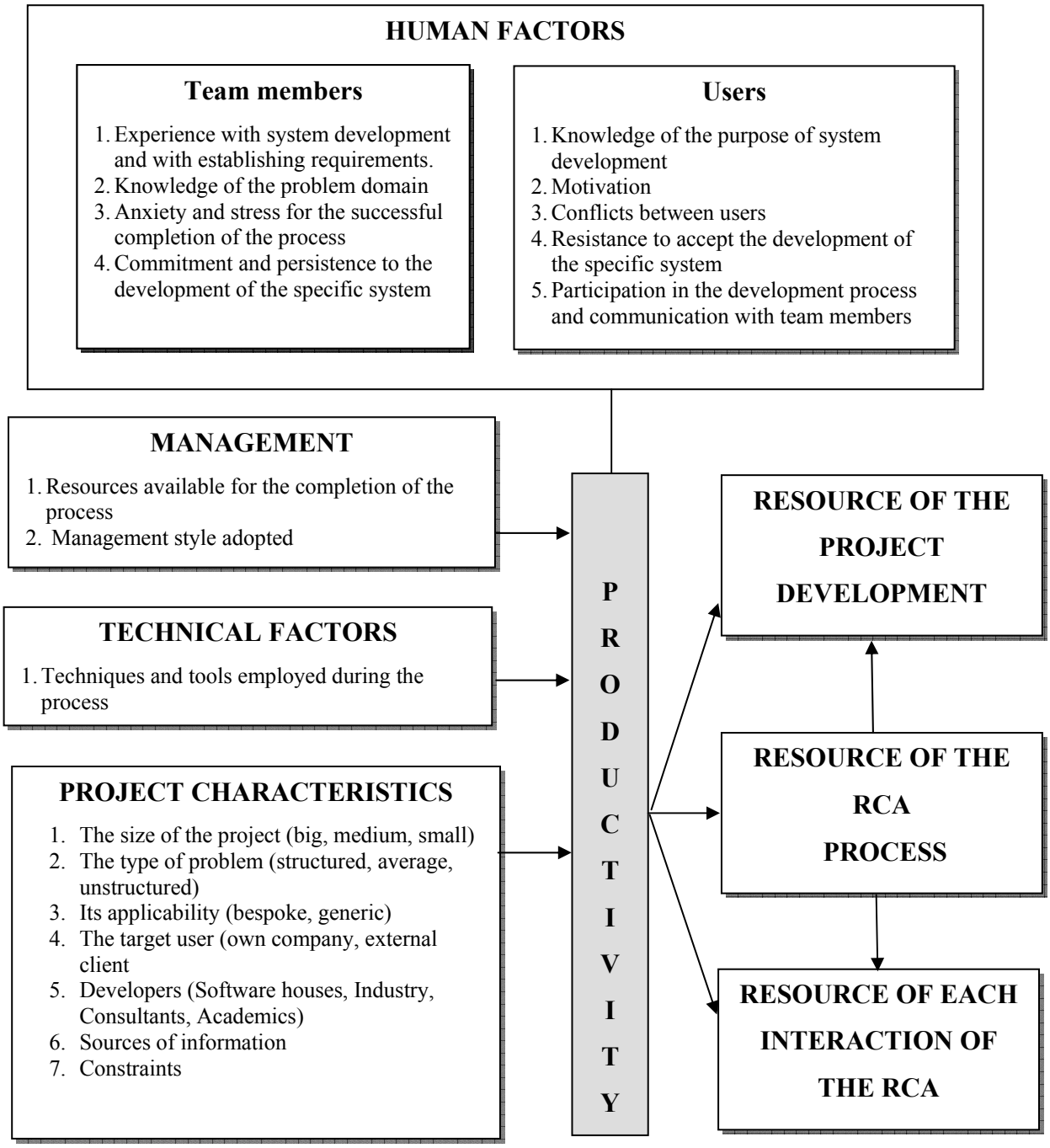

Figure 3.1 MARCS (Chatzoglou and Macaulay, 1998)

Requirements capturing and analysis (RCA) is a very important task in planning. Based on the customer requirements, the project team defines product specifications and then estimates time and efforts for the project. This stage corresponds to the steps 1, 3 and 4 of Step wise planning activities (Hughes and Cotterell, 2002) that was presented in Chapter 2. The Chatzoglou model offers a general approach to the input factors of planning that is applied in this study. The MARCS's output is allocation of resource of the whole project and RCA stage while this study centered on planning performance and project outcomes.

3.4.5.2 Planning dimensions in Dvir's study (2003)

The study of Dvir *et al.* (2003) focused on the relationship between the different aspects of project planning and project success through empirical research conducted in Israel. In this study, the planning efforts were considered by three dimensions:

- Development of functional requirements
- Development of technical specifications
- Implementation of project management processes and procedures

In the first level of planning, the functional requirements are developed. This focuses on defining the characteristics of the end product that is based on customer or end-user requirements. The next level is to develop the technical specifications. The team creates the product focused on the technical specifications of the project deliverables that are needed to support the functional requirements. Finally, at the project management level, the focus is on planning the activities and processes that need to be carried out.

Dvir *et al.* (2003) evaluated project success from the perspectives of the project team (as meeting planning goals), end-user (as end-user benefits) and contractors (as contractor benefits). To determine the relationship between planning and project success, Dvir (2003) used correlation analysis. They found important results. First, there was a high correlation between capturing and developing the functional specifications of the end product and the definition of technical specifications. They also indicated a significant positive relationship between the amount of effort invested in defining the goals of the project and the functional requirements and technical specifications of the product and project success.

Second, there was no correlation between the implementation of planning procedures and the various success dimensions. To explain this negative result, Dvir *et al.* (2003) presented their evidence. The important role of planning was emphasized heavily by commonly accepted professional standards, such as the Guide to the Project management Body of Knowledge of Project Management Institute (PMI). The assumption behind this position is that planning reduces uncertainty and increases the likelihood of project success. Currently with the advancements in computerized planning techniques and the increase in project management training, a certain level of planning is done in all projects. Therefore, there were no significant statistical correlations in the data.

Their last finding related to the project success measures. All four success-measure (meeting planning goals, end-user benefits, contractor benefits and overall project success) are highly inter – correlated, implying that projects perceived to be successful are successful for all their stakeholders.

The important contribution of Dvir *et al.* study for this research is their approach to planning. It considered four dimensions, including defining requirements and specifications; estimating project time and effort; setting the schedule and risk analysis. Their study measured Project outcomes from different points of view. These include meeting planning goals, end – user benefits, contractor benefits and overall project success.

In brief, both studies of Chatzoulog *et al.* (1996 – 1998) and Dvir *et al*. (2003) emphasized planning in software projects. Chatzoulog *et al.* focused on the influence of personnel, technical and management factors on the effort spent for requirements capturing and analysis – an important stage of planning and for the whole project as well. Dvir *et al*. centered on the relationships between the specific dimensions of planning and project success.

3.5 SUMMARY

This chapter examined the previous studies related to software project management. Through classification of the criteria used for project success evaluation from related researches, the most common criteria were identified. They include the project result in terms of time, cost and quality, and the satisfaction of customers. The relationships between planning factors and project success in previous studies were analyzed to indicate what factors are important and why they will be used in this study. These analyses also indicate the gaps in literature on planning in software project management. The technical factors were not much considered by previous researches.

The importance of planning to project outcomes was analyzed to construct the framework for this research which will be presented in the next chapter. The main criteria for project evaluation identified in this chapter will be used to evaluate the project outcomes of this research.

4

CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

The examination of literature in Chapter Three reviewed the previous studies that considered the factors influencing project results and demonstrated the important role of project planning. In the first section of this chapter, the related studies are analyzed to define the gap concerning the role of planning in project success and the factors influencing the planning process. This analysis will be used to develop the conceptual framework and hypotheses for this study, which is presented in the next section. The last section of this chapter will propose the research methodology.

4.1 PLANNING FACTORS AND PERFORMANCE

Previous studies have identified many of the critical factors which influence project results. Various significant relationships between personnel, technical and management factors and project success or failure were considered. The role of these factors should be recognized in planning software projects. The reason for this emphasis is that bad decisions or poor performance in planning will considerably influence the project results. Planning performance is evaluated based on four main tasks, including identifying customer requirements and defining product specifications, estimating time and efforts, scheduling, and analyzing risks.

Most studies have considered personnel the most vital factor for project success during project life cycle. Personnel in software project include both the project team and customers. The knowledge and experience of the project team in planning will affect planning performance, especially in defining the customer requirements and estimating the effort necessary for the project. The involvement of the customer is a factor that many studies have identified. This commitment, especially in the initial stage of the project is crucial to capture and analyze customer or user requirements and to ensure the project teams' understanding of product specifications. Management support is also documented as an important factor for project success. In software project planning, management support means the involvement and support of top management, functional departments and the sponsor. Many authors have examined the important role of clearly defining objectives and customer requirements. These activities take place in the initial stage of a project and strongly affect the development process and project results. Late changes in objectives and user requirements are costly. The choice of methods or techniques to be used in managing the project is also made in the planning stage. This decision could

influence the success or failure of a project (Verner, Overmyer and McCain, 1999; Yeo, 2002; Nguyen M., 2003).

According to the study of Sauer and Cuthbertson (2003), 97% of project managers have participated in managing the necessary requirements and specifications. They spend about 12.3% of their time in planning. However, the practice of planning is not always good. Thayer, Pyster and Wood (1981) found that poor estimates and plans are a common problem in software projects. In an empirical study in a developing country (Vietnam), 85% project managers agreed with these common problems (Nguyen M., 2003). Planning skills are also considered as important for successful project managers (Sauer and Cuthbertson, 2003).

The role of planning in a software project was studied in more detail in the research of Chatzoglou *et al.* (1997 – 1999) and Dvir *et al.* (2003). The Chatzoglou model provides a broader view of the input factors in planning such as human, management and technical factors. This model, with the acronym MARCS, offers project managers a new approach to make more accurate predictions of project time, cost and requirements of the project development process and the requirement capture and analysis (RCA). The classification of inputs in Chatzoglou model is more useful for my study on planning software projects. It provides the list of factors being considered as the inputs that influence planning which will be used to construct a conceptual framework that will be presented in the next section.

The Chatzoglou (1997) model only considers planning in the Requirement Capture and Analysis (RCA) stage of the waterfall life-cycle model. However, this model seems to be no longer appropriate for modern software development project (Verner *et al.,* 1999). In fact, the RCA stage is an interactive process during software development cycle (similar to spiral or prototyping approaches). My study will examine the influence of the input factors not on planning in the RCA stage as in the study of Chatzoglou *et al.* (1996 a, b) but throughout the whole planning cycle. The reason for this is that the software projects in my study context have much smaller size than Chatzoglou *et al.* (1996b), which were usually completed in 5 months and employed from 5 – 10 people (Nguyen M., 2003). Projects in Chatzoglou *et al*. study (1996b) were of medium size, completed within 3 years involving 30 people. In small projects, it is difficult to separate the influence of factors only in the RCA process.

If the Chatzoglou *et al*. (1999) study provided the approach related to input factors of planning, the study of Dvir *et al.* (2003) considered the major tasks of planning. It includes the development of the functional requirements, technical specifications and the implementation of the project. Dvir *et al*. (2003) examined the relationships between the accomplishment of these tasks and the project results. Their findings explain the key activities of planning stage and project success from different points of view. This approach is very useful to develop a new conceptual model for evaluating the role of planning. However, the study of Dvir *et al.* (2003) did not show which factors in planning will lead to the better development of technical specifications, the estimation of time and effort for the project or those which will increase the chance of project success.

In summary, the conceptual framework of this study will apply the classification of input factors in the planning process of Chatzoglou model (1999). The impacts of these input factors are examined in the assessment of planning performance. Then, how planning performance influences the final project outcomes will also be assessed.

4.2 CONCEPTUAL FRAMEWORK

Based on the literature analysis, a conceptual framework for evaluating the impact of input factors on planning performance and identifying the relationships between planning performance and different project outcomes is constructed. This conceptual framework is described in Figure 4.1.

The first part of this framework examines the relationships between personnel, management and the technical factors and planning. These factors are based on the study of Chatzoglou and Macaulay (1998) and builds on the synthesis of previous studies on critical factors for project success or failure. The planning process is evaluated through the performance of four main tasks: defining requirement and specifications, estimating time and effort; scheduling, and risk analysis. The second part of this framework examines the relationships between planning and project outcomes. Project outcomes are evaluated by results in terms of completion time and cost, product quality, customer satisfaction, organizational benefits and personnel benefits. This model also considers the moderating effects that project characteristics have on the relationship between input factors and planning performance. Three characteristics are considered, project size, project type and

the ownership. The assumptions and explanations of these relationships will be presented in the next section.

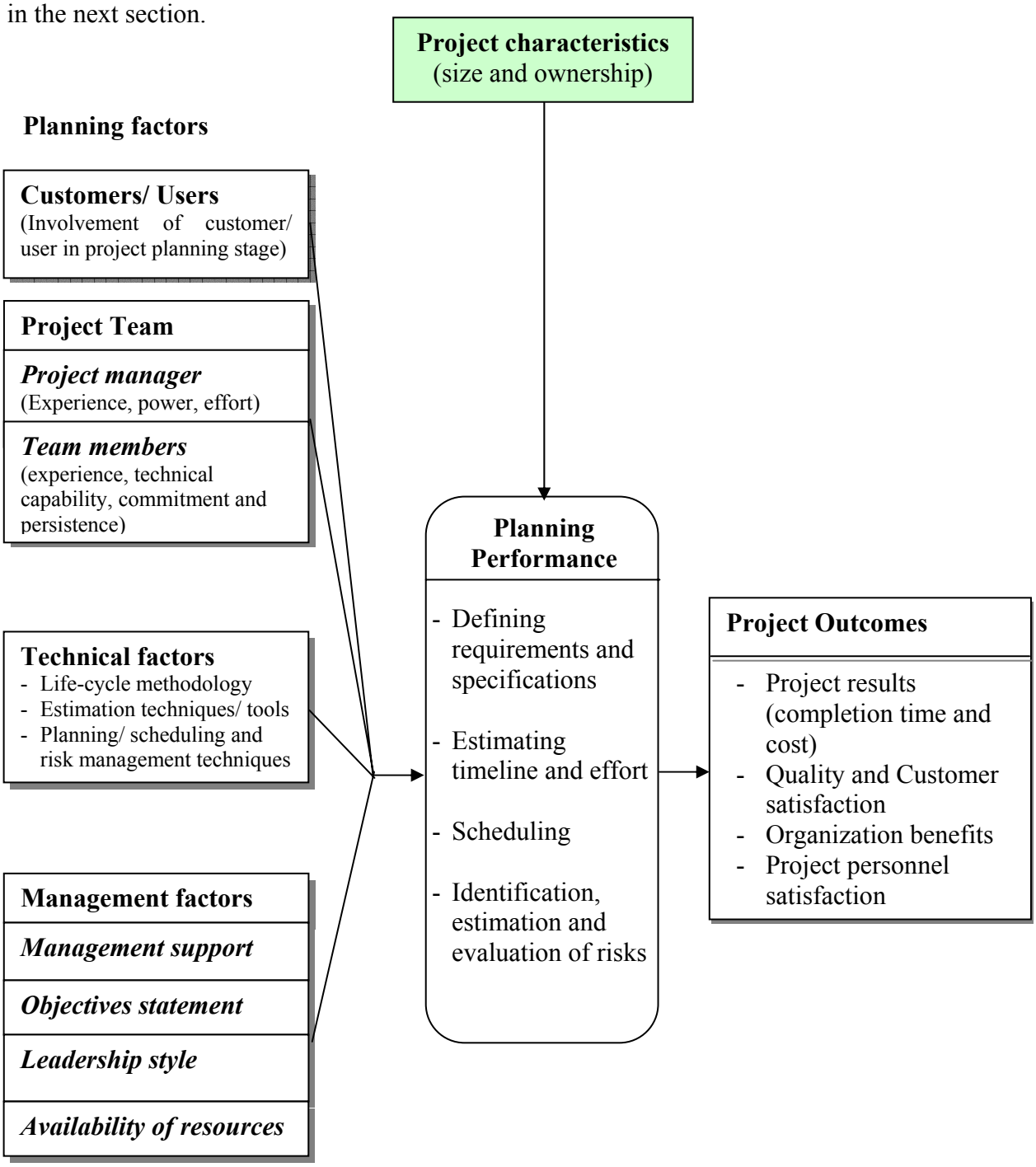

Figure 4.1: Conceptual framework of planning factors, planning performance and project outcomes

The development of the hypotheses related to the relationship between planning factors and planning performance and project outcomes is described in the next sections.

4.3 DEVELOPMENT OF THE HYPOTHESES

The important role of planning to project results is confirmed by many previous studies. This research explores in more detail the impact of different factors in the planning process. The relationship between the planning process and different project outcomes are examined. Based on the research objectives and the conceptual framework, the hypotheses of this study are specified.

4.3.1 Hypothesis 1: The Impact of Personnel Factors on Planning Performance

The human factor in the Chatzoglou model (1998) includes team members and users. However, these people have very different roles and responsibilities in a software project. From the management perspective, the project manager can control team members and satisfy the client. This model will consider human factors separately as external and internal stakeholders.

Internal stakeholders mean the members in the project team. The important role of project manager has been affirmed in past research. Verner *et al.* (1999) have found, in successful projects, the respondents did not often comment on the project manager. Over half of the unsuccessful projects encounter problems with the project manager, such as no experience, insufficient time spent on project planning and the lack of an integrated project plan. Callahan and Moretton (2001) have identified the relationship between the project leader's power and software development time. The greater the power, the shorter the development time. Nguyen M. (2003) also found the relationship between a capable project manager and potential project success.

In brief, previous studies have confirmed the influence of the project manager's effort and experience on project outcomes. Chatzoglou *et al.* (1997) considered the role of experience and knowledge of team members in the allocation of resources in planning, but did not clarify the role of the project manager.

This study focuses on planning, so the influence of project manager in terms of his effort and experience on planning performance is explored. There are two variables to be examined. The first is the effort that project managers spend for planning. Barry *et al.*

(2002) indicated that a longer project duration required, more effort for the project. In this study, it is expected that if project managers spend more effort in the planning stage, they will achieve the better planning performance. The second variable is the project manager's experience. As mentioned by Verner *et al.* (1999) and Nguyen M. (2003), the project manager with more experience will reduce the possibility of the failure of the project. The following hypotheses are proposed:

H1a: There is a positive relationship between the effort that project manager spends for the planning stage and planning performance.

H1b: There is a positive relationship between the experience of the project manager and planning performance.

Regarding the role of team members, Krishnan (1998) found that a software team with more capable staff exhibits a significantly lower number of defects in their products. The capability of personnel in the team is measured by the technical competence of the team as a whole relative to other software project teams in the firm. The assessment ranged from (1) very low capability to (5) very high capability. Defects measure the number of customer reported defects. Once customer complaints are received, they will be analyzed for their validity. A valid complaint is passed to the second level of service support for more detailed analysis. This complaint is identified as a field defect, and was collected from the central defect database of the software companies.

According to Chatzoglou and Macaulay (1996 – 1998), the project team members can affect the resource allocation in the requirement capture and analysis as well as in the whole development process. The project team members are assessed by their experience with system development, requirements definition, and knowledge of the application domain.

Barry *et al*. (2002) also considered project team skills as a variable that can influence the project effort measured by time units to complete the project requirements. Their study didn't find a link between this factor and project effort or duration. However the project team skills were rated as high or low. These results of Barry *et al*. (2002) are consistent with other studies. The skills of the project team and the effort that the project team spends

to complete project requirements could be considered as two different dimensions that influence project results.

In planning, team members have to capture and analyze the customer's requirements. These are used to define the product specifications. From this, the necessary activities for software development process are determined. For this reason, team member capability could influence the planning performance in terms of defining requirements and product specifications. The following hypothesis is proposed:

H1c: There is a positive relationship between the capability of team members and planning performance

In a software company, the most important external stakeholder is the customer. Chatzoglou (1997), proposed five determinants from the customer that could influence project planning. The first is the customer's knowledge of the purpose of the IT system and software. Second, is the customer's motivation for ordering the software. Next, is the level of conflicts between the users. Fourth, is the resistance to the development of the specific system. Finally, the participation of customers in the development process and communication with project team members is influential.

Historical data are usually unavailable for the first four determinants because the software company was not aware of the necessity to investigate them. Participation of the customers is easier to evaluate and has been discussed in many previous studies. Verner, Overmyer and McCain (1999) indicated that problems with customers and users affected nearly 50% of the failed projects. One of these problems is the insufficient involvement of the user community. According to Yeo (2002), the lack of user involvement and their inputs from the beginning are key factors related to project failure. Procaccino *et al.* (2002) indicated that the higher involvement of the customer or user, the higher the chance for project success. The study of Dvir, Raz and Shenhar (2003) also found that "end-user representatives involved in need definition" is the most important factor in the development of the functional requirements of software.
In current study, it is expected that the level of customer involvement influences the planning performance. The following hypothesis is developed:

H1d: There is a positive relationship between customer involvement and planning performance

4.3.2 Hypothesis 2: The Impact of Technical Factors on Planning Performance

Technical factors refer to the quality of techniques and tools employed and their efficient use in the planning stage. Chatzoglou (1996a) treated technical factors as one input in his model. Verner, Overmyer and McCain (1999) concluded that applying appropriate and efficient techniques and tools in the software development process will increase the chance for project success. In this study, applying the tools and techniques in the planning stage will be considered. These methods and techniques are categorized as project management approaches, system development methods and life-cycle methodology.

The application of project management techniques was surveyed in the study of White and Fortune (2002). They indicated that the Gantt chart and project management software were the most used techniques in project management. Applying project management methods or tools did not appear in the list of factors critical to the project outcomes they identified.

Regarding software projects, the system development methods and life-cycle methodology are also considered. These methods are used in the early stage and throughout the software project life – cycle. Choosing system development methods and life-cycle methodology in a software project depends on the technology of software engineering. These technologies have changed over time, from the structured approach to object – oriented programming. Today, many methods and tools are available. They range from a basic approach (like object – oriented) to more complex applications (like RUP). These methods were described in the Chapter 2. The use of these methods has not been studied in depth in previous studies. This study assumes that applying the methods or techniques in project planning with improve planning performance. The following hypotheses are proposed:

H2a: There is a positive relationship between applying project management methods and planning performance.

H2b: There is a positive relationship between applying system development methods and planning performance.

H2c: There is a positive relationship between applying life-cycle methodologies and planning performance.

4.3.3 Hypothesis 3: The Impact of Management Factors on Planning Performance

In previous studies, many management factors were examined. This study will examine the impact of management support, objective setting, the availability of resources and management style on planning performance.

Management support in planning stage

Whittaker (1999) found that a lack of management involvement and support was a cause for project failures. Verner, Overmyer and McCain (1999) also indicated that almost all of the failed projects were affected by the lack of higher level of management support. Belout and Gauvreau (2003) also confirmed the positive correlation between management support and project success. Callahan and Moretton (2001) found a significant negative relationship between the supplier, involvement of sales and marketing department and the software development time. More involvement resulted in a shorter software development time. Procaccino *et al.* (2002) identified a significant correlation between a committed sponsor and project success.

In this study, management support in the planning stage will be considered at different levels: top management support, committed sponsorship and early involvement of sales and marketing departments. The following hypothesis is proposed:

H3a: There is a positive relationship between management support and planning performance.

Objectives Setting

Clearly defining the project mission, goal and scope are very important to project success. This action should be undertaken at the very start of the software development process. Abdel-Hamid *et al*. (1999) found that different in project goals such as minimizing overruns in cost, schedule or quality and reducing overrun affects planning and resource allocation. This significantly influences project performance.

The results of Yeo (2002) also indicated that a weak definition of requirements and project scope is one of the biggest failure factors in a software project. Belout and Gauvreau (2003) found the link between the project mission defined in the planning stage and project success. In the framework of this study, the clear definition of project goals influences planning performance. Several project objectives are examined: cost and time criteria and customer oriented criteria. It is hypothesized that:

H3b: There is a positive relationship between clear project objectives and the planning performance.

Availability of resources

The availability of resources related to allocation in the project influences project results. Resources usually mean people, time and money. Chatzoglou & Macaulay (1997) found that spending less than 15% of the total time and 15% of total cost in the requirements capture and the analysis process was insufficient for the successful completion of this process. White and Fortune (2002) ranked "adequate funds and resources" as the major factor that influenced project outcomes. The allocation of resources is determined in the project plan, and availability of sufficient resources is a constraint for planning. Resources such as qualified personnel or infrastructure will be advantageous for planning. In this framework, availability is considered as an important management factor that influences planning performance. The following hypothesis is proposed:

H3c: There is a positive relationship between the sufficient availability of resources and planning performance

Project management style

Chatzoglou and Macaulay (1998) specified management style as a factor that affects the software development process. Yeo (2002) also proposed that a top-down management style can negatively influence project success. However, only in the study of Loo (2002), is this management style specified. He identified the commonly adopted leadership styles in project management, including people-oriented, participative, transformational, and situational leadership. An appropriate management style could speed up the process and motivate project team members. This will contribute to the success of a project. The pilot survey of project managers in Vietnam indicated that these styles are unknown or not

commonly used. An alternative management style is considered, such as people – oriented, work – oriented, etc. In a software project, personnel play the important role in developing products. The people – oriented style would be appropriate to this type of project. In this study, it is supposed that:

H3d: There is a positive relationship between the people – oriented management style and planning performance

4.3.4 Hypothesis 4: The Impact of Planning Performance on Project Outcomes

Whittaker (1999) indicated that poor project planning, specifically, inadequate risk management and a weak project plan are the common reasons for project failure. Project planning has a mediating effect on the link between project uncertainty and IT project success (Aladwani 2002). Poor planning in software projects in Vietnam was the most important cause of project failure (Nguyen M., 2003). Project planning is definitely affected by human, technical and management factors.

In current study, the relationship between project planning performance and different project outcomes are examined. If there is a relationship between planning and project success, the relationship of different factors related to personnel, applied techniques and the management approach in planning to final project outcomes is also determined. Dvir *et al.* (2003) considered planning through three dimensions, including the development of functional requirements, technical specifications, and the implementation of project management. Planning performance is evaluated the through defining requirements and specifications, estimating effort and time, setting schedules, and risk analysis.

To measure the outcomes, multiple criteria are used. Through a synthesis of the common criteria used for project evaluation in Chapter 3, the most frequent evaluation criteria used are:

- Project results in terms of time, cost and quality (Wateridge, 1998; Abdel-Hamid *et al.*, 1999: Dvir *et al., 2003*)
- Customer satisfaction (Wateridge, 1998; Seen *et al.,* 2001; Dvir *et al., 2003*)
- Organization benefits (Seen *et al.,* 2001; Dvir *et al.,* 2003)
- Project team members satisfaction (Wateridge, 1998)

Estimating the project duration, cost and budget, scheduling and budget are very important tasks of planning. A good project plan with accurate estimation, good scheduling and appropriate risk analysis could help the project to be completed on time and within budget. Planning performance influences project outcome in terms of time and cost. Quality and customer satisfaction are the most important criteria for the evaluation project results. In planning, the customer requirements are defined as product specifications. Besides the criteria of product quality, the satisfaction of customers depends on how much the requirements are met. For that reason, the definition of product requirements and specifications in the planning will affect product quality and customer satisfaction.

Organization and project team benefits could be categorized as financial and intrinsic benefits. Better planning performance with an accurate estimation of cost, time and allocation of resource will increase the financial benefit of the projects. Financial benefits are defined as the benefits in money for both the parent companies and project teams. Explicit requirements and specifications of the software product will contribute to the qualitative benefits of a project. Non – financial benefits include improving the company image, enhancing the project team capability, customer satisfaction. This study expects that planning performance is related to the accomplishment of project outcomes and the possibility of project success. It is proposed that the better the planning performance, the lower the project completion time and cost. The following hypotheses will be tested:

Hypothesis 4a: There is a positive relationship between effective planning performance and project success

Hypothesis 4b: There is a positive relationship between effective planning performance and the project's financial benefits

Hypothesis 4c: There is a positive relationship between effective planning performance and project's qualitative benefits

Hypothesis 4d: There is a negative relationship between effective planning performance and project completion time

Hypothesis 4e: There is a negative relationship between effective planning performance and project completion costs

4.3.5 Hypothesis 5: The Impact of Project Characteristics on Planning Performance

The essence of relationships between planning factors, planning performance and project outcomes can differ between projects with different characteristics (Chatzoglou, 1997a, 1998; Krishnan, 1998; Aladwani, 2002 and Westerveld, 2003). Project characteristics that were commonly considered in previous studies included project size, type, target user, and sectors.

Although the study of Nguyen M. (2003) indicated that there is no difference between projects with different sizes, but the project size in that study is small and measured by number of people in project team. The common measurement for project size is number of man – month spent for the project. This data, however, was not recorded in all projects, especially small ones. Using the duration of project and number of people involved in project team to measure project size could confirm similar results as previous studies. It is assumed that projects with a longer duration will be difficult to control and manage. In planning also, it is difficult to estimate the effort and risk for the project with longer duration and more people participate. This study considers project size as a project characteristic that influences planning performance.

Software projects are developed by different types of software companies. The companies are classified by their ownership, such as foreign and local. It is expected that there are differences in the management process and technology between foreign and local companies. These differences could influence planning performance. It is assumed that the differences (if any) come from technology and management process transferred by foreign partners.

In brief, there are three project characteristics that will be considered as factors influencing the planning performance. These are project duration, project type and project ownership. The following hypotheses are proposed:

H5a: There is a negative relationship between project size and effective planning performance.

H5b: There is positive relationship between project ownership (international company) and planning performance.

4.4 OPERATIONALIZATION OF THE VARIABLES

The operationalization of variables in the study is done in two steps. In the first step, the measurements for the constructs that have been developed in the conceptual framework are defined. In the second step, the items of each construct are specified to define the variables.

The constructs include:

- Project manager effort
- Project manager experience
- Team member knowledge, experience and attitude
- Customer involvement
- Project management method
- System development method
- Life-cycle method
- Management support
- Objective of the project
- Resource availability
- Management style
- Planning performance
- Project outcomes
- Project characteristics

The types of scaling for these constructs are both nominal and interval scale. The methods or techniques applied in the project, including *project management method, system development method, and life – cycle method* and the project characteristics such as *project duration, project type and project ownership* use the nominal scale.

A five point Likert scale is developed to measure most of the constructs. The scale used in these measures is modified to meet the specific purpose of each construct. The following constructs used this scale: *Project manager effort; Project manager experiences; Team*

member ability; Customer involvement; Management support; Project objective; Availability of resource; Management style; Planning performance; Project outcomes.

The scale used to measure *Completion time and Completion cost* of the project is a four - point scale. It includes 1 = ahead of schedule/ budget; 2 = On time/ within planned budget; 3 = Over 30% behind schedule/ cost overrun; 4 = Over 50% behind schedule/ cost overrun.

Time and effort spent for planning is measured by "% of elapsed time" and "% of total involved in the whole project".

The nominal scales that indicate the background characteristics of the software companies and projects are also specified. These items covered Location (Location); Enterprise ownership (*Local or Foreign*); Year of foundation (*Company age*); Number of employees (*Company size*); Field of products (*Products*); Clients location (*Clients*); Software project type (*Project type*); and the Number of people involved in project (*Project size*).

The summary of these measurements is presented in Appendix C, Table 4.1

4.5 VARIABLES RELATED TO PLANNING FACTORS AND PLANNING PERFORMANCE

Dependent variable: Hypothesis 1 – 3

The dependent variable for Hypothesis 1 through Hypothesis 3 is *Planning Performance*. As described in the conceptual framework, planning performance is measured through the implementation of the four tasks of planning, including defining requirement and specifications, estimating cost and time, setting the schedule and risk analysis. Respondents were asked to indicate how they evaluate these tasks in planning. A five – point rating scale is used, in which 1 = very poor; 2 = poor; 3 = average; 4 = good; 5 = very good. As alternative, we recode also the Planning performance variable as a dummy variable, in which 4 and 5 are recoded as 1 that represents the satisfied planning performance and 1, 2 and 3 take the zero value that represents the dissatisfied planning performance.

Independent variables: Hypothesis 1 – 3

The independent variables for Hypothesis 1 through Hypothesis 3 include: project manager experience, project manager effort, team ability and commitment, customer involvement, applying project management method, applying system development method, applying the life-cycle method, management support, project objectives, availability of resources, and management styles.

Project manager experience represents the level of management experience of the project manager or team leader. This experience assessed managing teams, communication with the customer and technical knowledge and skills applied in the initial stage of a project. The project manager's experience is measured by the five – point rating scale, in which 1 = very low; 2 = low; 3 =average; 4 = high; 5 = very high.

Project manager effort represents the level of effort that a manager spends for project planning. The effort is revealed through the activities the manager carries out for project planning and the extent of control of product specifications. The effort of the project manager in the project is evaluated by a comparison to other projects management experience. A five – point rating scale is used for these items, in which 1 = much lower; 2 = lower; 3 = equal; 4 = higher; 5 = much higher.

Team member's ability and commitment represents the knowledge and experience of project members in analysis of requirements, system development and their commitment in planning. These items are evaluated by the project manager through a comparison to work requirements. A five – point rating scale is used, in which 1 = very low; 2 = low; 3 = average; 4 = good; 5 = very good.

Customer involvement indicates the level of participation of the customer in planning. It is evaluated by the project manager. A five – point rating scale is used, in which 1 = very low; 2 = low; 3 = average; 4 = good; 5 = very good.

The project management method specifies the application of a specific project management method in the project. This is a dummy variable with 1 = Yes (applied) and 0 = No (not applied).

The system development method identifies a specific method that was applied in the project. The most used method is determined. The variables then are formed from these most frequently used methods. They include object – oriented and RUP method. These are also dummy variables.

The life-cycle method indicates a specific method that was applied in the project. The most frequent life-cycle methods are chosen to form the variables. They are waterfall and spiral model. This is also a dummy variable.

Management support represents the extent of support from different internal and external stakeholders that are related to the project. They include top management, sponsor, sale and marketing department of the software company, the functional departments of the client. The involvement of these stakeholders is evaluated separately. A five – point rating scale is used for these items, in which 1 = strongly disagree; 2 = agree; 3 = neutral; 4 = agree; 5 = strongly agree.

Project objectives indicate the level of importance of the different outcomes that the project wants to achieve. The common objectives are listed and respondents are asked to rate the importance of each. Two variables named "Cost and time oriented" and "Customer oriented" were established. A five – point rating scale is used for these items, in which 1 = very unimportant; 2 = unimportant; 3 = neutral; 4 = important; 5 = very important.

Availability of resources identifies the level of four important resources used in a project, including manpower, time, budget and infrastructure. A five – point rating scale is used for these items, in which 1 = very unimportant; 2 = unimportant; 3 = neutral; 4 = important; 5 = very important.

Management style specifies the extent of applying different management styles in the planning of a project. Three decision making styles and two leadership styles are considered. The definitions of these styles are different from what was proposed in the conceptual framework. The pilot survey indicated that respondents didn't know or apply the styles identified by past research, such as people-oriented, participative, transformational, and situational leadership. These styles are modified and respondents are

asked to rate the level of use of these styles. The variables then are formed from the most frequently used methods. This is set up as a dummy variable.

4.6 VARIABLES RELATED TO PLANNING PERFORMANCE AND PROJECT OUTCOMES

Dependent variables: Hypothesis 4a – 4e

The dependent variables for Hypothesis 4 are project outcomes. They include project success, qualitative benefits, financial benefits, completion time and completion cost

Project success represents the level of success is evaluated from different points of view, including the project team, parent company, customer and sponsor (if available).

Qualitative benefit identifies the extent of the contribution of the project results on the qualitative benefits of the software company such as enhancing the image of company or improving the team member capability.

Financial benefit indicates the extent of the contribution of the project results on the financial returns for the software company and the project members.

Completion time specifies the level of accomplishment within time of the project.

Completion cost identifies the level of accomplishment within the budget of the project.

The scale of these dependent variables has been described in the previous section. We have also recoded them as binary variables. For project success, qualitative benefits and financial benefit, values of 4 and 5 are changed to 1 that represents the satisfaction outcomes, values of 1, 2 and 3 are changed to 0 that represents the dissatisfaction. Regarding completion time and completion cost, values 1 and 2 are recoded to 1 as the satisfaction outcome and values 4 and 5 are changed to 0 that represents the dissatisfaction outcome.

Independent variable: Hypothesis 4a – 4e

The independent variable for hypothesis 4 is *planning performance* that indicates the level to which the performance of the four main tasks of planning is accomplished.

4.7 VARIABLES RELATED TO PROJECT CHARACTERISTICS AND PLANNING PERFORMANCE

The dependent variable for hypothesis 5 is the same for hypotheses 1 – 3, that is planning performance. The independent variables for hypothesis 5 are also the same for hypotheses 1 – 3; with three more variables added. These are project size, type and ownership. These characteristics are treated as dummy variables. For project size, value of 1 is assigned for the below average size group and 0 is assigned for the above average size group. For project ownership, value of 1 denotes a project of the foreign company and value 0 denotes a project of local company. Only most frequent type of made – to – order is chosen for project type variable. The value of 1 is assigned for a made – to – order project and value of 0 for the others.

To examine the moderating effect of the project characteristics on the relationship between planning factors and planning performance, the interaction variables are established. These variables are defined by product of planning factor variables (independent variables) and project characteristics (moderating variables).

4.8 STATISTICAL METHODS

This study uses various statistical techniques to analyze the results of the survey. The descriptive statistics are used to indicate the status of planning in software projects presented in Chapter Seven. In chapter eight, we test by mean of several t – tests the differences in planning performance according to different characteristics of the project. The independent-samples t – test is used for examining the different between two groups of project size (below and above average size) and project ownership (local and foreign company). The ANOVA analysis is applied for testing the different between three groups of project type (commercial, made-to-order, and outsourcing). The results of this analysis are presented in Chapter Eight.

For testing the proposed hypotheses of relationships between planning factors, planning performance and project outcomes, two regression analysis techniques are used: the classical multiple regression model and the binary logit regression model.

Three models are developed to test Hypotheses 1 – 5. Specifically, the Model 1 named the importance of planning factors which is used to test the sets of Hypotheses 1 – 3 predicts the impact of planning factors on planning performance. The results of relationship analysis are presented in Chapter Nine. Mathematically, Model 1 is expressed in Figure 4.2.

Model 1: **The importance of planning factors**

PLAN = f (H_1, H_2, H_3, H_4, T_1, T_2, T_3, T_4, T_5, M_1, M_2, M_3, M_4, M_5, M_6)

where: PLAN = Planning performance

H_1 = Project manager experiences

H_2 = Project manager efforts

H_3 = Team member ability and commitment

H_4 = Customer involvement in planning

T_1 = Project management method

T_2 = System development method 1 (Object - oriented)

T_3 = System development method 2 (RUP)

T_4 = Life-cycle method 1 (Waterfall)

T_5 = Life-cycle method 2 (Spiral)

M_1 = Support from top management and functional department

M_2 = The importance of Project objective 1 (Cost & time oriented)

M_3 = The importance of Project objective 2 (Customer oriented)

M_4 = Availability of resource

M_5 = Applying level of management style 1 (People oriented)

M_6 = Applying level of management style 2 (Work oriented)

Figure 4.2: Model 1: The importance of planning factors

Model 2 analyses the importance of planning with 5 variations and is used to test Hypothesis 4a – 4e which predicts the causal relationship between planning performance and project outcomes and success. Mathematically, Model 2 is expressed in Figure 4.3.

Model 2: **The importance of planning**

Model 2a: **Impact of planning performance on project success of a software project**

OUT1 = *g1*(PLAN)

Model 2b: **Impact of planning performance on Qualitative benefits of a software project**

OUT 2= *g2*(PLAN)

Model 2c: **Impact of planning performance on Financial benefits of a software project**

OUT 3= *g3*(PLAN)

Model 2d: **Impact of planning performance on Completion time of a software project**

OUT 4= *g4*(PLAN)

Model 2e: **Impact of planning performance on Completion cost of a software project**

OUT 5= *g5*(PLAN)

where:

PLAN = Planning performance

OUT 1 = Project outcome 1 (Project success)

OUT 2 = Project outcome 2 (Qualitative benefits)

OUT 3 = Project outcome 3 (Financial benefits)

Figure 4.3: Model 2: The importance of planning

Model 3 is developed to test the effects of the *Project characteristics* on the planning performance. The variables of project size (SIZ), and project ownership (OWN) are added into the model. Mathematically, Model 3 named the role of project characteristics is expressed in Figure 4.4.

Model 3: **Impacts of Project characteristics on Planning performance**

$$\textbf{PLAN} = k(H_1, H_2, H_3, H_4, T_1, T_2, T_3, T_4, T_5, M_1, M_2, M_3, M_4, M_5, M_6, SIZ, OWN)$$

where: SIZ = Project size

OWN = Project ownership

Figure 4.4: Model 3: The role of Project characteristics

4.9 DATA COLLECTION

4.9.1 Sample Sources

The information used for this study includes both primary and secondary data. The unit of analysis in this survey is a software project. However, the population frame is based on the list of software companies. There are some available lists of software companies, such as the Yellow Pages, Vietnam Software Association (VINASA) and Vietnam IT Directory. Among them, the Vietnam IT Directory (2002) is the most complete. Therefore, collecting secondary data in both exploratory and in – depth studies, the information was collected from this source. This database provides the information of Name, Address, number of employees, ownership of software companies. Based on this list, about 375 companies were really involved in software development activities in the whole country, of which about 265 were located in Hanoi and Hochiminh City. Data was collected from these two locations.

4.9.2 Questionnaire Design and Pre – test for the Exploratory Study

To address the research questions of this exploratory study, a quantitative survey was conducted using a self-administered questionnaire. First a pre-pilot survey was conducted by interviewing project managers in five software companies. The purpose of the pre-pilot is to understand the language of programmers in term of project management and to collect their ideas concerning the research issues. Then a questionnaire was developed and revised through a pilot survey with ten managers of software projects. The sample for pilot survey

was chosen by convenient method. However, it covered both local and foreign software companies with different size. The pilot survey was designed to ensure all the questions were clearly understandable without further explanations.

The revised questionnaire includes 20 questions that explored the following areas:

- information about the respondent, the project and the company
- project management practices (focused on team, quality, and time management) and major problems in managing the software project.
- the criteria used for evaluating project outcomes
- the critical factors influencing project success

The questionnaire is displayed in the Appendix A1 and the list of companies in this exploratory survey is shown in Appendix B1.

Once the questionnaire was reviewed, 120 copies were sent to project managers in software companies by mail. 55 accepted responses were received from 46 software companies. Some larger companies (with more than 100 employees) provided more than 1 response. A few responses with missing data have been excluded from this sample.

4.9.3 Questionnaire Design and Pre-test for the In – depth study

The in – depth survey to identify the role of planning in software project management was conducted through two steps. The first is a pilot survey using by in-depth interviews with the 13 project managers or executive managers of software companies in two locations of Hanoi and HCMC. They were asked to describe the most recent project in which they have participated. Most questions were open-ended, but followed the framework developed for this study. The interviewees in this in – depth interviews are come from both local and foreign companies. The selection was based on convenient method however the sample should cover software companies in both local and foreign sectors and with different size. Most of popular software companies like FPT, CMC, PSV and TMA were included in this sample. The goal of this interview is to provide the understanding of project management in software companies for questionnaire design and qualitative analysis.

Based on the conceptual framework, measurements presented in previous sections and interviews, a questionnaire with 35 questions, including 90 variables was designed. The respondents for this survey were project managers or team leaders. Top managers and customers (if available) of the project were interviewed to consider the different point of view on issues such as the involvement of customer or user, the satisfaction of customer, the support of the top manager and the success of the project. This questionnaire was translated into Vietnamese, except for the well-known technical terminology.

The collected data consists of:

- Background data of the software companies (name, location, number of employees, products, clients)
- Background data of the software projects (name, type of project, clients, project duration and cost, number of people involve in project)
- People in project planning (experience and authority of project manager; knowledge, experience and commitment of team members; involvement of customer)
- Techniques in project planning (application of method/ tools/ software in project management; system development and life-cycle software development model)
- Management in project planning (management support; objective statements, leadership style; communication methods and goals; availability of resources)
- Planning performance in software projects (in terms of defining requirements and technical specification of software product; estimating timeline and cost; scheduling; analyzing risks)
- Project outcomes (in terms of time, cost, quality of delivered product, customer satisfaction, organization benefits and project personnel satisfaction)

This questionnaire is presented in Appendix A2. The results of these in-depth interviews are also used for the qualitative analysis in Chapter 6.

4.9.4 Sample Size and Collection Method in the In – depth study

According to Neuman (2000), the sample size of small population should be rather large, i.e about 30% of the population size. Applying this rule, sample size for our survey would be 80. In this case, an empirical research is conducted to apply the conceptual model of the

relationship of factors of people, management and tools to planning performance and to project results. With this emphasis, the questionnaire is designed to collect detailed information from a specific software project.

This survey is conducted by using a self-administrated questionnaire, distributed by mail or email and contact to respondents, or by giving it and collecting it later. Similar to the exploratory study, the response rate of mail survey is very low (about 8%). Many software companies that were selected randomly in the list were not still existence or not focused on the software activities as their describing. Therefore, the snowball method was applied to reach the respondents. The initial project managers were asked to suggest other potential respondents. The author got a lot of supports from project managers in various software companies. Through their introduction, the new samples were selected. The response rate of this method is much higher than mailing (about 60%).

Totally 400 questionnaires were distributed by random mailing and snowball method. 80 qualified responses from software projects were received from 65 software companies (20%). Some companies sent more than one response (from different software projects). This sample size is acceptable according to suggested by Newman (2000). The "representativity" of the sample will be examined through comparing the background of the sample and the population. This will be presented in the Chapter Seven.

4.9.5 Sampling Errors

The estimates from a sample survey are affected by two types of errors: (1) non – sampling errors, and (2) sampling errors. Non – sampling errors are the results of mistake made in implementing data collection, such as inability to obtain information from different persons in a sample. In the survey questionnaire, there is a question that should be answered differently by different people such as project managers, top managers and project clients. In some projects, I could not assess all these persons, so the question was answered through the evaluation of the project manager. The other errors include differences in question interpretation, in ability or unwillingness of respondents to provide accurate information, inability to recall information. For these types of error, the data collection method by interviewing in this study could reduce them. Except some responses received by mail or email, most of data were collected through interview. Some sensitive questions

related to revenue, specific clients were not in the questionnaires to help the interviewees fell free to answer. Some non – sampling errors relate to data analysis such as processing errors, imputation errors. Although numerous efforts were made during the implementation of this survey to minimize this errors, non – sampling errors are impossible to avoid completely and difficult to evaluate statistically.

Sampling errors, on the other hand, can be evaluated statistically. The sample of software companies selected in this study is only one of many samples that could have been selected from the same population. Each of samples would yield results that differ somewhat from the results of actual sample selected. In this study, to examine the representative of the sample, the characteristics of the current sample will be compared to the other studies' and population information. However, this comparison is limited because there is only some characteristics of the population such as company ownership, size, age are available. Another comparison is the comparison between 2 sub-samples that extract from the original sample of this study. Because the data were collected in a quite long time, the 20 last samples that collected in the beginning of the year of 2004 will be compared to the first 60 samples. The results of these comparisons will be presented in Chapter 7.

4.10 SUMMARY

This chapter discusses the research design relevant to this study. The design included the conceptual framework, development of the hypotheses, operationalization of variables, statistical methods and sampling.

The conceptual framework and hypotheses were developed based on the analysis of previous research. This analysis determined the gap in the literature on software project management, especially the role of planning. The conceptual framework is used to develop the hypotheses that will be tested. The constructs used in conceptual framework were generalized, not specifically for the Vietnamese context. Most of the variables were operationalized by adopting measures developed in previous research. The multiple and logistic regression models will be used for hypotheses testing are also presented. The sampling method in this study is integrated between mailing (and receiving randomly) and snowball method. The sample of 80 projects was collected, mainly in which come from the snowball method.

5

PLANNING IN SOFTWARE PROJECTS – A CASE STUDY OF THE FINANCING AND PROMOTING TECHNOLOGY CORPORATION

5.1 INTRODUCTION

This chapter will describe the planning process in a specific software project in the leading software company in Vietnam. This qualitative analysis brings the real case that helps to understand how an actual project plan works. The chapter begins with methodology for conducting the in – depth interview. It is followed by background of the company. In the next section, the project planning process is described. The last sections present the project outcomes and the relationship between planning and these outcomes.

In – depth interviews were conducted with 13 project managers of software companies in Hanoi and Hochiminh City (the Questionnaires for this survey is presented in the Appendix A3). Through these interviews, the project managers described their projects, and defined the influences of key factors on planning performance and outcomes. They also explained these relationships. These interviews provide information for qualitative analysis that support or explain the quantitative results. A leading software company in Vietnam was chosen for an in – depth case analysis in this chapter. The Financing and Promoting Technology Corporation (FPT) agreed to participate. The impact of the performance of real software projects will help to describe planning in practice and explain the relationships that related to performance. The analysis will be conducted based on the Step wide planning framework of Hughes and Cotterell (2002) that was presented in Chapter Two.

5.2 THE FINANCING AND PROMOTING TECHNOLOGY CORPORATION (FPT) – AN INTRODUCTION

FPT is a large local joint – stock company that mainly operates in IT. Founded in 1988 with only 13 employees with a head office located in Hanoi, FPT Corp. has grown to 2045 employees. It operates six business units, including software development which is its main focus, system integration, distribution, internet service, computer manufacturing and software professional training service with many branches in Hochiminh City, other provinces as well as representative offices in the USA, Japan, and India.

FPT has focused on software engineering since 1990 for both local the market and export. Also in 1990, the Software Development Center was established for a new direction. By the end of 2003, FPT had 800 employees in software units and is the largest software producer in Vietnam. FPT has re-structured its software development activities into two subsidiaries, FPT Software Company (FSOFT) and FPT Software Solutions Company (FSS). FSOFT concentrates on the outsourcing market abroad, and FSS provides the Solutions and Software services to business units and government organizations in Vietnam and the Asian region.

Both FSOFT and FSS employ an advanced quality assurance system to insure customer satisfaction, FPT Software has become the first Information Technology Company of Vietnam to achieve the ISO 9001:2000 certificate. In 2004 it became one of the first companies in Asia to achieve the SEI CMM 5 certificate. Also, FSOFT has also conducted a program for Insight management, which is highly appreciated by customers. In addition, FSOFT is determined to achieve other international standards such as CMM Integrated and Six Sigma. Based on business requirements, the quality certificates have helped FSOFT build and maintain customer relationship.

With more than 15 years in software development, FPT Software has done work for major clients in the local market like Citibank, Deutsche Bank, HSBC, Vietnam Industrial Commercial Bank, Stock Exchange Centre, VMS Mobile phone Company Ministry of Finance, General Department of Taxation, State Treasury, and Vietnam Airline. The overseas customer list includes many

leading firms like Harvey Nash (UK); WinSoft (Canada); ProDX, Ambient (USA); NEC, Hitachi Soft, Nissen, Sanyo Electric, and NTT-IT (Japan).

FPT Software has gained many awards like "The Most Credible IT Company" awarded by PC WORLD Vietnam for 6 consecutive years from 1998 to 2003 and "The Best Software Exporter" awarded by the Ministry of Trade of Vietnam in 2003. This company is still the leader in IT sector in 2005 (HCA, 2006)..

5.3 PROJECT CHARACTERISTICS

With an advanced quality assurance system and the professional staff, the management of software project development in FPT Software has been standardized. Project managers and developers are provided with the necessary tools, methods and training for their work. FPT Software is one of few professional software developers in Vietnam. The evaluation of project managers concerning the role of different factors of project planning and their impact on project outcomes were drawn from this context.

Although FPT Software is strong in both outsourcing software and build – to – order projects, in this case study, the analysis of a typical build – to – order project will be assessed. It is not a strategic project with a major investment, so it can represent many other projects of FPT. Through this project, the process and methods of project management in FPT Software will also be described.

The project selected for analysis is to develop software for Hospital Administration made to order for a state hospital in Vietnam. This project was implemented by the FPT Software Branch in Hochiminh City. Because of the requirement of the interviewee – the project manager of this project – the name of client was not disclosed. This project was planned to be completed in 18 months. The schedule was met but the actual cost for the project was over budget by 140%. The total number of people involved was 7 developers, for which coding was the largest effort (6 persons). Planning included only 1 person – the project manager. In this project, the FPT team implemented the whole process, from defining customer requirements to deployment and maintenance.

The project manager of this project was has had 5 years of experience in project management and has managed over 10 projects.

5.4 PROJECT PLANNING

Project planning is the first stage of a project. Planning was implemented by the project manager. The content of the project plan included 7 steps. The first step is the overview of the project in which the characteristics, software delivery, scope, and related documents were described. The second step presented the project organization, team and procedures to coordinate with other units. The third step specified quality management including criteria and control procedures. The fourth step described the project process and schedule with specific milestones. The fifth detailed the project configuration. The last steps considered resources and risk management.

The time allocated for planning this project was one month with only one person; it accounted for 0.75% of total effort spent for the project. This effort is very small as compared to the average of 22% of surveyed projects. The main activities of the planning are presented in the next section.

5.4.1 Defining The Customer Requirements , Scope and Objectives

Based on the customer proposal, the initial requirements were defined. In the initial meetings between the client and project team (usually the project manager), the scope and objectives were identified. The client's objective for this software was to improve the management system of the hospital, reduce the procedures for customers – patients, and better manage the clinical records. The first objective was to deliver good quality software that met the customer's objective. The project team also set their own objectives, such as return from the project, and to gain potential customer from other hospitals through developing this software. Although both sides obtained an agreement for the general objectives of the project, there were still differences in defining the specific features of the software. Because the customer had little experience in office management and software, they could not clearly define their requirements for the software in hospital management. To deliver the customer the best product to improve their operations management, and to define the customer requirements and product specifications, the project

team had proposed to change some requirements with the agreement of the customer. Therefore, the requirements of this software were defined by both the project team and the customer. The risk management procedure of FPT was presented for the customer's agreement. This procedure was to minimize the changes like customer requirements or late collection of information throughout the whole software development process.

The main objective of the project was to satisfy the customer. To evaluate the project results, many quantitative criteria were identified. These objectives followed the Quality Assurance (QA) criteria, the key expected results were:

- Actual project time: not over 120% of plan
- Actual project cost: not over 130 % of budget
- For unit test or system test: not over 2 errors/ man – month
- For customer test: not over 1 error/ man – month

The QA includes many criteria to control the quality of a project. Depending on the characteristics of a specific project, the project manager could consider how to apply these criteria to the project. In this project, the project manager selected about 80% of QA requirements of the company.

5.4.2 The Project Manager's Authority and Project Infrastructure

In this project, the project manager had full authority to decide all issues related to the project like selection and assigning the personnel, dealing with customers, project financing, subcontracting and the decision to continue or cancel the project. The initial project budget could be approved by project leader or the Board of Directors depending on the importance or the level of resource utilization. When there are changes in the plan that require more resources (personnel or finance), the project manager needs to get approval from top management. The project team could also require support from other functional departments through the Product manager or Board of Directors. However, in this project, after the contract was signed, the Sales and Marketing department did not participate in any stage of the software development. With the described

authority, the project manager evaluated that it was enough to help him handle the project's issues.

Defining the project infrastructure included the selection of team members, and defining communication methods. The selection of project team members was implemented by the project manager based on the work. In the schedule, the project manager defined who would be involved in specific tasks and at a specific time.

The methods of communication with the customer and within the project team were also defined in the plan. The most common communication methods in this project were meetings and email. Email was used to inform and communicate with the project team, and meetings helped to solve the project problems, review the progress of team members and motivate the team. The minutes of meetings with the customer and the reviews of project team meetings were recorded by a specific department in FPT.

5.4.3 Analyzing The Project Characteristics

The general purpose of this analysis is to ensure that the appropriate methods were used in the project. The methods that are reviewed here concern the project management, system development and the project life cycle.

Like all software projects of FPT, this software project applied the management process designed by FPT Software. This process based on the Microsoft Solution Framework. The project team also used MS Project software and templates designed by the company to support project management. The common tools used in this project included the Gannt chart, resource allocation and time sheets to manage the time spent by developers for the project.

The life cycle method used for this project is Prototyping. This method was selected because of the lack of experience of the customer. This was the first time the customer would be applying management software to their services by an outsource contract. The lack of customer's experiences could lead to difficulties in defining their requirements or to change during the

project duration. The project team could face risks if they chose the traditional methods like waterfall in which the requirements are fixed and the experiences of software team specified. The prototyping method reduces the uncertainty by conducting experiments in the design.

The development system method applied in this project was Object – oriented using UML (Unified Modeling Language)*. Without experience in software development, the customer was not involved in the decision to choose these methods. The project manager took responsibility for this choice.

5.4.4 Identifying The Project Activities And Estimation

Based on the proposal of the customer and the pilot survey of their activities, the product specifications and project activities were defined. In this project, the manager selected the Use-Case - Point (UCP) to estimate the effort for the project. The UCP system was developed by FPT Software and applied for their projects. The number of man-months was calculated on the basis of use-case and the cost of project was estimated. Based on experience, the project manager defined and estimated the human resources needed for analysis and design, coding, testing, and deploying. According to this project manager, the effort for analysis and design accounted for 30%, coding 40% and testing 30%.

In the master plan, the schedule with important milestones based on the required output to the customer was defined.

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* The Unified Modeling Language (UML) is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems. The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems. The UML is a very important part of developing object oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects. Using the UML helps project teams to communicate, explore potential designs, and validate the architectural design of the software (http://pigseye.kennesaw.edu/~dbraun/csis4650/A&D/UML_tutorial/what_is_uml.htm)

5.4.5 Identifying Activity Risks

A risk plan was established to manage changes in the projects. In this plan, the potential risks were listed. The solutions to prevent or overcome these risks were proposed in the plan. The planner could refer to the risk database established by FPT Software. The risk management plan was reviewed and updated weekly. In fact in this project, there was a risk in the information collection and deployment stage. Because of the complexity of customer activity, the duration of collecting data for defining the product requirements and specifications was extended compared to the plan. Time for deploying this software to actual activities of customer was also longer than planned. However these changes were estimated in the plan, the project manager also had to increase time and effort of the project team to meet the planned time. The actual cost of project therefore exceeded the budget. The causes of these risks were mainly the responsibility of the customer, so this project manager negotiated the agreement with the customer to share this excessive cost.

5.4.6 Allocation Of Resources

After estimating the effort and time for the project, the task list was established. This task list was based on template files designed by FPT Software. This list included the job description for each position like the project manager, technical leader, tester and developer. The training documents were attached to this task list. In this task list, the responsibility of team members was defined by RADIO principle, with R is Review, A is Approve, D is Do, I is Inform and O is Omit. With this task list, personnel allocated for a specific task at a specific time.

5.5 THE EVALUATION OF PLANNING PERFORMANCE AND PROJECT OUTCOMES

In the plan of this project, the list of project activities, schedule and workforce assignment were defined. To evaluate this plan, four criteria of planning performance are considered. The first is the analysis and defining of product specifications. The project manager evaluated the customer requirements were understood but defining the product specifications was not very good. The

second is the estimation of effort, time and cost for the project. This was an accurate estimation. The third was scheduling the project which defined the timeline with important milestones for the project. The project manager evaluated this schedule good. The last was risk analysis. This project did not have a very good risk management plan, because some changes were not estimated or accurate. This risk related to the customer. In the deployment stage, the customer did not have good preparation for their staff's knowledge, facilities and time. This led to a longer time for software deployment to the customer, with some software functions changed. This led to increased project costs.

Project outcomes were evaluated in terms of project time, cost, overall success, financial and non – financial benefits. This project was completed on time but over budget. The budget was exceeded because of the changes in time required for data collection and deployment. This higher cost was shared by the customer so it did not influence the financial benefits of the project. This project was successful from the evaluation of the customer and the parent company. However, the project team was not satisfied with the quality of the delivered software. Although this software met the customer's requirements, the project team had expected to produce a better product with more features. Therefore, they evaluated the results of this project as average. The project manager indicated that, the project gained some non – financial benefits such as improving the team's knowledge and experience in software engineering and applications for hospital management. This project was a first step to access the market for hospital management software. This product could be modified for other hospitals.

5.6 FACTORS INFLUENCING THE PLANNING PERFORMANCE

The planning process, performance and project outcomes were described above. This section will present the influence of human, technical and management factors on the planning performance and the role of planning to the project outcomes. These influences were evaluated by the project manager. The reasons of the relationships are also explained.

For the human factor, the project manager had a high appreciation of the role of customer involvement. In this project although the customer had close contact and support from the project

team, their lack of knowledge and poor preparation in deployment limited the project results. The role of project manager was important to produce a good plan, especially when the client company did not set up management processes, or other related procedures. The project manager should be flexible in deciding what processes could be applied in his project and to adapt to the characteristics of each project. The effort that the project manager spent for planning also shows commitment to the project. The project manager spent much of his effort to produce the plan. The project manager was very experienced in the estimation of cost, time and effort for the project. The project manager identified the parameters for the estimation. Techniques were used only to facilitate this calculation.

The project manager also confirmed the relationship between team member's knowledge and experience in the analysis of requirements and for system development and planning. This influence however, was less important than customer involvement and project manager effort and experience. In this project, the project manager also defined the main requirements and product specifications. In a small project like this, the project manager was involved in both management and technical tasks. He took the main responsibility for defining the customer's requirement and product specification. The team members involved mainly in coding stage. For this reason the project manager of this project evaluated the factor of team member's knowledge and experience in requirement analysis and system development in planning as not very important.

This project applied some methods and techniques of project management and system development that were designed by the parent company – FPT Software. These methods and techniques were considered very appropriate by the evaluation of the project manager. However, he did not rank applying technical methods as an important factor influencing the planning. There were two reasons. Firstly, FPT – Software has designed processes, and procedures for project management, and quality assurance and they should be applied for every project of the company. In FPT Software, all projects regardless of failure or success have the same management process. Secondly, there are no good or bad methods, but only appropriate or inappropriate application. The selection of methods for projects, like system development or life cycle method depends on the project manager's knowledge and experiences. In some cases, it could depend on the customer.

In the management factors, management support is important for a good plan. In this project, only top – down support was mentioned. The functional departments of FPT – Software were not involved in the planning. According to the project manager, management support was very necessary especially when the company has many parallel projects. However, in software companies, projects made to the customer's order are a major business, these projects usually get the high support from their managers.

The project manager of this project however ranked setting the project goal and scope as more important than management support. The objectives were set by the project team and the customer will decide the outcomes are expected. In this project, there were few conflicts between the project team and customer goals. The project team wanted to deliver the best quality products (in the project team's view) while the customer needed an acceptable product (in the customer's view) in the planned time. The result is the project team accepted the elimination of some software features, and increased costs so the project could match planned time.

The two final management factors were the availability of resources and management styles. The availability of resources was evaluated as unimportant. This was because this project was small, using the human resource available for this project did not conflict with other projects of the parent company. Other resources like finance, facilities were not constraints for the project. The project manager received all resources required for the project. Concerning management style, the project manager did not have a consistent style to manage his project. He just followed the project management procedures of the company. Moreover, this project had only seven members (in the peak stage), and managing project was not too complicated. The project manager did not indicate any the relationship between management style and planning performance. In general, the project manager followed a task – oriented style to manage the team.

The role of planning was very important to project outcomes in the project manager's evaluation. It provides the framework for project implementation. In this project, every project activity, the assignment of team members, timelines, and important milestones were defined. The changes were also estimated. Although, there were some changes in the actual implementation, but the plan was reviewed frequently to update the plan.

5.7 SUMMARY

In this chapter, the planning activities of an FPT project of hospital administration software made to order of a hospital in HCM City has been described. This is small project with only 7 developers and was developed in 18 months. By following the management process and quality assurance system of FPT Corporation the plan of this project was done very professionally. The main problem of this project was the risks related to the changing requirements of the customer, this led to an increased cost of 140%. The plan was good in terms of defining requirements and product specifications, estimation of effort, and scheduling. Risk analysis was not accurate. This project was evaluated as successful by the customer, but the project team was not satisfied because it was over budget and it had insufficient product features compared to their expectations. In this project, the role of project manager's experience and effort, customer involvement and setting project goal and scope were very important. The next important factors were management support and team member's knowledge and experience. Applying technical methods, the availability of resource, and management styles were not important. The project manager also emphasized the role of planning in the success of a project. This case study helps to increase the understanding of the planning process in practice and the relationships between factors in planning as well as between planning and project outcomes.

6

SOFTWARE PROJECT MANAGEMENT IN VIETNAM – DESCRIPTIVE RESULTS

6.1 INTRODUCTION

An exploratory research was conducted to provide an overview of project management in software companies in HCM City. This chapter is to present the current status of project management practices and to identify the key criteria that project managers use for project evaluation and the factors influencing project success. The chapter concludes with a general summary of all findings and suggestions for a further in – depth research.

6.2 SAMPLE

All companies in the sample were operating in software business, most (43) were in Hochiminh city, the 3 remaining companies operated in Hanoi and Cantho. They produce

many kinds of software, however they focused mainly on service software for local customers (75.6%) and packaged software for the local market (53.3%). The main products included software for managing business (83.3%), accounting (55.6%) and office automation (66.7%). Only 26.7% have centered on outsourcing and 22.2% on packaged software for foreign customers. Almost all software companies were private (86%), companies with foreign investment account for 8.8% and state – owned companies were only 5.1%. Software companies were mostly small: 63% had less than 25 employees and only 2% had more than 200 employees (in the software field) (Figure 6.1). Qualified respondents were project leaders or general managers. They have an average of 7 years of field experience. Approximately 26% of managers in the sample have graduate education and 72% have a bachelor degree (Figure 6.2). All of the respondents are Vietnamese.

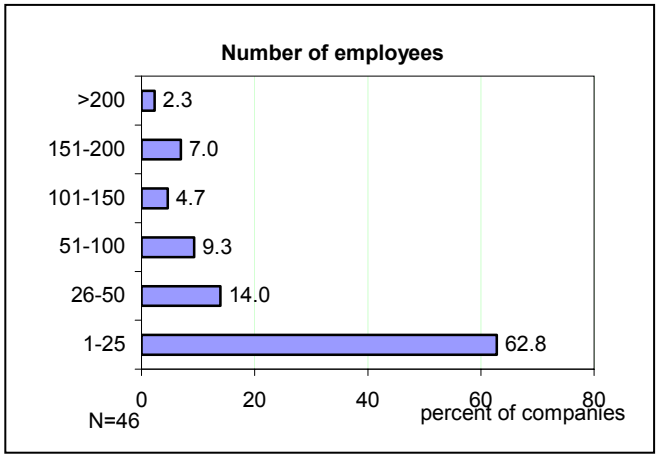

Figure 6.1: Company size (software field)

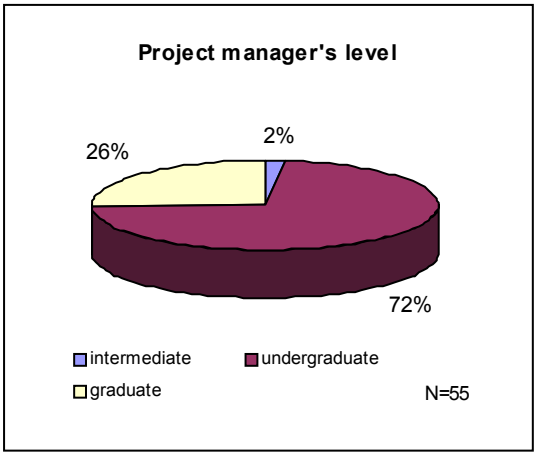

Figure 6.2: Project manager's level

6.3 THE CURRENT STATUS OF SOFTWARE PROJECT MANAGEMENT

Software projects in Vietnam companies were rather small. The average duration for product development is about 5 months. According to Whittaker (1999), a small project was completed within 12 months or less. Project size in terms of team members varies from 5 to 10 people. Ideally, project size should be measured by the number of man – months (or man – years) that integrated both the time and the personnel effort spent for the project, however this data was not recorded by all projects.

The project managers spent most of their time managing project teams and quality (3.81), followed by communication and time management, and the least effort for cost

management (2.43). In the next section managing the team, quality, time and risk in the software projects are discussed.

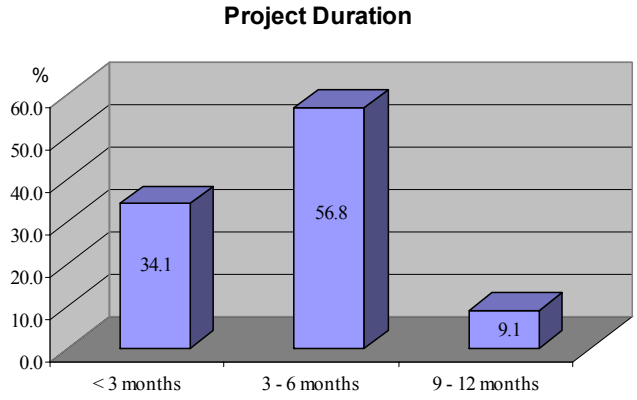

Figure 6.3: Project duration

6.3.1 Team Management

In personnel management, measuring productivity provides the base for evaluation and the motivation of employees. However, only 48% of software companies have measured productivity, and the most commonly used indicator is the Function point (FP)[1]/ man-month. The Table 6.1 presents indicators used for productivity measurement in software companies.

For evaluating a programmer's performance, the emphasis was on productivity. However, only a few respondents could provide concrete figures. The most common indicator used for productivity measurement was FP/ man - month. Some companies have used the average revenue per employee as an indicator to measure productivity. However, most companies either do not disclose their revenue or could not separate this figure only for software products. Therefore, the productivity of Vietnamese programmers can not be indicated by this indicator.

[1] Function point (FP) metric is composed of the weighted totals of five external aspects of software application, namely inputs, outputs, logical files, inquiries, interfaces (Jones, 1998)

Table 6.1: Productivity indicators used in software companies

Productivity indicators	Frequency	Percentage/ total cases	Percentage/ measured productivity cases
KLOC [2]/ man-month	4	8.7	18.2
Defects/ KLOC	2	4.3	9.1
Errors/ man-month	5	10.9	22.7
FP/man-month	11	23.9	50.0
Defects/ FP	8	17.4	36.4
Others	5	10.9	22.7

Most project managers had technical backgrounds without much management competence. Software companies did not pay attention to training in project management: 30% of the companies have no training in project management for their employees, and about 54% organized short term training, only 1 – 2 times per year. This creates many of the problems in project management. The evaluation of project personnel was done by the project manager based on comparison of work requirements. Approximately 60% evaluated the level of project management competence of managers in their company as average or below. However, cooperation between team members received a better assessment, more than 60% evaluated the coordination of developers in project team as good or very good (Figure 6.4).

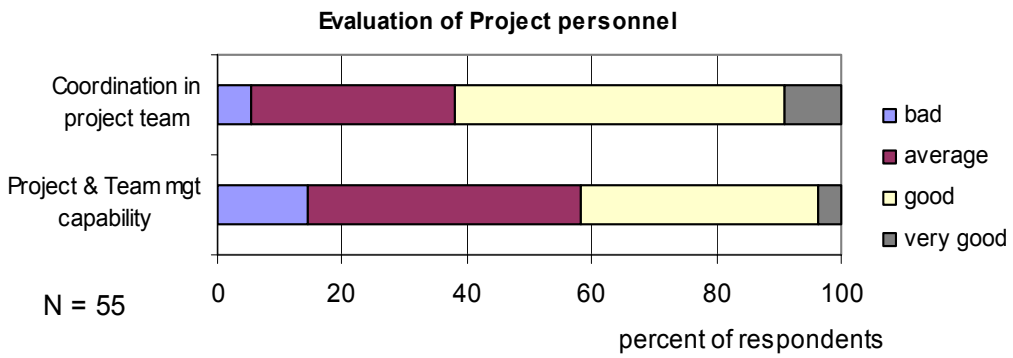

Figure 6.4: Project personnel evaluation

[2] KLOC: thousand line of code

6.3.2 Planning (including time management and risk estimation)

According to Whittaker (1999), planning can be considered in two aspects, project planning and risk estimation. The findings of this study indicates that about 65% of projects always consider risks in the planning stage, and only 4% projects have never considered risks. This means that estimating risk was considered important in software companies. Risks seem to be minimal in these projects except for the risk of changing requirements of customers. The frequency of risks in software project is presented in Figure 6.5. This result shows that changing requirements from the customer is most common problem faced by projects. The next risk is poor communication with customers. This finding implies the risks of project usually coming from outside are difficult to control. Therefore, the project managers should treat the problem of customer's requirements as a key activity of the software project and build this into their project management methodology.

For project planning, estimation of cost and time and techniques used for time management in the planning stage are considered. Only 22% of the projects used specialized software for estimating time and cost, most projects (95%) were based on experiences. Only 15% of the projects did not use any planning technique. Approximately 73% of projects have used MS Project software for project planning. This ratio was 80% reported in White and Fortune (2002). However a simple tool such as the Gantt chart was not in common use (only applied in 47% projects).

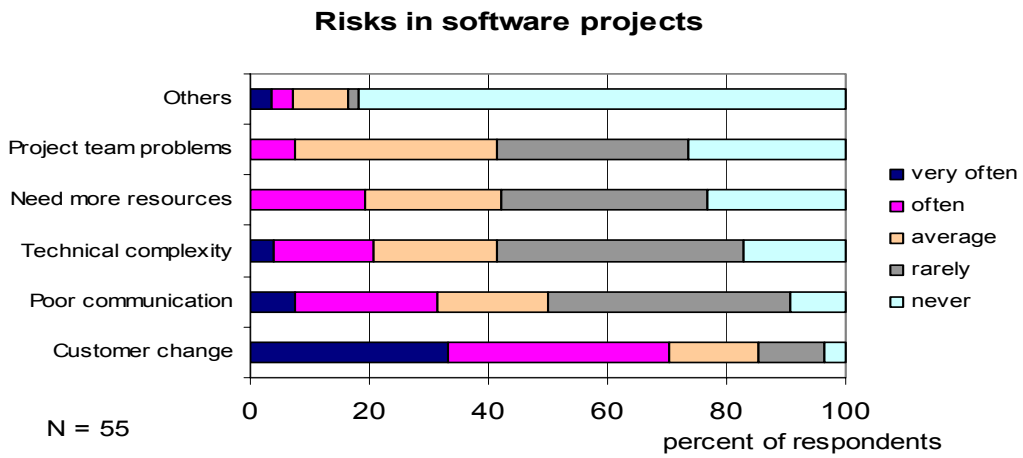

Figure 6.5: Risks in software projects

6.3.3 Quality Management

A quality management system is an issue that many project managers mentioned. 50% of software companies have not yet applied a quality management system. About 32% of companies applied the quality management system of ISO 9000 (however not all certified); and 17.4% followed the Capability Maturity Model (CMM). The reason for preferring the ISO quality system is that it has international recognition in Vietnam. 80% of the project managers knew the ISO 9000 system; 56% recognized CMM but only 20% knew about TQM in the software industry.

Although half of the project managers said their company has applied ISO or CMM for quality but they still agreed that now they need a quality management system. This indicates that they may not be satisfied with their current quality approach. Graham (1994) stated that small companies are in a relatively disadvantaged position for obtaining ISO certification because of limited resources. Few project leaders indicated that with a small scale, the current quality systems are not appropriate to their company. However, the in – depth interview showed that many project managers disagree with this idea. They think software quality does not only depend on the programmer's capability, but the quality control system. This confirms the necessity of a quality management system. The project managers' ideas are indicated in Table 6.2.

Table 6.2: Quality management system

Ideas	Agree	Disagree
My company now needs a quality management systems	69.2%	9.6%
Current quality management systems in the world are not suitable to small software companies in Vietnam	24.5%	51%
Software quality mainly depends on programmer's capability	22.2 %	50%

According to Yang (2001), most people based their estimates of a software product's quality on its functionality and the design of its user interface. This finding confirmed this view. Software reliability is considered an important attribute by 95% of the respondents,

followed by user efficiency (90%). The remaining attributes such as modifiability and portability are considered not very important for software products.

6.4 COMMON PROBLEMS OF SOFTWARE PROJECT MANAGEMENT

The common problems addressed in this analysis confirmed the results of a study of Thayer, Pyster and Wood (1981). Two additional problems mentioned by interviewees in the pilot survey are considered. The results indicate that poor project planning is still a common problem in software companies. Lack of knowledge in related business fields is also another important problem, for example, programmers with no experience in producing software for accounting, banking or management applications. The responses are presented in Figure 6.6.

Additional items concerning poor knowledge in related field and lack of software contracts to gain experience in project management were added to the survey after the pilot study was conducted. However this issue did not have much agreement among respondents. Their ideas were also very different. With project managers in the large software companies, the lack of software contracts was a problem unlike the small companies.

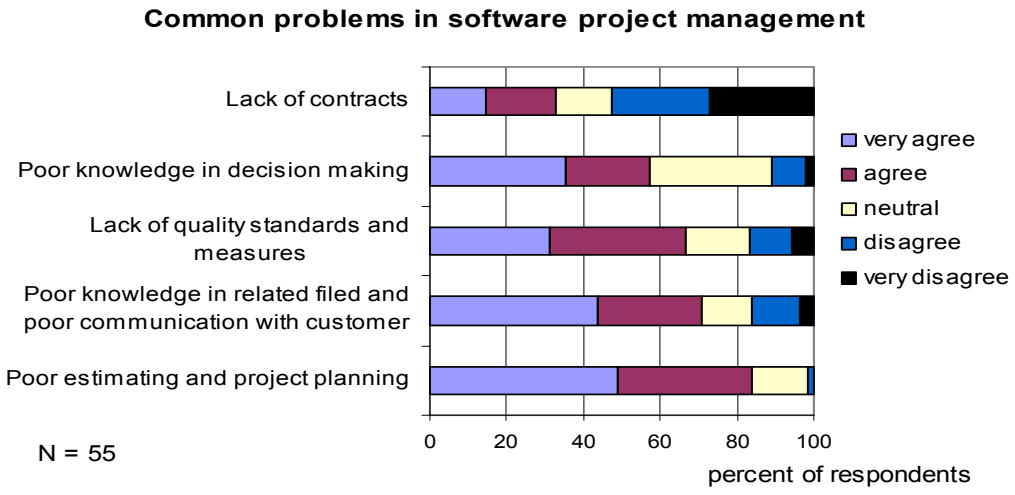

Figure 6.6: Common problems in software projects

6.5 EVALUATION CRITERIA AND SUCCESS FACTORS

About 58% of projects were evaluated as completed on time, within budget and satisfying quality requirements. These results are lower if the project size is larger (Jones, 1999). The

respondents also evaluated their projects through specific criteria such as time, cost and quality. For these outcomes, the percentage of projects completed at desired level of quality is highest (79%). Quality is the highest priority of project managers. Respondents were also asked to rank the criteria they used for project evaluation. The ranks were re-coded (1=5, 2=4, 3=3, 4=2, 5=1 and criteria not chosen = 0). The sum of re-coded responses is displayed in Table 6.3. This finding indicates that customer satisfaction is the most important criteria, the next is completion at a desired level of quality.

This result confirms the finding of Tukel and Rom (2001) and White and Fortune (2002), in which quality is a primary success measure and the most important objective is meeting customer needs. Sometimes the project managers ignore other criteria and spend their effort on quality. This explains why the percentage of projects completed at the required quality level is ranked highest.

Table 6.3: Project evaluation criteria

Criteria	Sum of re-coded ranking	Sums ranked
Customer satisfaction	227	1
Completed at a desired level of quality	210	2
Completed on planned time	188	3
Completed within budget	122	4
Capability improvement for the company	81	5

The factors that influence project results were specified in the questionnaire. The results indicated that the project manager's capability is an important factor that has a strong effect on the success of a project. Project size and technical complexity have a negative impact on project results, but this effect is not significant. The ideas of the respondents are very different on these two issues. Other factors such as understanding customer expectations, programmers' capability, working procedures and working environment also have a positive effect on project results (see Table 6.4).

Table 6.4: Factors influencing project success

	Factors	N	Mean	Std. deviation
1	Manager' capability	55	2.82	0.43
2	Understanding the customer expectation	55	2.55	0.74
2	Employees' capability	54	2.35	0.65
4	Good working environment	55	2.27	0.68
5	Clear working procedures	55	2.25	0.70
6	Project size	52	-0.44	1.39
7	Technical complexity	51	-0.78	1.53

3: strong positive effect 0: no effect -3: strong negative effect

To verify the impact of these factors on project outcomes, a nonparametric test using the Spearman rank correlation coefficient was used. The results show a significant correlation (at the 0.05 level) between using software for project planning and the percentage of projects completed on time (correlation coefficient R = 0.313, see Appendix C, Table 6.1). Regarding the relationship between project size and project results, the analysis failed to support this relationship in both cases: measuring project size by project duration and by the number of people in project team. This result confirms the finding of Aladwani (2002) it does not match Jones (1999) research (in which project size was measured by Function point – FP). However, this result is consistent with the respondent's perspective on the impact of project size on project outcomes presented in Table 6.4.

Using a similar analysis, the relationship between Project manager's capability and project results is supported (correlation coefficient R = 0.67, significant = 0.000, see Appendix C, Table 6.3). This supports the role of a capable project manager in project success.

6.6 CONCLUSIONS

The pilot survey provided an overview of project management in software industry in Vietnam. The size of the company and projects were small. The project managers' capability is evaluated as average. Project managers have an urgent need to develop a quality management system in software companies. Applying ISO 9000 seems to be more favorable because of the knowledge of software companies' manager. The survey indicates

project planning is the main weakness of project managers for these standards. The findings also clearly demonstrate the importance of project management in the success of software projects. The characteristics of a project as project size, technical complexity have no impact on project result. However the human factors, especially role of project manager is critical to the success of a project. In regard to evaluation criteria, the most important objective for project managers is to fully satisfy the customer. They also focus on quality rather than meet the targets of time and budget. From a managerial point of view, the research findings underscore the need to develop a quality management system in software companies; and to improve the capability of project managers for better planning and project success.

7

DESCRIPTIVE ANALYSIS OF THE SURVEY ON PLANNING IN SOFTWARE PROJECT MANAGEMENT

7.1 INTRODUCTION

This chapter presents the initial results of this survey – the descriptive statistics of planning in software projects. It begins with the sample demographics of the study. Next, the planning approaches in software projects are described through summarizing personnel, technical and management factors. This is followed by an assessment of planning performance and the outcomes. The last section is a summary of the key points.

7.2 SAMPLE DEMOGRAPHICS

In term of ownership, 58.5 % are local private or joint- stock companies; 29.2% are foreign investors and the rest (12.3%) are state-owned. Software companies in Vietnam are mostly young and small. 61% have been established within 1- 5 years, 27% from 6 – 10 years, and only 4% were established more than 15 years (see Figure 7.1 and 7.2). 44% are small companies having less than 20 employees. Only 10% have more than 140 employees.

The most prevalent software products are applications in Finance & Accounting (62.5%) and for Commercial and Services (58%). Other software applications are for Education and Training (45%), Government administration (45%), Telecommunication (34.4%) and Manufacturing (36%). Very few companies have developed software in the engineering area such as software for construction or specific sectors (see Figure 7.3). Only 7.8% of companies are specialized in one field. Most companies produce software for 2 – 4 areas of application (64%).

Most also produce software for both local and foreign clients. The major international clients are in North America (36%) and Europe (36%). An interesting future international market is Japan. In the local market, products are developed mainly for private companies (79.5%) and government organizations (70.5%) (see Figure 7.4).

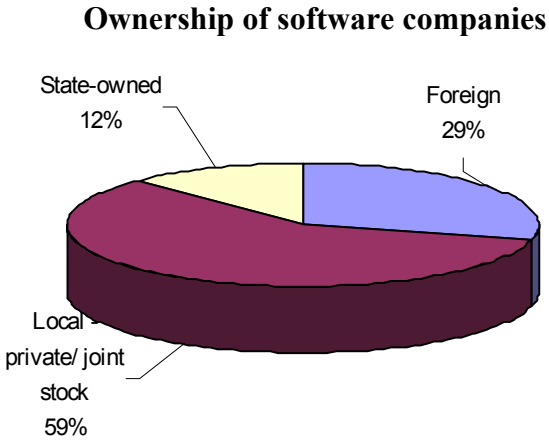

Figure 7.1: Ownership of software companies

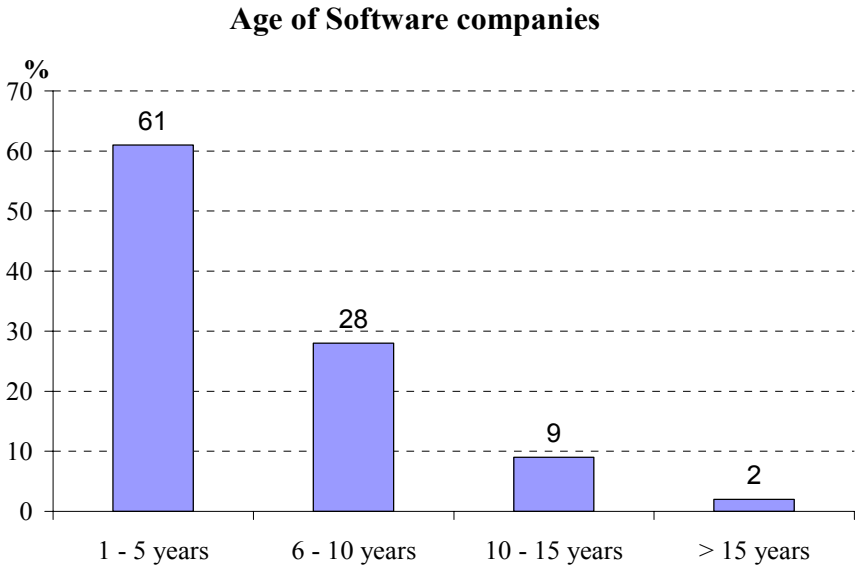

Figure 7.2: Age of software companies

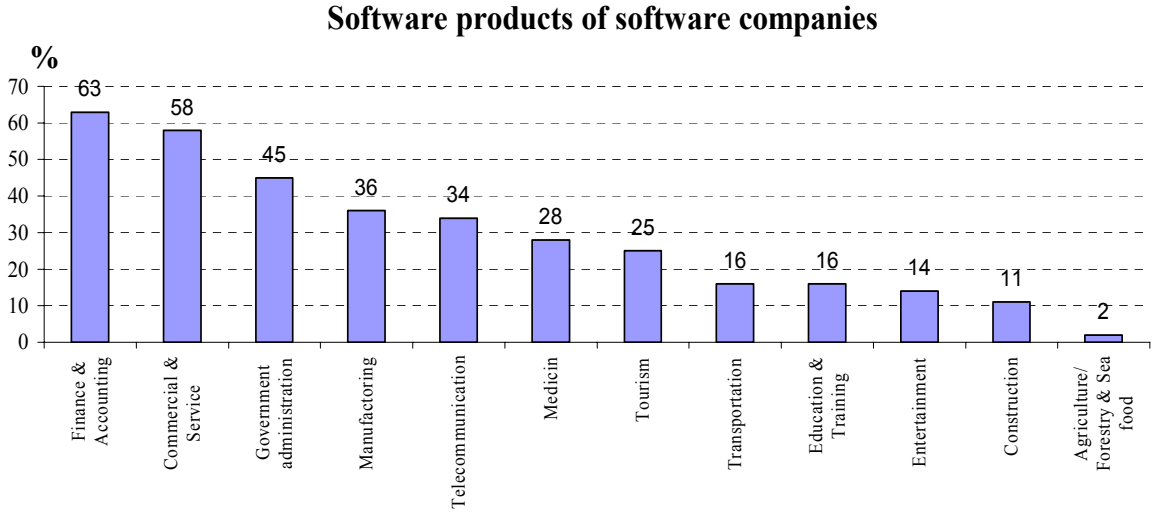

Figure 7.3: Software products of software companies

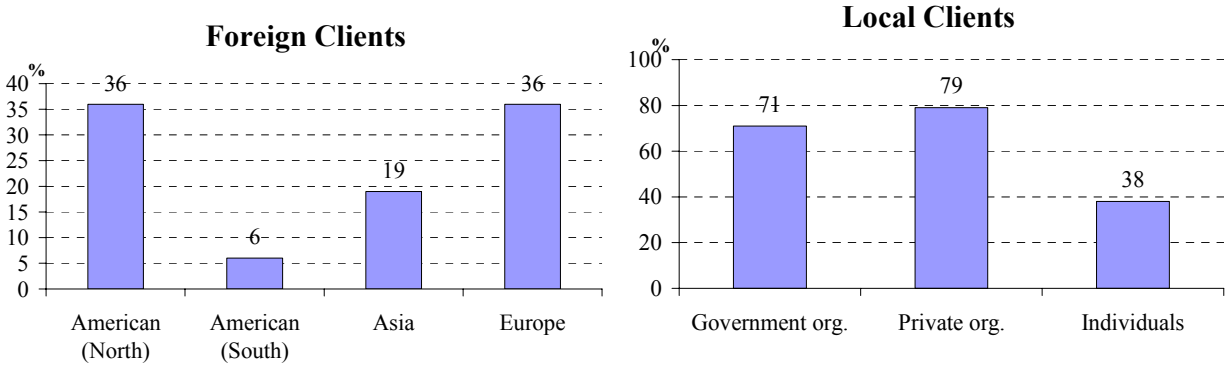

Figure 7.4: Clients of software companies

7.3 REPRESENTATIVE OF THE SAMPLE

Although the data was not randomly collected, our sample contains the main chacracteristics of the population. To examine the representative of sample, the characteristics of the sample are compared to the background of the population. The information of population background is based on the reports of The Vietnam Software Industry Development Program 2006 – 2010 prepared by the Post and Telecommunication Ministry (2005) and The Picture of Vietnamese Software Businesses of Hochiminh Computer Association (Tran L.H., 2005). The sample in my study was collected from September 2003 to March 2004. The data from those reports was mainly collected in the year of 2004. Due to the difference of time of data collection is not very much; the comparison is acceptable.

The background data includes company ownership, size, age and market. This data of the sample of this study and other sources is presented in Table 7.1

Table 7.1: Background of the sample and other sources

Characteristics	Current Sample	Report of Post and Telecommunication Ministry (2005)	Report of Hochiminh Computer Association (Tran L.H, 2005)
Ownership			
Limited and joint stock Co.	59.0%	86.0 %	77.0%
Foreign	29.0%	8.0 %	17.0%
State owned	12.0%	5.1%	6.0%

Current Sample		Report of Post and Telecommunication Ministry		Report of Tran L.H (HCA)	
Age					
1 – 5 years	61%		NA	≤ 4 years	54%
6 – 10 years	28%		NA	5 – 10 years	32%
11 – 15 years	9%		NA	11 – 15 years	11%
> 15 years	2%		NA	> 15 years	3%
Size (number of employees)					
< 40	66.7%	<30	86.2%	<30	65%
40 – 60	12.7%	30 – 50	5.4%	30 – 50	17%
60 – 100	6.3%	50 – 100	4.8%	50 – 100	6%
≤ 100	*85.7%*	*≤ 100*	*96.4*	*≤ 100*	*88%*
100 – 160	8%		NA	100 – 150	6%
> 300	3.5%		NA	> 300	4%
Oversea market					
North American	36%		NA	American	37%
Europe	36%		NA	Western Europe	21%
Asia	19%		NA	Asia	12%

This comparison indicates that except the ownership, the sample characteristics like company size, age and oversea market are similar to the data from the reports of the Ministry of Post and Telecommunication and the Hochiminh Computer Association (HCA). Regarding the ownership of software companies, the ratio of private and joint stock companies in the sample is lower than in the other sources. The reason could come from the data collection method of snowball used in current research. The popular companies were accessed first. They are usually big companies having the ownership of joint stock, state owned and foreign. The survey network established from these initial interviews, therefore have much relates to such kind of ownership. This bias does not much influence the research findings because the analyses do not relate much on the specific kind of ownership.

To consider the sampling errors occurring when the data was collected in different time, a comparison between two sample groups of 60 first cases and 20 last cases are conducted. The results are presented in Table 7.2.

Table 7.2: Sample characteristics

Characteristics	60 first cases	20 last cases
Location of software companies		
HCMC	75.5%	87.5%
Hanoi	22.4%	12.5%
Others	2.0%	0%
Year of foundation (age)		
1 – 5 years	57.1%	75%
6 – 10 years	28.6%	25%
> 10 years	14.3%	0%
Number of employees (size)		
< 20	45%	43.0%
20 – 60	32.6%	42.7%
60 – 100	12.1%	0.0%
100 – 140	4.1%	7.2%
> 140	2%	7.1%
Software products in …		
Education & training	45.8%	43.8%
Finance & Accounting	60.4%	68.8%
Telecommunication	39.6%	18.8%
Commercial and Service	56.3%	62.5%
Manufacturing	27.1%	37.5%
Oversea markets		
North American	37.3%	31.6%
Europe	35.6%	36.8%
Asia	10.2%	31.6%
Local market		
Government organizations	71.2%	68.4%
Private organizations	79.7%	78.9%

Individuals	40.7%	31.6%
Type of software projects		
Commercial	20.3%	30%
Build to order	53.9%	70%
Outsourcing	16.7%	0%
Project duration		
< 6 months	41.7%	45%
6 – 12 months	33.3%	20%
12 – 24 months	18.3%	20%
> 24 months	6.7%	15%
Number of people involved in the projects	9	11
Respondents		
Project managers	81.7%	70%
Top managers	11.7%	25%
Team members	6.7%	5%
Project manager experiences (No. of years)	2.9	3.3

The comparisons include software company characteristics (including location, age, size, software products, client markets) and the project characteristics (including project type, duration, project size in term of number of project staffs) and the respondents. The results in Table 7.2 indicates only few big different between these sample groups, such as the company age. In the group of last 20 cases, the ratio of young companies (less than 5 years) is higher than in the group of first 60 cases. There is not outsourcing projects in the sample group of 20 last cases while this ratio of first 60 cases is 16.7%. These differences indicate that, the sample collected in different time has few differences in sample structure. However, it cans still conclude that, the sample in this study represents to the population.

7.4 SOFTWARE PROJECT CHARACTERISTICS

7.4.1 Project Types

Most of projects are made – to – order (62%), 23% are commercial software and 13% are outsourcing projects (Figure 7.5). Project managers emphasized made-to-order projects because of the high volume of this kind of project in their business. These software projects are mainly for Education and Training (23.4%) and Finance & Accounting (17%). Some software projects were developed for clients in both oversea and local organizations. However, the main clients of these projects are from local (87%). This indicates that the local segment is still the main market for software companies (both local and international).

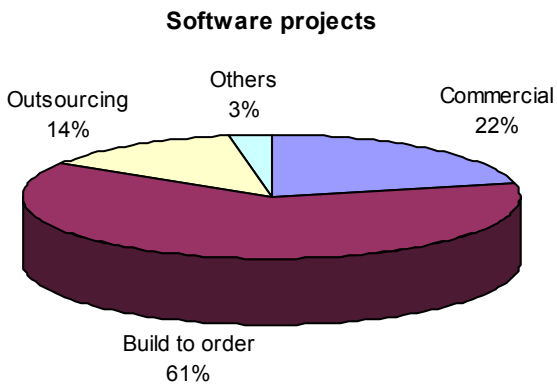

Figure 7.5: Types of software projects

7.4.2 Project Cost And Duration

The size of software projects is rather small in terms of duration and the number of project team members. 42% of the projects were implemented within 6 months, 30% were completed from 6 – 12 months, and 19% of projects had duration from 1 – 2 years. The remaining took more than 2 years (see Figure 7.6).

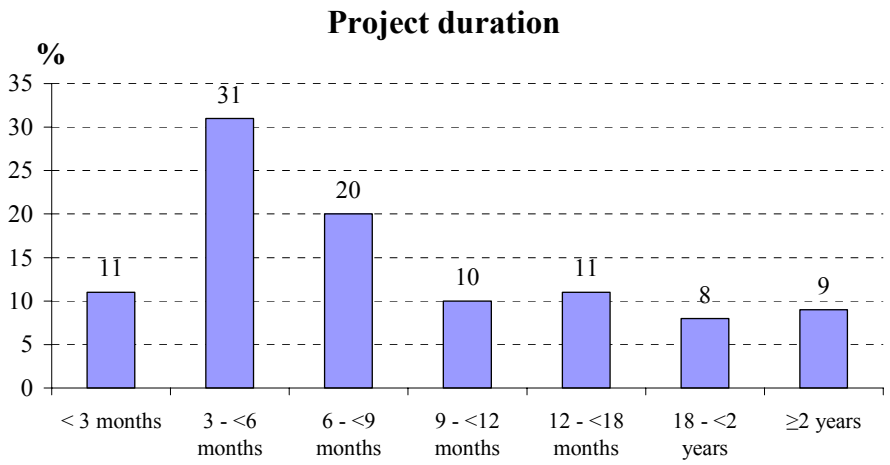

Figure 7.6: Project duration

Regarding the actual costs of a software project, most projects were controlled somewhat well. About 64% projects did not exceed their initial budget. Only 7% projects had an actual cost more than 150% over the planned budget (Figure 7.7).

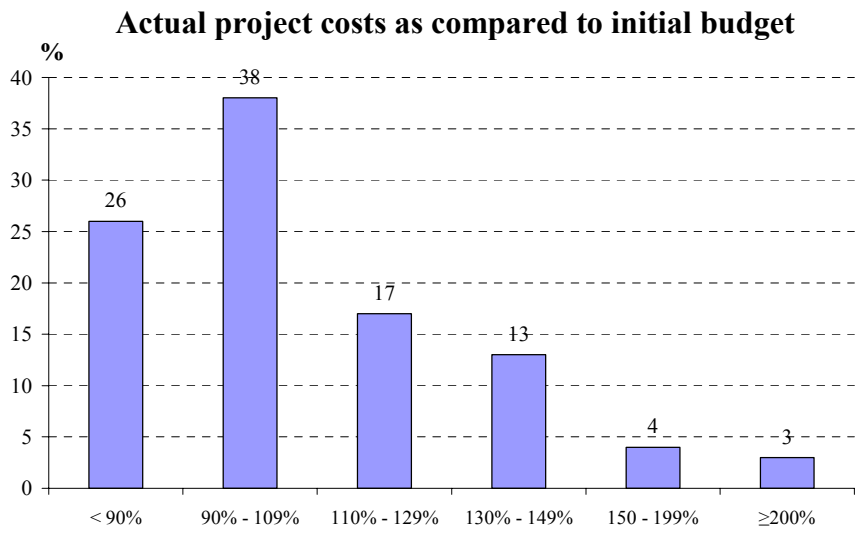

Figure 7.7: Actual project cost as compared to initial budget

The human resource involvement during different stages of software development in these projects is described Figure 7.8. The number of people involved in the project team is shown in Table 7.3.

Table 7.3: Number of people involved in the software development process

Number of people	Mean	Percent/ total
Whole project life cycle	9.63	100%
Planning stage	2.31	24 %
Analysis and design stage	2.77	29 %
Coding stage	5.49	57 %
Testing stage	2.94	31 %
Deploying stage	4.59	48 %
Documentation stage	2.37	25 %
Maintenance stage	2.44	25 %

The average number of people involved in a project team throughout the whole project life cycle is about 9 persons. The coding stage used the most people with 57% of the total personnel in the project. The next is deployment stage with 48%. The analysis and design stage only used 29% of project personnel. The planning stage used the fewest people (24%). The reason is some software projects were outsourced for coding or testing with the designs provided from clients, so personnel of these projects concentrated on coding and testing. Regarding made-to-order projects, experts in software projects stated that such kind of projects in Vietnam are also small and not very complicated, so programmers did not spend much effort in software analysis and design.

Human resources involved in stages of software project development

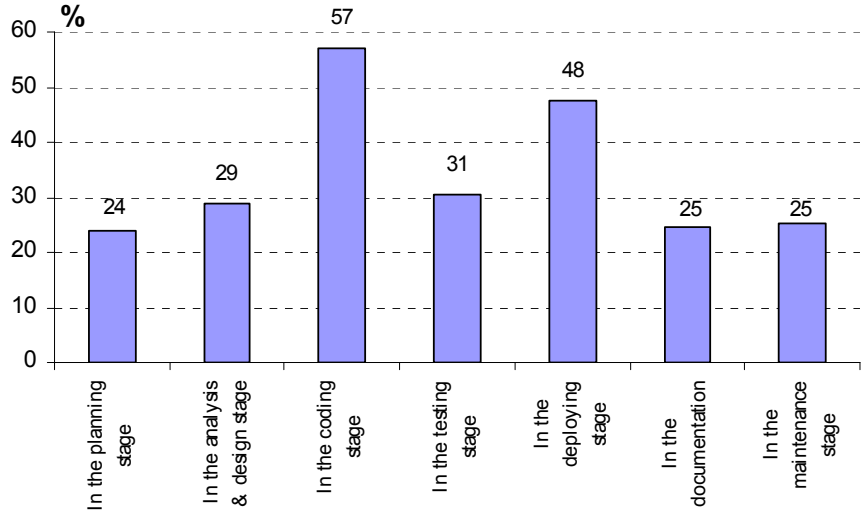

Figure 7.8: Human resource involved in stages of software project development

7.5 PEOPLE FACTORS IN PLANNING

Human resources in software project planning include the project managers, team members and customers. The general characteristics of human factors related to planning are presented in Table 7.4.

Table 7.4 Human factors in planning

Items	N	Means	Std. Deviation
Project manager experience (in years)	64	2.99	1.70
Project manager experience (in number of projects)	80	6.11	5.05
Role of experience of Project manager (*)	80	3.71	.62
Project manager effort (*)	80	3.70	.66
Technical ability - team members (*)	80	3.59	.64
Customer involvement (*)	80	3.70	.74

(*) Highest score is 5

7.5.1 Customers

The involvement of the customer in the early stages of software development process has a major effect on capturing their requirements, especially in the case of software made to order. For commercial software, the involvement of the customer is less and the project team sometimes interprets the needs of users. They put themselves into the perspective of users to identify the customer requirements, especially related to software for individual use like electronic dictionaries, games.

The results in Figure 7.9 indicate that, 59% projects had high customer involvement in planning, only 3% evaluated it as low. The project managers (through in – depth interviews) explained that the customers of these projects don't have much knowledge about software engineering and they could not visualize how the software will work. Customer involvement in the software development process (except for the commercial software projects) is through assigning a representative person or a group to participate with the project team. The high involvement of customers was confirmed through the level of participation of the functional

departments of a client with the project team. As is described in Figure 7.10, 56.7% of software project managers agree that this involvement is high.

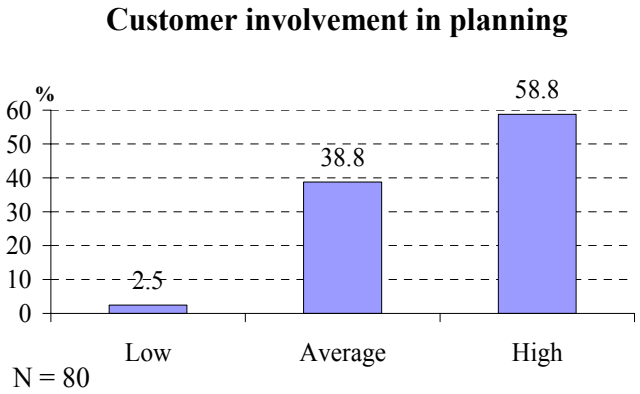

Figure 7.9: Customer involvement in planning

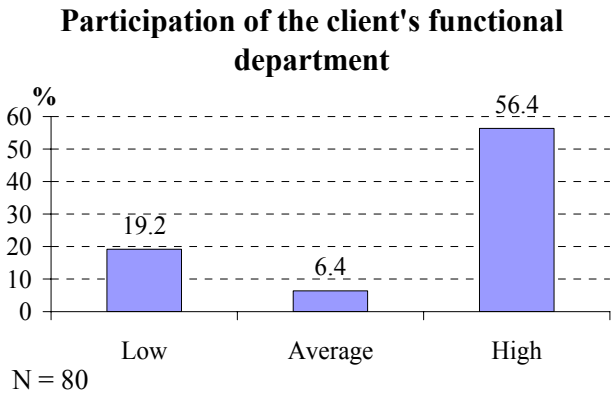

Figure 7.10: Participation of the client's functional department.

7.5.2 Project Managers

Previous studies identified the role of the project team, especially the project manager, is very important. The project managers in this survey had approximately 3 years in this position and managed 6 projects on average. They considered this experience very positively. It is the most important factor in managing the project team (82.5%). The next important skill is communication with the customer and defining the scope and objectives of projects (71%). The importance of experience is lower in the estimation of cost, time and effort and in scheduling (see Table 7.5). According to project managers in the interviews, these activities depend on each specific project, therefore the role of experience also differs from project to project.

Table 7.5: Role of experience in managing project

Project manager's experience (*)	Mean	Very important (%)
Managing project team	4.16	82.50
Defining objectives and scope	3.92	71.25
Estimation of cost, time and effort	3.79	61.25
Setting schedule	3.85	65.00
Communication with clients	4.00	71.25

(*) Highest score is 5

Regarding effort of project managers, 59% said that they spent more effort for this project than others. With greater effort, they have better control of specifications. 60% evaluated their level of control on specifications is high while only 1.3 % said that it is low (see Figure 7.11 and 7.12). Controlling the specifications of the software product is important for planning. With higher control the project manager can easier to estimate the cost and assign works. The effort of the project manager in planning is more important than in other stages. In the planning stage, project managers take the main responsibility to establish and plan the project. The relationship between the project manager's efforts and planning performance will be analyzed in Chapter Nine.

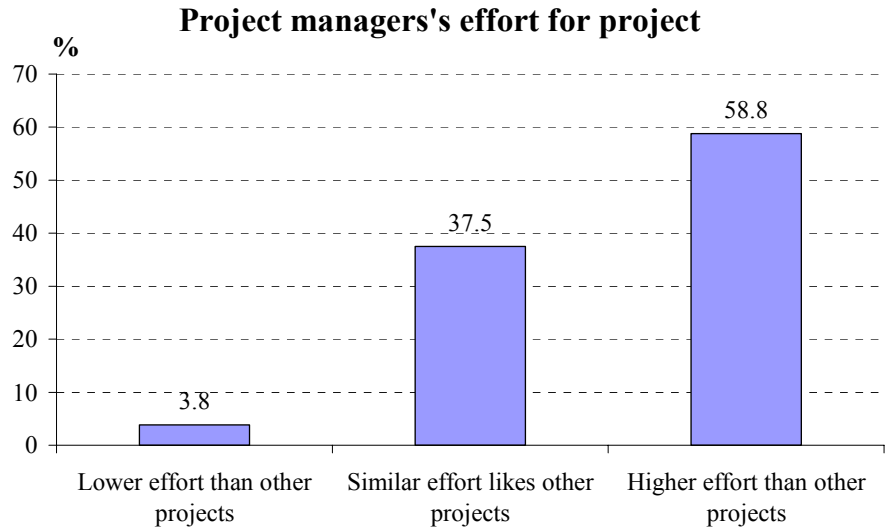

Figure 7.11: Project manager's effort for project

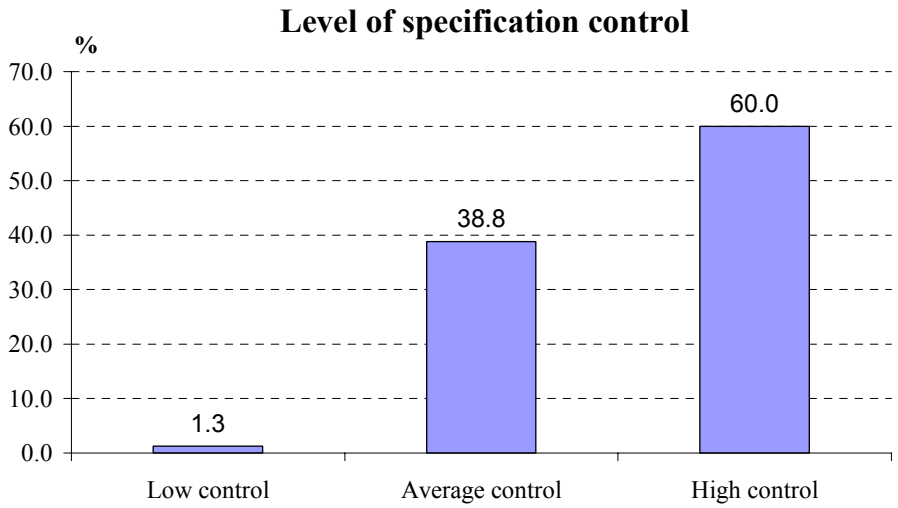

Figure 7.12: Level of specification control

7.5.3 Project Team Members

Project team members are selected based on their ability and commitment to the project. Their knowledge in system development and the definition of requirements is average (3.28 with 5 as very high). Only about 6% of the projects had a project team with very high ability. The experience of the project team is also average (3.6). Only 10% of the projects indicated that the project team has a very high level of experience in system development and requirements definition. Although the necessary knowledge and experience of team members for planning is evaluated as only average, their commitment and persistence during this stage is good (70% of projects indicate this level) (see Figure 7.13). In the planning stage, it is uncertain whether the projects will be accepted, the high commitment of project team could improve the success potential of the project.

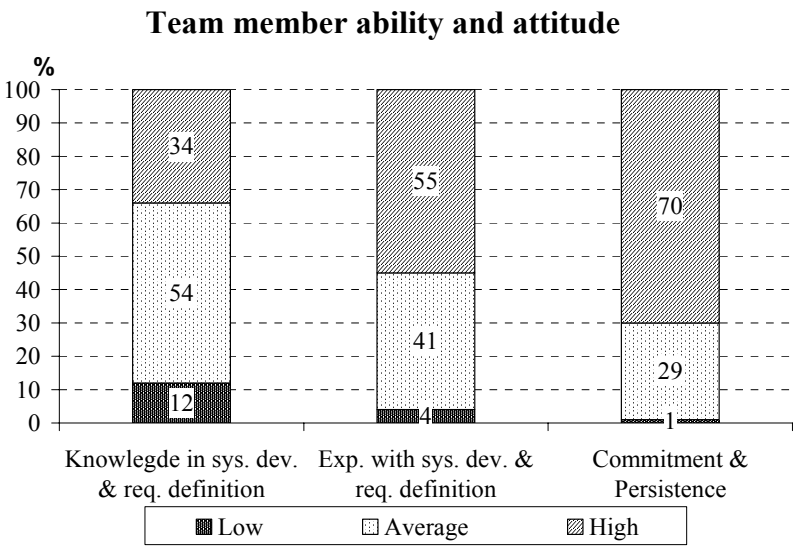

Figure 7.13: Team member ability and attitude

7.6 TECHNICAL FACTORS IN PLANNING

Three kinds of methods in software project development are surveyed, including project management, system development and life-cycle. The application of these methods in software projects is presented in Table 7.6.

Table 7.6 Applying methods and tools in software projects

Items	N	Means (*)	Std. Deviation
Apply project management methods	80	.55	.50
Using software for project management	79	.66	.48
Apply system development method	79	.95	.22
Tools or techniques for system development	80	.36	.48
Apply life – cycle method	80	.65	.48

(*) 1= Yes, 0 = No

7.6.1 Project Management Methods

62% projects have applied various project management methods. These methods are borrowed from foreign software companies (55%). Some of these methods are the Rational Unified Process (RUP) and Rational Rose. These methods were designed by Rational, a software development company in the USA. The Rational Unified Process is a software engineering process. It provides a disciplined approach to assign tasks and responsibilities within a development organization. Its goal is to ensure the production of high-quality software that meets the needs of its end-users, within a predictable schedule and budget.

These approaches usually apply in the popular local or foreign companies like Financing and Promoting Technology (FPT), CMC, Tuong Minh Association (TMA) or Global EIS. The details of these are given in Appendix B2. In FPT - the biggest local software company – a project management procedure was designed based on RUP.

Regarding project management methods, only half the projects applied a particular method. 41% of which have developed that method by themselves. 66% have applied different software and tools to support project management. 94% of these tools come from foreign companies. Many projects used Microsoft Project Management. A few companies developed their own software or tools (like the worksheet) for project management, mainly for scheduling and tracking the project progress. Through interviews, the project managers indicated two main reasons why they do not apply project management methods. Firstly, many software companies don’t have a system for managing software development and quality assurance. Secondly, the available methodologies are not appropriate to the small projects.

Regarding the tools for project management, some common tools are indicated. Most projects used Gannt chart (48%), Progress tracking (40%); Work Breakdown Structure (WBS) (35%); and Workforce assignment (33%). These tools were mainly for time management. Other tools like CPM, PERT, Weekend modifiers, etc. were rarely applied (10 – 16%), especially only 7% project used tools for budget management.

7.6.2 System Development Methods

Regarding system development, 94% projects indicated a specific method was used in their project. The remaining projects were unknown. The most common method was object-oriented (44%), followed by Rational Unified Process (RUP) with 29% of the projects. Other methods such as the structured approach, prototyping or Rapid Application Development (RAD) represented for 15 – 16% each (Figure 7.14). The applied system development method could affect the management of the project, for example RUP is also a method to guide software project management. The system development methods were also borrowed from foreign companies (65%) which are their partners or from manuals and modifying by software companies themselves (27%).

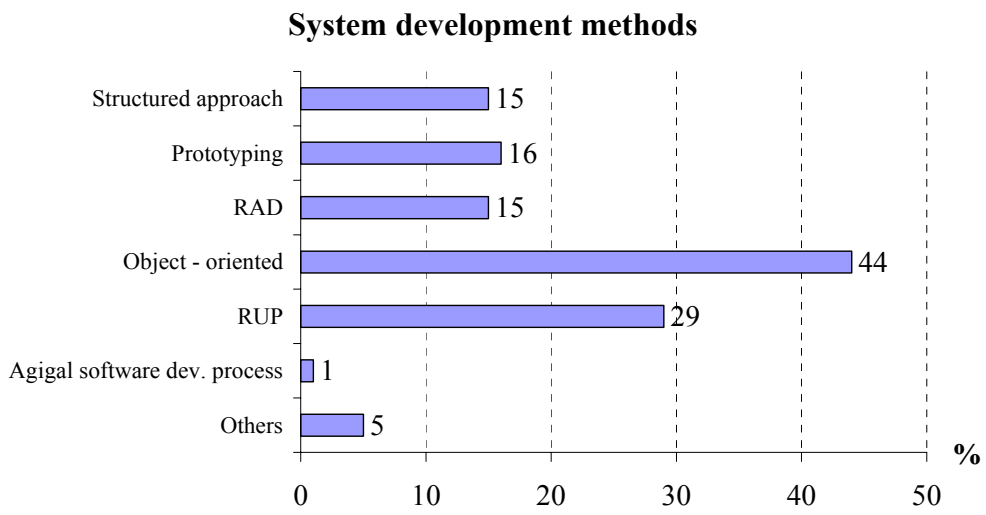

Figure 7.14: System development methods

Only 36% projects applied techniques that support the system development method. The common was the Rational Rose. These tools came from foreign providers (86%). Only 10% of the projects developed tools for themselves.

7.6.3 Life-cycle Methods

The life-cycle method for software development is very important. It is a framework for the project team to follow during the process of software development. However about 35% project managers did not apply any life-cycle method. They are usually small and local companies. The most commonly used methods are Spiral (20%), Waterfall (19%), followed Prototyping and Incremental delivery (both 12.5%) (Figure 7.15). The Life-cycle method affects the way project team plans projects. With the Waterfall method, the software development process can be separated into different stages, but not with the Spiral model. The Spiral or Incremental model is assessed as the most current method to become more flexible to customer requirements. Although the Waterfall model is obsolete, project managers believe if the software is not too complex or familiar to the project team, and the customer could clearly define their requirements, the Waterfall model will be applied. In the other cases, the developers need to apply the Spiral or Prototyping model. Using these models helps programmers to be more flexible in identifying the customer's requirements for the analysis and design of the software.

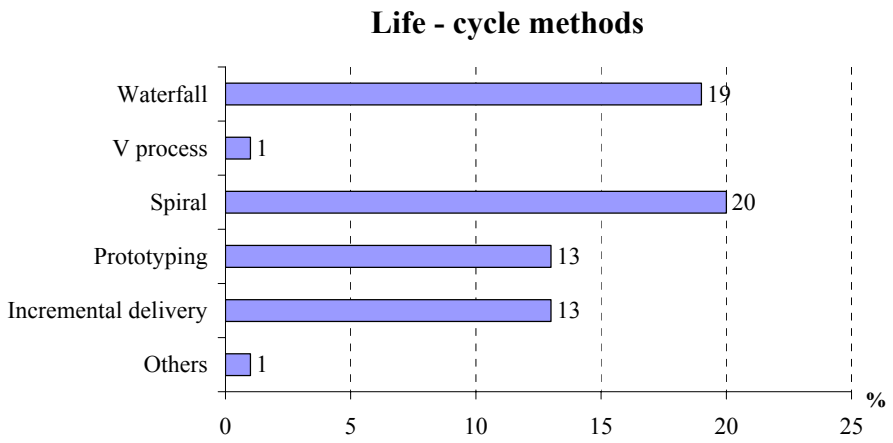

Figure 7.15: Life-cycle methods

Project managers focused more on software engineering methods (system development) rather than management (project management and project life-cycle). This indicated that the project managers lacked of project management knowledge and spent much their time for technical aspects. They are project managers and developers as well. Usually this identity happened in small projects.

Choosing the methods and tools in software development and project management was mainly the responsibility of project managers (81%). Sometimes the clients were involved in this selection (29%). The top manager (22%) did not participate very much but usually decided the process or method that would be applied for project management in the whole company.

7.7 MANAGEMENT APPROACH

Management factors in planning in this analysis include management support, setting project objectives, communication methods, availability of resources, and management styles. The general evaluation of these factors is presented in Table 7.7.

Table 7.7: Management factors in planning software projects

Factors (*)	N	Means	Std Deviation
Management support			
Top-down support	80	4.13	.72
Functional support	80	3.70	.81
Project objectives			
Cost and time oriented	80	3.46	.73
Customer oriented	80	4.34	.68
Communication methods			
Formal meeting	80	3.43	.91
Email	80	4.23	.99
Resource availability			
Human resource and time availability	80	3.44	.80
Financial availability	80	3.71	.72
Management styles			
People oriented	80	2.54	1.09
Work oriented	80	3.48	1.24
Participative	80	2.14	1.11
Consultative	80	3.89	1.16

(*) Highest score is 5

7.7.1 Management Supports

Management support was considered through the effort of top managers and functional departments in the parent company and the client organization. Most project managers said they were given full authority for all work related to their project (71%), especially in technical and personnel issues. Related to financial issues, they sometimes needed the approval from a higher level. With sponsoring projects, the project team also had the commitment to support the project (64%) from sponsors (third party). In short, most projects got good support from top management. Project managers were satisfied with this situation. The evaluation of management support is given in Table 7.8.

Table 7.8: Management support

Management support (*)	N	Mean	Std. Deviation
Project manager was given with full authority	80	3.99	0.82
Project with committed sponsor	44	3.80	1.05
Functional departments participated	80	3.60	0.79
Client functional departments participated	78	3.40	1.21

(*) Highest score is 5

7.7.2 Defining Objectives And Scope

Defining the objectives in the early stage of the software development process can influence project outcomes, although they can be adjusted during the process. Four common objectives were considered, including product quality, customer satisfaction, minimize cost and reduce overruns of cost and time. The importance of each objective is presented in Figure 7.16. Only 55% of the projects indicated that software quality was a very important goal. Customer satisfaction was the next major objective. 43% of the project managers considered it as very important. Minimizing costs was not a major objective (it is very important only in 5% of the projects). Defining the project goal in planning did not always satisfy all the members within the project team and customers. 11% of the projects indicated conflicts in the goal definition process.

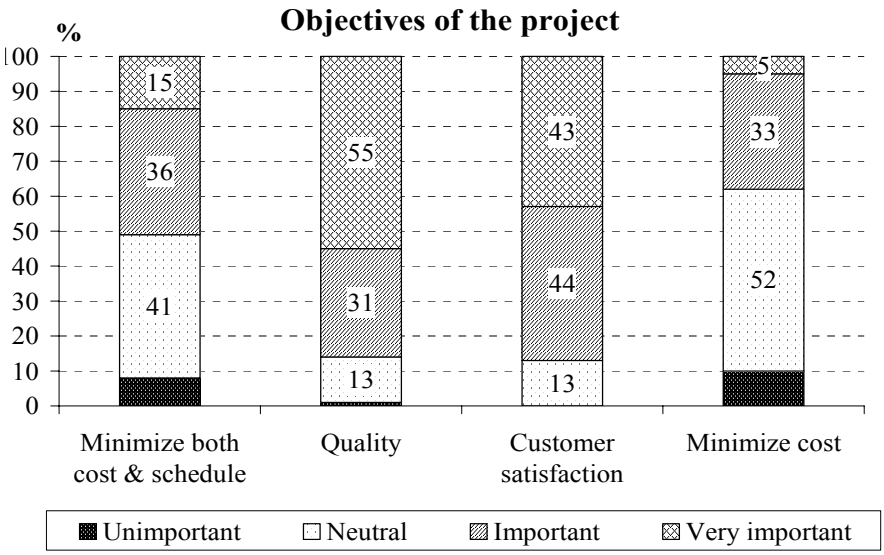

Figure 7.16: Goals of the project

7.7.3 Communication Methods

Communication is very important not only with the customers but also within the project team. With the customer, the common method was by email (78%) and telephone (73%). Formal meetings were not preferred (only 36% of the projects). A formal meeting was only used when the project team and the customer had to discuss important issues related to their contracts. Other discussions during the software development process were usually done through telephone and email. These save time and solve the distance problem with clients overseas. The frequency of communication methods with customers is presented in Figure 7.17.

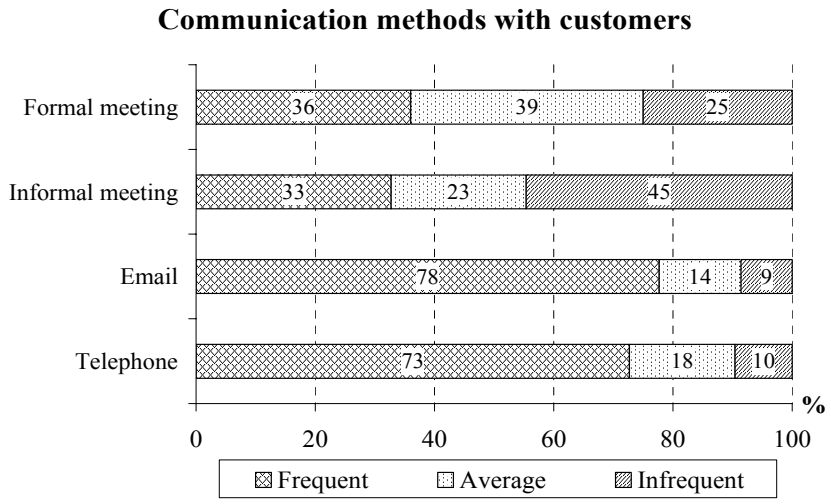

Figure 7.17 Communication methods with customers

Within the project team, communication by email was the most common (86%), but formal meetings and the telephone were also usual (61%). The frequency of these communication methods within the project team is presented in Figure 7.18.

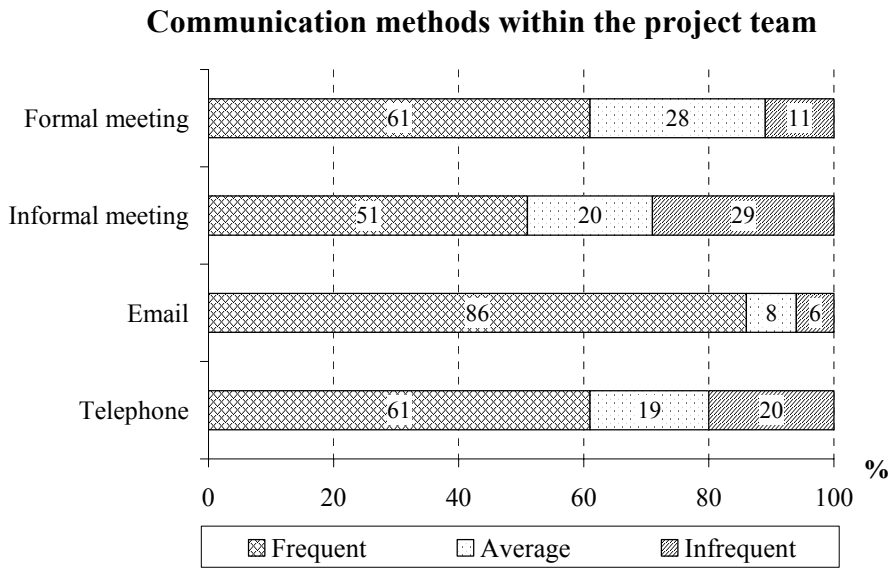

Figure 7.18 Communication methods within the project team

For formal meetings, the main objectives were to solve issues in the project (93%), to motivate the project team (84%) and also to stimulate the project team into action (70%). The reasons for the meetings of project teams are presented in Table 7.9. Many software professionals referred to "chatting" as the communication approach that they used not only within the project team but also with customers. This informal method was interested because cheap, very convenient and overcome the long distance problem.

Table 7.9 The reasons for meeting within project teams

Reasons for meeting (*)	N	Mean	Std. Deviation
Contact with senior manager or sponsor	79	2.19	1.039
Solve issues in the project	80	4.69	.608
Have greater awareness	80	3.89	1.019
Force the team into action	80	3.86	1.156
Create peer pressure	80	2.59	1.280
Motivate the project team	80	4.30	.833

(*) Highest score is 5

7.7.4 Resource Availability

The availability of resources such as time, human resource, budget and infrastructure could affect the project plan and influence the project outcomes. The survey results indicated that the availability of all resources in projects was average. The availability of infrastructure like offices, computers, communication devices, was the highest (65% projects). The availability of manpower including qualified people as project requirements was lowest compared to other aspects (18% projects indicated a low availability). The availability of other resources like time and budget were average. This is shown in Figure 7.19. In short, resource availability was not a major constraint for planning or in the whole software development process.

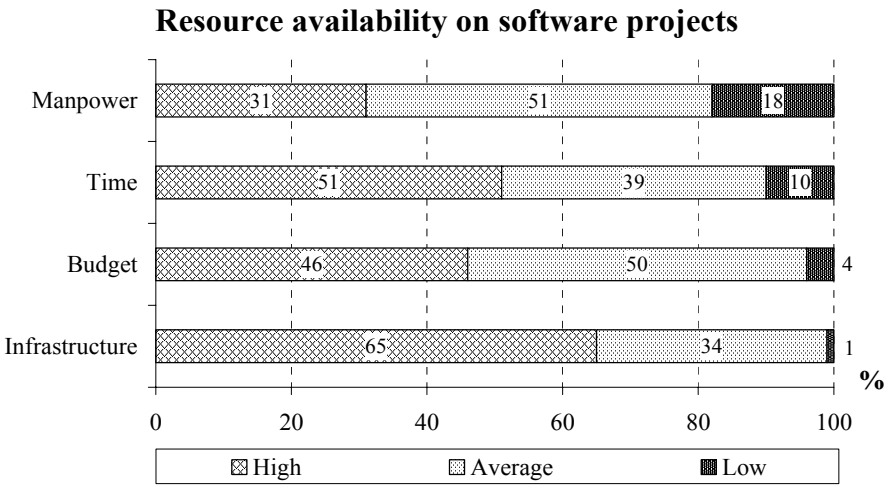

Figure 7.19: Resource availability on software projects

7.7.5 Management Styles

Management style in the project influences the project outcomes. Management styles include people oriented, work oriented and decision styles including unilateral, consultative, and participative decision making. These styles were modified to fit the practice of the survey context. In fact, not all project managers could identify the management styles that they applied. In this survey, the making decision approach was "to consult the project team before make final decisions" (consultative style - 61%). The common management style was work – oriented (51%). The participative style was not applied very much, only 12% of the projects indicated that all members in their project could participate in the decision process. 21% of the projects applied a people-oriented management style.

7.8 PLANNING PERFORMANCE AND PROJECT OUTCOMES

The planning performance of a project is assessed through defining requirements and specifications, estimating time and effort for the whole project, scheduling and analyzing risks. The evaluation of project managers in project planning is presented in Table 7.10.

Table 7.10 Project planning performance

Planning performance (*)	N	Mean	Std. Deviation
Defining requirements and specifications	80	3.58	.911
Estimating time and effort for the whole project	80	3.47	.856
Scheduling	80	3.81	.943
Analyzing risks	80	3.21	.937

(*) Highest score is 5

In general, the planning of software projects was average (3.2 – 3.8). Scheduling got the best performance in planning. It was evaluated as “very good” by 28% of projects. The next was defining requirements and specifications (19%). Only 11% of the projects evaluated their estimating project time and effort and analyzing risk as very good. 23% of projects were poor in risk analysis (Figure 7.20). This evaluation reflected the difficulty in estimating time and effort for projects. A software project always has uncertainty and the analysis of project risks is also not very good. According to project managers, it was very difficult to produce an exact estimation even if many tools and software are available for this. One reason for this difficulty was the change of customer requirements. This was also the most common risk that software projects face.

As mentioned in Figure 7.8, the level of staff involvement in the planning of software projects was lowest. The time and effort that a project team spent for planning was not much. 41% of the projects spent less than 10% of the time and 48% spent less than 10% of the total effort for planning.

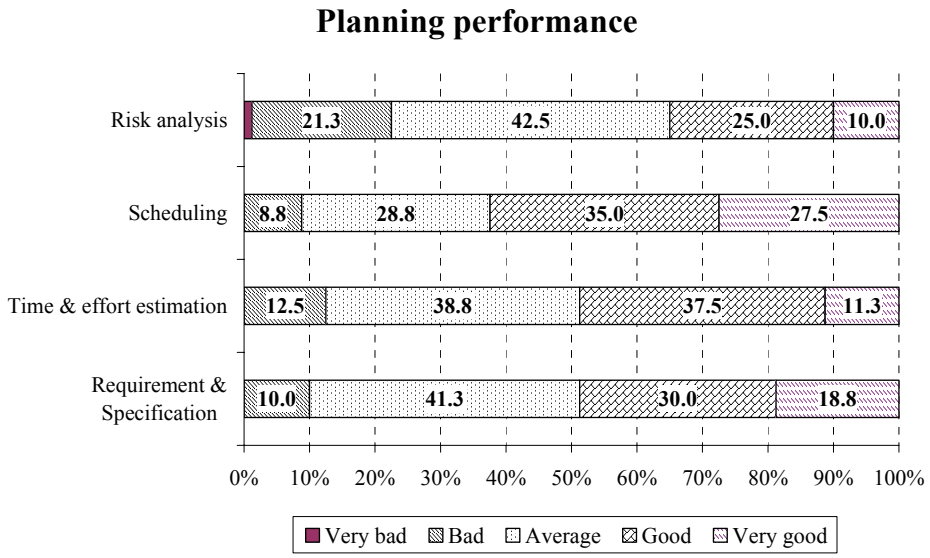

Figure 7.20: Planning performance

The project outcomes were considered quantitatively and qualitatively. The quantitative indicators measured how the project duration and cost matched the plan. The qualitative assessment considered how the project results satisfied the customer, project team and the company. These indicators were evaluated by the project managers. The results are presented in Table 7.11.

Table 7.11 Outcomes of software projects

	N	Mean	Std. Deviation
Project result in terms of time (*)	80	2.49	.811
Project result in terms of cost (**)	80	2.19	.887
Meet all specifications defined in plan stage (***)	80	3.98	.675
Satisfy customer needs (***)	80	3.96	.605
Enhance company image (***)	80	4.13	.644
Improve project team capability (***)	80	4.33	.632
Financial benefits to company (***)	80	3.70	.736
Financial benefits to team members (***)	80	3.39	.646

(*): 1 = under planned time, 2 = on planned time, 3 = over 30%, 4 = over 50%

(**): 1 = under planned budget, 2 = on planned budget, 3 = over 30%, 4 = over 50%

(***): Highest score is 5

The analysis indicated that, about 51% of the projects were completed on time and 62% of projects were completed within the planned budget. The ratio of projects completed late and over budget was high. 49% of the projects were over; 30% behind schedule and 38% had cost overruns.

However, 70% of the projects were self-evaluated as successful. The satisfaction of the project team was not based on completion on time or budget, because it was not their major objective. 80% of the project managers agreed that they satisfied the customer. 76% of the projects indicated that the delivered software met all specifications defining in the plan. Other outcomes of the project were to improve the project team capability (91%), and to enhance the company image (85%). Concerning the financial issues, 61% of the projects indicated the software project bring financial benefits to the company. Some project managers indicated that their company implemented the project for other benefits (such as a long-term relationship with a customer) rather than money.

In short, the software projects achieved good results by qualitative criteria but were rated only average or below by quantitative indicators. This demonstrated that the projects emphasize mainly customer satisfaction and quality.

7.9 SUMMARY

This chapter described the characteristics of the sample, including the size, age, products and clients of the software companies. In the study, most Vietnamese software companies are small and young with 44% of companies having less than 20 employees and 61% established within 5 years. 61% of software projects are made – to – order projects. Most of projects were implemented in 3 – 9 months (51%) with the participation of about 10 persons, in average.

The planning of software projects was considered through three sets of factors, including human, technical and management. The involvement of the customer in planning and the effort of project managers for planning were high. Concerning the technical factor, 94% of the projects applied system development methods while only 65% of projects used project management methods. The management support from top managers of software companies was very good. Software project teams also received the support from functional departments,

such as sales and marketing, finance from the parent company or related departments of client organizations. The projects focused more on customer satisfaction than other objectives.

In planning, setting the schedule had a positive evaluation by the project managers while risk analysis was inadequate (average level). Although only 51% and 62% of project were completed on time and budget, respectively, but 70% of projects were evaluated as successful. The project managers appreciated the intrinsic benefits that their project received more than financial benefits.

8

DIFFERENCES IN PROJECTS BY SIZE, TYPE AND OWNERSHIP

This chapter presents the results and discussion of comparisons between software projects by size, type and ownership. The differences in planning between projects are examined through project characteristics, planning factors, planning performance and project outcomes. The chapter is completed with the summury of our findings.

8.1 DIFFERENCES IN SOFTWARE PROJECTS BY SIZE

As described in Chapter Seven, the descriptive analysis of survey, project size in this study was considered by its duration and the number of persons in the project team. Typically, project size should be measured by man – month or man – year. However, this data was missing in most software projects in this survey. To analyze the differences by size, project size will be measured by a modified indicator that is calculated by the number of people in the project team multiplied by its duration. The average size of the projects was determined, as approximately 100 man – months. This data does not reflect the real size of a project because the number of persons involved in different project stages are not similar. However, it could be used to classify projects by size. This data then was recoded into two groups: projects which were below 100 man – months and projects which were above 100 man – month. Hereinafter, below and above average size (100 man – months) groups are called smaller and bigger.

By this classification, the sample includes 47 projects in the smaller group and 25 projects in the bigger group. The differences between these two groups are analyzed by the characteristics of projects and the human, technical and management factors.

8.1.1 General Characteristics Of Software Projects

The characteristics of software projects include types, clients, duration, cost and the number of team members involved in different stages of the project.

The analysis indicates that there is no significant difference between the bigger and the smaller size group related to project types (commercial, made-to-order and outsourcing). It means all project types are implemented with different size. There is also no difference in project size between local clients. Regarding the international clients of projects, only in the European market, the number of big projects (more than 100 man – months) is significant

higher than the number of smaller projects. The results of analysis of international clients are presented in Table 8.1. Other results related to differences in project type, local client market, are presented in Appendix C, Table 8.2 and 8.3.

Table 8.1: International clients by size of projects

Clients		Number of observations (N)	Means	Std Deviation	T - value	p - value
North America	Smaller	46	.22	.42	-.657	.514
	Bigger	24	.29	.46		
South America	Smaller	46	.02	.15	-.424	.674
	Bigger	24	.04	.20		
Asia	Smaller	46	.09	.28	-.471	.640
	Bigger	24	.13	.34		
Europe	Smaller	46	.09	.28	-1.985	**.050**
	Bigger	24	.29	.46		

The differences in project cost and number of project team members are analyzed. This analysis shows that the smaller projects controlled costs better than the bigger projects. In the large the projects, the more people involved and the more tasks that should be implemented. Therefore, estimation for the cost of such projects is more difficult. The larger projects usually have the longer duration, that leads to more changes in the final stages of projects. These projects have difficulty to produce an accurate cost estimates and to control the changes in the final project stages indicate that bigger projects have the higher rate of cost overrun. The analysis results are presented in Table 8.2.

Table 8.2: Project duration and cost by size

		N	Means	Std Deviation	T - value	p - value
Duration *	Smaller	47	2.38	1.13	-8.950	**.000**
	Bigger	25	5.16	1.31		
Actual cost ** (as compared to budget)	Smaller	46	2.11	1.08	-2.133	**.037**
	Bigger	24	2.75	1.39		

(*) 1 = < 3 month, 2 = 3 - <6 months, 3 = 6 – <9 months, 4 = 9 – <12 months, 5 = 12 – <18 months, 6 = 18 – <24 months, 7 = > 24 months

(**) 1 = < 90%, 2 = 90 – 109%, 3 = 110 – 129%, 4 = 130 – 149%, 5 = 150 – 199%, 6 = > 200%

The total number of people involved in the whole project cycle of projects in the bigger projects is significantly higher than smaller projects. However, this is not always true for all stages of the project life cycle. The results indicate that in coding, deploying, documentation and maintenance stages, the number of people participating in the bigger projects was significantly higher than in smaller projects. In planning, analysis and design, and testing stages there were no significant differences. The results are presented in Table 8.3.

Table 8.3: People participated in different stages by size

People participated in …		N	Means	Std Deviation	T – value	p - value
the whole project life cycle	Smaller	47	7.55	4.15	-4.644	**.000**
	Bigger	25	13.52	5.67		
the planning stage	Smaller	44	2.25	1.14	-.239	.813
	Bigger	21	2.33	1.39		
the analysis and design stage	Smaller	44	2.59	1.42	-1.585	.120
	Bigger	20	3.10	1.07		
the coding stage	Small	44	4.80	3.20	-2.512	**.017**
	Bigger	21	7.38	4.17		
the testing stage	Smaller	44	2.57	2.10	-1.182	.249
	Bigger	21	4.00	5.36		
the deploying stage	Smaller	44	3.32	3.96	-2.192	**.037**
	Bigger	21	6.81	6.76		

the documentation	Smaller	44	1.73	1.19	-2.089	**.048**
	Bigger	21	3.43	3.64		
the maintenance stage	Small	44	2.09	1.51	-2.061	**.043**
	Bigger	21	3.19	2.80		

8.1.2 Human Factors

Analyzing the differences in human factors between sizes of projects does not show any significant differences, except the role of experiences. Although the level of experience of project managers in the two groups is similar, the managers in smaller projects appreciated experience more than in bigger projects. The evaluation of project managers on technical ability of the team members and the effort that they spent for planning is similar between the two groups. There is also no significant difference in the involvement of customers. The results are presented in Appendix C, Table 8.4.

8.1.3 Technical Factors

The application of project management, system development and life – cycle methods and tools related to the project size is not significantly different (see Appendix C, Table 8.5 for analysis results). In smaller projects, the managers have more flexible to choose technical tools and methods than in bigger projects. This difference is presented in Table 8.4.

Table 8.4: Selection of technical methods of projects by size

Selecting technical methods in the project		N	Means	Std Deviation	T - value	p - value
By Project manager	Smaller	47	.87	.34	1.995	**.050**
	Bigger	25	.68	.48		
By Top manager	Smaller	47	.23	.43	.331	.742
	Bigger	25	.20	.41		
By Client	Smaller	47	.23	.43	-1.731	.091
	Bigger	47	.87	.34		

8.1.4 Management Factors

Analyzing the differences in management factors was based on the factors such as the support from top managers and from functional departments, the project objectives, the communication methods, the availability of resources and the management styles. The analysis results indicate no significant differences by size in all of these factors. The results are presented in Appendix C, Table 8.6.

In general, the differences in human, technical and management factors related to size are not significant.

8.1.5 Planning Performance And Project Outcomes

The rate of effort and time that project managers spent for planning the projects is similar for projects regardless of size. Planning performance is evaluated through four main tasks of planning: defining the requirements and specifications, estimating time and effort for the project, setting a schedule and analyzing risks. The analysis indicates that there is a significant difference only in the performance of schedule setting. The smaller projects scheduled better than bigger ones. Because the duration of smaller projects is shorter, so project managers could estimate and control time and project activities better. Table 8.5 presents this result.

Table 8.5: Planning evaluation of projects by size

		N	Means	Std Deviation	T - value	p - value
% time for planning	Smaller	46	22.098	15.060	-.136	.893
	Bigger	23	22.739	19.939		
% effort for planning	Smaller	38	19.197	14.087	.713	.484
	Bigger	13	15.923	14.361		
Requirements and specifications defining	Smaller	47	3.62	.90	.404	.688
	Bigger	25	3.52	1.00		
Time and effort estimating	Smaller	47	3.62	.82	1.629	.110
	Bigger	25	3.28	.84		

Schedule setting	Smaller	47	3.98	.97	2.046	**.046**
	Bigger	25	3.52	.87		
Risk analyzing	Smaller	47	3.26	1.01	.071	.943
	Bigger	25	3.24	.78		

Project outcomes of projects by size are presented in Table 8.6. Although there are minor differences in human, technical and management factors between projects, the outcomes of small projects were better than bigger projects. These projects had better cost control, a better match of product specifications, a better company image and more improved project team capability than bigger projects. In general, the small projects had better qualitative benefits than the bigger projects. The analysis in Table 8.6 also indicates that there is no significant difference in financial benefits between the projects.

Table 8.6: Project outcomes of the projects by size

Project outcomes		N	Means	Std Deviation	T - value	p - value
Project result in term of time (*)	Smaller	47	2.38	.80	-1.239	.222
	Bigger	25	2.64	.86		
Project result in term of cost (**)	Smaller	47	1.98	.79	-2.493	**.017**
	Bigger	25	2.52	.92		
Project success	Smaller	47	3.85	.65	1.413	.163
	Bigger	25	3.65	.53		
Meet all specifications defined in the planning	Smaller	47	4.09	.69	2.068	**.042**
	Bigger	25	3.76	.52		
Satisfied customer need	Smaller	47	4.09	.62	1.479	.145
	Bigger	25	3.88	.53		
Enhanced company image	Smaller	47	4.26	.64	2.864	**.006**
	Bigger	25	3.84	.55		
Improved project team capability	Smaller	47	4.40	.61	2.075	**.043**
	Bigger	25	4.08	.64		
Financial benefits to company	Smaller	47	3.79	.72	.799	.428
	Bigger	25	3.64	.76		

Financial benefits to team members	Smaller	47	3.49	.62	1.283	.206
	Bigger	25	3.28	.68		

(*): 1 = under planned time, 2 = on planned time, 3 = over 30%, 4 = over 50%

(**): 1 = under planned budget, 2 = on planned budget, 3 = over 30%, 4 = over 50%

8.1.6 Summary

In this analysis the project size is based on the average size in term of man – months of 80 projects of this survey. The analysis of differences in characteristics by projects size showed only a few significant differences. These were mainly related to the allocation of human resources during project life – cycle. The results also indicated a few minor differences in human, technical and management factors, however, the analysis for project outcomes indicated that smaller projects had significantly better non – financial benefits than larger projects.

8.2 DIFFERENCES IN SOFTWARE PROJECTS BETWEEN LOCAL AND INTERNATIONAL COMPANIES

As assumed in Chapter Four, the types of ownership of software companies could lead to differences in the management approach of software projects and project outcomes. This study considers two types of ownership: local companies (including both private and state-owned) and international companies. The sample includes 23 projects in international companies and 57 projects of local companies. The following analysis will compare the two groups of ownership: international projects and local projects.

8.2.1 General Characteristics Of Software Companies And Projects

The analysis for equality of age and number of employees does not show any differences by ownership. This means the international and local companies have a similar size and experience in the Vietnamese market. The international and local companies produce many kinds of software products and with little focus. There are also no significant differences in project types that are implemented by either international and local companies (see Appendix C, Table 8.7 and Table 8.8 for analysis results).

The international companies focuses on foreign clients more than local companies, especially in the North American and European markets (with a level of significant of $\alpha < 0.05$) while local companies have focus more on the local market (for all clients including government, private sectors and individual). These results indicate that the local companies have more advantages in the local markets than international companies. On the contrary, for the two main oversea markets, North America and Europe, foreign companies have greater advantages. The results are presented in Table 8.7.

Table 8.7: Project clients by ownership

Clients *		N	Means	Std Deviation	T – value	p - value
North America	International	23	.52	.51	1.987	**.050**
	Local	55	.29	.46		
South America	International	23	.09	.29	.480	.634
	Local	55	.06	.23		
Asia	International	23	.26	.45	1.477	.150
	Local	55	.11	.31		
Europe	International	23	.61	.50	2.957	**.005**
	Local	55	.25	.44		
India	International	23	.00	.00	-1.765	.083
	Local	55	.05	.23		
Government organization	International	23	.43	.51	-3.249	**.003**
	Local	55	.82	.39		
Private organization	International	23	.57	.51	-2.860	**.008**
	Local	55	.89	.31		
Individuals	International	23	.22	.42	-2.136	**.038**
	Local	55	.45	.50		

The average number of people participating in an international project is about 11 persons while in a LC project it is 9 persons. However, this difference is not significant. The results also indicated that the project duration and actual project cost of software projects were not different between international and local software companies (see Appendix C, Table 8.9). In

brief, the project characteristics between software projects of the international and local companies tend to be similar except for the markets they emphasize.

8.2.2 Human Factors

The analysis of human factors in international and local company's projects is presented in Table 8.8. Regarding project managers, the difference of average experience (measured by number of years and projects as project managers) between international company's project managers and local company's project managers is not significant. The analysis indicates that project managers of international companies put forth significantly greater effort than their colleagues in projects of local companies.

The team members are evaluated by their knowledge and experience in system development and requirements analysis and their commitment and persistence in planning. The experience and knowledge of team members in projects of international companies are significantly higher than those in local companies.

The involvement of customers in the planning of software projects of international companies is greater than that in projects of local companies. The reason is that clients of international companies are usually overseas, more experienced and demanding. They have more knowledge in software engineering and they require participation in planning to ensure that their requirements are captured by the project team. The results of the analysis are presented in Table 8.8.

Table 8.8: Human factors by the project ownership

Items		N	Means	Std Deviation	T - value	p - value
Project manager experiences (in years)	International	20	3.20	1.70	.656	.516
	Local	44	2.89	1.72		
PM experiences (No. of projects)	International	23	6.83	6.10	.711	.482
	Local	57	5.82	4.59		
Role of experience of Project manager	International	23	3.90	.49	2.018	**.049**
	Local	57	3.64	.65		

Technical ability - team members	International	23	3.81	.57	2.115	**.040**
	Local	57	3.50	.65		
Project manager effort	International	23	3.93	.59	2.184	**.034**
	Local	57	3.60	.66		
Customer involvement	International	23	4.17	.65	4.077	**.000**
	Local	57	3.51	.69		

In brief, the human factors are very different between projects of international and local software companies. The differences reflect the better human resource management and development policies of international companies. The international companies have higher requirements for recruitment, they also have the better compensation and training policies for their personnel.

8.2.3 Technical Factors

The analysis of the differences in applying technical methods and tools between projects of international and local companies indicates that, in general, the application of project management, system development and life – cycle methods was similar in projects of international and local software companies. However, the projects in international companies applied significantly more project management's software and tools than those in local companies. These tools like Gannt chart, progress tracking, overbooking of resources, and workforce assignments. Regarding system development methods, there were no differences in applications between projects in international and local companies. The exception is the Rational Unified Process (RUP) method. Projects in international companies used RUP significantly more than in local.

The results of the significant differences are presented in Table 8.9. Other results are presented in Appendix C, Table 8.10.

Table 8.9: Application of technical methods in the planning by projects ownership

Items		N	Means	Std Deviation	T - value	p - value
Using software for project management	International	23	.91	.29	3.994	**.000**
	Local	56	.55	.50		
Apply RUP	International	23	.52	.51	3.074	**.003**
	Local	57	.19	.40		

The authority for selection of technical methods and tools applications in the software projects belongs to project managers, clients or top managers in software companies. The results indicate that there are no significant differences between projects in international and local companies (see Appendix C, Table 8.11).

8.2.4 Management Approach

The analysis of the differences of management factors between projects in international and local companies indicates some significant differences. Regarding the management support, the availability of resources and management styles, there was little differences between projects in international and local companies. The results show that projects in international companies focus on the objective of minimizing cost and maintaining the schedule more than in local companies. Other objectives such as quality and customer satisfaction show no significant differences between projects in local and international software companies.

The use of communication methods is somewhat different between projects in the international and local companies. Projects in international companies use email to communicate to their customers more frequently than their colleagues in local companies, however they also had less informal meetings with the customer. The reason is that they have more clients overseas than local companies. Communication by email helps to overcome the long-distance problem.

Table 8.10 only presents the results of significant differences. Other results are presented in Appendix C, Table 8.12.

Table 8.10: Management factors by projects ownership

Factors		N	Means	Std Deviation	T - value	p - value
Project objectives						
Cost and time oriented	International	23	3.72	.58	2.333	**.023**
	Local	57	3.35	.76		
Customer oriented	International	23	4.44	.63	.800	.428
	Local	57	4.31	.69		
Communication methods						
Formal meetings	International	23	3.22	.85	-1.395	.170
	Local	57	3.52	.92		
Email	International	23	4.59	.58	2.650	**.010**
	Local	57	4.09	1.09		

8.2.5 Planning Performance And Project Outcomes

Regarding the effort spent for planning, the analysis indicates that the average time and effort that project managers spent were not significant between projects in international and local software companies. The planning performance of projects by ownership is presented in Table 8.11. The projects in international companies indicate a better performance in scheduling and risk analysis than those in local companies.

Table 8.11: Planning evaluation by projects ownership

		N	Means	Std Deviation	T - value	p - value
% time for planning	International	22	24.54	16.84	.627	.534
	Local	54	21.87	16.76		
% effort for planning	International	17	18.94	12.33	.220	.827
	Local	37	18.10	14.72		
Requirements and specifications defining	International	23	3.83	.89	1.597	.118
	Local	57	3.47	.91		
Time and effort estimating	International	23	3.61	.78	.934	.355
	Local	57	3.42	.89		

Schedule setting	International	23	4.22	.74	2.836	**.006**
	Local	57	3.65	.97		
Risk analyzing	International	23	3.61	.78	2.695	**.010**
	Local	57	3.05	.95		

The project outcomes of projects in international companies were evaluated by completion time and cost as well as financial and qualitative benefits (customer satisfaction, enhancing company image, improving staff abilities). The results do not indicate any significant differences in these outcomes between the two groups. These results are presented in Appendix C, Table 8.13. Although there were some differences in planning factors, the outcomes of projects in the international and local companies were similar evaluation. The reasons come from the differences in project objectives and customer requirements. The international companies with focus of oversea clients usually face the high requirements from their customers. The evaluation of success of projects, especially the intangible benefits is the relatively, between outcomes and objectives. Therefore, the similarity in project outcomes between international and local companies does not mean they gain the same results.

8.2.6 Summary

To determine the differences between the two groups, projects in international companies and local companies, the independent – samples t – test was applied. Some significant statistical differences were found. The international company has emphasized oversea clients more than local companies. For this reason, projects in the international companies have more customer involvement and more frequently used email than projects in the local companies. The human factors in international companies were more emphasized than local companies. The projects in the international companies also applied more software tools for project management and used the RUP method for system development than in local companies. In brief, the main significant differences between project in international and local companies related human resource management. Regarding the planning performance, projects in the international companies were better in scheduling and risk analysis. However, there are not significant differences in project outcomes between projects in international and local companies. The relationship between planning input factors and planning performance with project outcomes will be examined in Chapter Nine and these results will provide some explanations for the analysis of differences in these section.

8.3 DIFFERENCES IN SOFTWARE PROJECT TYPES

This section will analyze the differences between three types of software projects: commercial, made-to-order and outsourcing. These project types are abbreviated to C, M and O respectively. The sample includes 18 commercial, 49 made-to-order and 10 outsourcing projects. The purpose of the analysis is to identify the differences in personnel, technical and management factors, planning performance and project outcomes.

8.3.1 Project Characteristics

Clients of software projects are divided into two groups: overseas and local. The analysis indicated that commercial projects have clients in North and South America and European markets more than the made-to-order projects. Outsourcing projects were done mainly for clients in the North American market. The clients of made-to-order projects are local government organizations (Vietnam). There were no differences in the client categories between commercial and outsourcing projects. The results of significant differences are presented in Table 8.12. See Appendix C, Table 8.14 for all analysis results of differences in clients market.

Table 8.12: Project clients by project type

Project clients		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
North America	Commercial	18	.39	.50	**.023**		
	Made-to-order	48	.08	.28		**.035**	
	Outsourcing	10	.50	.53			.593
South America	Commercial	18	.11	.32	**.019**		
	Made-to-order	48	.00	.00			
	Outsourcing	10	.00	.00			.163
Europe	Commercial	18	.33	.49	**.050**		
	Made-to-order	48	.08	.28		.880	
	Outsourcing	10	.10	.32			.137
Government organization	Commercial	18	.56	.51	.731		
	Made-to-order	48	.60	.49		**.018**	
	Outsourcing	10	.20	.42			.061

The analysis of the project duration, cost, and size between the three types of projects indicates that there is no significant difference in the duration between these projects. Made-to-order projects control costs better than commercial projects. In fact, the cost for made-to-order projects depends mainly on the client and is difficulty to change, while the cost for commercial software projects is controlled by the parent company. The budget for commercial projects could be changed if the changes in project specifications proposed by project team are approved by the parent company. With made-to-order projects, the change in budget is more difficult to approve. The project size in terms of number of project members in outsourcing is significantly higher than made-to-order projects. Table 8.13 only presents the analysis of significant differences. Other results are presented in Appendix C, Table 8.15.

Table 8.13: Project duration, cost and size by project type

Items		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
Project cost (**)	Commercial	17	3.00	1.54	**.042**		
	Made-to-order	48	2.13	1.06		.341	
	Outsourcing	10	2.60	1.43			.503
Project size (number of people in project team)	Commercial	17	10.44	5.24	.128		
	Made-to-order	43	8.6	5.14		**.050**	
	Outsourcing	9	12.44	6.17			.544
(**) 1 = < 90%, 2 = 90 – 109%, 3 = 110 – 129%, 4 = 130 – 149%, 5 = 150 – 199%, 6 = > 200%							

8.3.2 Human Factors

The analysis of differences in human factors between the three groups of project types indicates that there are significant differences in the effort that project managers spend for planning. The level of effort in the commercial project is greater than in the made-to-order and outsourcing projects. Commercial software is a product that is developed by the software companies for an anticipated market need. The project manager has to define the product specifications, scope, etc. based on the project team's estimation of user needs. This process requires more effort than made-to-order or outsourcing projects in which the requirements are defined mainly by the customer. The experience of project managers in all project types is not significantly different.

Another significant comparison is the involvement of the customer in planning. This is highest in commercial projects as compared to made-to-order and outsourcing. This seems unlikely but in practice, the commercial projects have to define the customer needs. They use professionals in the project as a role of end – user, or in some cases they put themselves in the position of the user. For this reason, the involvement of customer in commercial project was evaluated as high. The analysis also indicates no significant differences in evaluation of team capability between the three types of projects. The significant results are presented in Table 8.14. All analysis results are presented in Appendix C, Table 8.16.

Table 8.14: Human factors by project type

Human factors		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
Project manager effort	Commercial	18	3.97	.61	**.046**		
	Made-to-order	49	3.62	.63		.497	
	Outsourcing	10	3.45	.73			**.050**
Customer involvement	Commercial	18	4.17	.78	**.009**		
	Made-to-order	49	3.57	.70		.719	
	Outsourcing	10	3.50	.53			**.013**

Highest score is 5

8.3.3 Technical Factors

Analysis indicates that there were no significant differences in applying project management, system development and life cycle methods between types of projects except for using software and tools in project management. The use of tools (software) for project management in commercial projects was higher than in made-to-order projects. In the outsourcing projects, the clients were more involved in the choice of the methods, tools and techniques than in commercial projects. Clients of outsourcing projects often are experts and have specific requirements for techniques used in the projects. Table 8.15 presents the significant differences. Other analysis results are presented in Appendix C, Table 8.17 and 8.18. In short, there are few significant differences in technical factors between the three types of projects.

Table 8.15: Technical factors by project type

Technical factors		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
Using software for project management	Commercial	18	.83	.38	**.024**		
	Made-to-order	48	.56	.50		.430	
	Outsourcing	10	.70	.48			.464
Selection technical tools and methods by clients	Commercial	18	.17	.38	.293		
	Made-to-order	49	.27	.46		.099	
	Outsourcing	10	.60	.52			**.035**

8.3.4 Management Approach

The management approach in projects is considered through the factors of management support, objectives, communication methods, resource availability, and management style. Although many aspects of the management approach were assessed, there were no significant differences between the types of projects. The analysis results are presented in Appendix C, Table 8.19.

Regarding management support, the analysis indicates that, in general, there were no significant differences in the top – down and functional support between the three project types. Analyzing the functional support through the participation of functional departments during sofware engineering process shows some significant differences. The functional support in commercial projects is higher than in outsourcing projects (See Table 8.16). This is because in the commercial projects, software specifications are defined by estimated requirements. The project team needs information from functional departments like sales, marketing, or customer service to define the specifications and scope for a commercial project. Similarly, in made-to-order projects, the project team needs to work closely with functional departments of the clients to define their requirements. The support of the client's functional departments in made-to-order projects is also higher than in outsourcing projects.

Table 8.16 Functional supports by project type

Participation of functional departments of …		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
Parent companies	Commercial	18	3.89	.68	.078		
	Made-to-order	49	3.53	.82		.173	
	Outsourcing	10	3.20	.63			**.014**
Clients	Commercial	17	3.35	1.41	.513		
	Made-to-order	48	3.60	1.11		**.018**	
	Outsourcing	10	2.50	1.18			.106

In brief, there were no significant differences in management factors between three project types. In fact, the management factors are influenced by the parent companies through the existing policies of human resources, quality management, customer relations, and etc. Therefore, the management factors will have the same influence on the three types of projects of a company.

8.3.5 Planning Performance And Project Outcomes

The analysis of planning performance indicated that commercial projects defined requirements and specifications better than made-to-order and outsourcing projects. Commercial projects also had a better risk planning than outsourcing projects. The requirements and specifications of commercial projects are mainly defined by the project team, not from outside parties. The project team, therefore, can well control software specifications as well as estimate the risks of their project. The effort spent for planning made-to-order projects was significantly higher than outsourcing projects. The reason is in made-to-order projects, the project team has to collaborate with their customers to clearly define the requirements and software specifications while in outsourcing project, this information is provided by the client. Table 8.17 presents the analysis results.

Table 8.17: Planning performance of projects by type

		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
% time for planning	Commercial	15	27.40	18.83	.390		
	Made-to-order	48	22.67	16.08		.342	
	Outsourcing	10	16.80	17.29			.162
% effort for planning	Commercial	10	14.20	12.08	.107		
	Made-to-order	34	21.93	14.42		**.000**	
	Outsourcing	7	6.43	3.46			.080
Requirements & specifications defining	Commercial	18	4.00	.84	**.030**		
	Made-to-order	49	3.47	.87		.456	
	Outsourcing	10	3.20	1.03			**.050**
Time and effort estimating	Commercial	18	3.61	.98	.439		
	Made-to-order	49	3.41	.81		.978	
	Outsourcing	10	3.40	.84			.556
Schedule setting	Commercial	18	4.06	1.06	.356		
	Made-to-order	49	3.80	.84		.225	
	Outsourcing	10	3.30	1.16			.106
Risk analyzing	Commercial	18	3.44	.92	.356		
	Made-to-order	49	3.20	.96		.063	
	Outsourcing	10	2.70	.67			**.022**

There are many project outcomes considered in this analysis. However, there were only significant differences related in the outcome of meeting specifications defined in different project types (Table 8.18). The commercial and made-to-order projects were evaluated better than outsourcing projects in terms of meeting specifications defined in the planning stage. The clients of outsourcing projects are more professional users or software dealers. Their requirements and evaluation are harder to satisfy than other clients. The successful outsourcing projects also did not have a positive evaluation by the parent company like commercial projects. Other outcomes such as project results in terms of cost and time, financial and non – financial benefits were not statistically significant between the commercial, made-to-order and outsourcing projects. All analysis results are presented in Appendix C, Table 8.20.

Table 8.18: Project outcomes by project type

Project outcomes		N	Means	Std Deviation	p - value		
					C - M	M - O	C - O
Meet all specifications defined in plan stage	Commercial	18	4.11	.58	.442		
	Made-to-order	49	3.98	.69		**.025**	
	Outsourcing	10	3.50	.53			**.010**

8.3.6 Summary

There are few important differences between the three types of projects. Some important results related to the customer and defining requirements and specifications. The involvement of the customer in commercial projects was higher than in made-to-order and outsourcing projects. Defining of customer requirements and product specifications of commercial projects was also better than other project types.

The other differences between three project types relate to efforts that project managers spent for planning, the participation of clients in choosing technical methods and techniques applied in software project, and the support of functional departments. In general, the project manager effort and the application of technical methods in commercial projects were more than made-to-order and outsourcing projects. The differences in planning performance and project outcomes (met product specifications) are related to customer involvement. The customer involvement was highest in commercial projects. This results in the best of product specifications satisfaction, and risk analysis of commercial.

9

THE RELATIONSHIP BETWEEN PLANNING FACTORS, PLANNING PERFORMANCE AND PROJECT OUTCOMES

9.1 INTRODUCTION

This chapter presents our main findings. In particular, we disscuss the results of the correlation and regression analyses and comment a lot of tests of hypotheses in order to verify the theoretical conjuntures we made. The chapter is completed with the summary of our findings.

As presented in Chapter Seven, the characteristics of the research sample include the composition of Vietnamese software companies as well as software projects in terms of company age, ownership, products, clients and project types, product, client, duration, size (in terms of the number of people involved in the project team and in different software engineering tasks). These characteristics are considered in this analysis and discussion about the findings.

9.2 DATA ANALYSIS

Chapter Four described the model to test the hypotheses that are analyzed in this chapter. The first model considered the relationships between personnel, technical and management factors and planning performance. The second model presented the relationships between planning performance and five project outcomes. The last model also considered the influence of project characteristics (size and ownership) on the planning performance. Two methods are employed to test these hypotheses: the classical multiple regression analysis and the binary logit regression analysis.

The variables used in the analysis of this research are presented in Appendix C, Table 9.1. Except for the variables that measure a specific value like technical methods applied in the project, most are operationalized by a multiple-item scale. The most important criterion of the quality measure is its validity that is, whether the designed measurement is measuring what it intends to measure (Baker, 1994). It is also important that a measure be consistent, such that

when it is repeatedly used, it will lead to the same results. This consistency in measurement is referred to as reliability. In the following section, the reliability and validity of the measures are assessed to ensure that the variables used in the models are empirically appropriate.

9.3 RELIABILITY AND VALIDITY OF MEASURES

9.3.1 Reliability

To evaluate the construct's internal consistency, reliability and factor analysis are used. Factor analysis reduces the number of variables and identifies the specific constructs in the research model. Internal consistency checks the degree to which a multiple–element dimension really measures a unique phenomenon or idea, and the degree to which the elements that belong to this dimension have internal consistency (Bryman and Cramer, 1994). Internal consistency was measured using Cronbach's alpha, which is the most widely applied method. The Cronbach' alpha calculates the mean value of the correlation coefficients between all possible split – half combinations. The Cronbach's alpha is computed for the relevant variables that are presented in Table 9.1. In general, the lower limit for Cronbach's alpha is 0.7, although it may decrease to 0.6 in exploratory research (Robinson *et al.*, 1991). The reliability of constructs presented in Table 9.1 indicates that the proposed constructs have a relatively high reliability, ranging from 0.69 – 0.93, which is considered as satisfactory (Nunnally, 1978, Robinson *et al.*, 1991).

Table 9.1: Consistency measure of the constructs

Variables	**Cronbach Alpha**
Independent variables	
Project manager effort	.767
Project manager experience	.719
Team members capability	.828
Management support	.685
Availability of resources	.777
Cost & time oriented	.835
Customer oriented	.833

Dependent variables	
Planning performance	.769
Success of the project	.758
Non- financial benefits of the project	.729
Financial benefits of the project	.741

9.3.2 Content Validity

Content validity concerns the instrument's adequacy for the measurement of the concept or idea that it measures. The measures should represent all the ideas relevant to a conceptual space (Neuman, 2000). The validity comes from the process to construct the conceptual framework and specify measurements. In this study, the conceptual framework and measurements are based on theory and previous studies. Many relevant results from other studies were reviewed in Chapter Two and Chapter Three providing the foundation for this study. The summary thereof establishes validity of the content.

9.3.3 Construct Validity

Construct validity relates to measures with multiple indicators. A construct is valid when its multiple measures operate in similar way and also diverge from opposing constructs. Factor analysis is conducted to provide evidence for the discriminant and convergent validity of the measures. The Kaiser Meyer Olkin test of sampling adequacy (KMO) is used to certify that factor analysis could be applied to the variables of each category. Then principal components analysis and an oblique rotation were used to extract those factors required to adequately describe the variables in each category.

The results indicated uni-dimensionality of every construct. Most of the loadings approached or exceeded 0.8. This provides support for the validity of the measurement. Parameters estimated by factor analysis are presented in Appendix C, Table 9.2. In the following sections, the validity of the variables will be analyzed.

The validity of planning factors

Planning factors include human, technical and management factors. However, reliability and validity assessment are only applied for human and management factors because the technical factors are measured by nominal scale.

The descriptive statistics for the human factors were presented in Chapter Seven, Table 7.3. The factor analysis identified two items of ***project manager effort*** as a single factor that explains 81% of the variance. The five items that measure the ***project manager experience*** is grouped as a single variable. The eigenvalue is 2.407 to explain 48% of the variance. Similarly, the factor analysis carried out for three items of ***team member*** ability yielded a single factor that explains 75% of the variance. Because ***customer involvement*** is measured by only one item, factor analysis is not applied.

There are three specific management factors, including management support, project objectives and resource availability. To increase the valid observations of management support, the item of "committed sponsor" was excluded because only half of the projects have sponsors. The factor analysis carried out on the observations of three items of ***management support*** yielded a single factor that explains 51% of the variance. Four items of project objectives were grouped into two factors including ***cost and time oriented*** and ***customer oriented*** with the percentage of total variance is 55% and 31% respectively. Similarly, four items of variables of ***Resource availability*** were also grouped into one factor with the percentage of total variance is 61. In this analysis, only the "*customer oriented"* variable had an average validity based on the percentage of variance; the others had adequate validity.

The validity of planning performance

The planning performance is measured through four items. The result of factor analysis created only one factor that explains 59% of the variance.

The validity of project results

Project outcomes are considered by different aspects, including six items to measure different outcomes of the project and four items to measure the success of the projects in different viewpoints.

Project success is considered through the evaluation of different perspectives of a software project. Because not all projects have sponsors, the item "Success –from the sponsor point of view" was excluded. Factor analysis produced only one item, which is called "success of the project", that explains 67% of the variance. Factor analysis for six items of project outcomes produced two factors, called ***Qualitative benefits*** or ***Non-financial benefits*** that explains 55% of the variance and ***Financial benefits*** that explains 79% of the variance.

9.4 CORRELATION ANALYSIS

Correlation analysis is conducted to consider the relationship between the variables. Table 9.2 presents the results of the correlation analysis between 16 variables, in which the variables from 1 to 15 are planning factors and variable 16 is planning performance. There is a significant correlation between planning performance and team members' ability, project manager effort, customer involvement, applying project management method, management support, both project objectives like cost and time oriented and customer oriented and resource availability. The correlation analysis indicated that, most of human factors are correlated to planning performance while only one of the technical factors was related. In the management factors, only management style had no correlation with planning performance. There are also some correlations between the independent variables. The significant correlations between the above variables are not considered the causal relationships between planning factors (independent variables) and planning performance (dependent variable) and project outcomes (dependent variables).

Table 9.2: Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	.697**	1														
3	.528**	.481**	1													
4	.104	.074	.289**	1												
5	.221*	.218	.282**	.131	1											
6	-.002	.000	-.052	-.181	.163	1										
7	-.099	-.047	.072	.173	.207	-.003	1									
8	.057	.148	.153	.091	-.025	.093	.119	1								
9	-.072	-.226*	-.051	.145	.000	-.126	.097	-.240*	1							
10	.617**	.609**	.455**	.082	.178	.026	-.050	.004	-.076	1						
11	.249*	.212	.129	-.120	-.119	.158	-.057	.051	-.056	.125	1					
12	.337**	.280**	.275*	.231**	.128	-.039	.017	.112	-.187	.320**	-.286*	1				
13	.510**	.475**	.323**	.067	.126	-.069	-.189	-.016	-.104	.335**	.060	.228*	1			
14	.053	.016	.014	-.027	.170	.051	.042	-.120	-.017	-.052	-.002	-.177	.141	1		
15	-.061	-.017	.227*	.020	-.037	-.156	.069	.049	-.015	.063	-.117	.135	-.062	-.696**	1	
16	**.840****	**.844****	**.606****	**.100**	**.262***	**.040**	**-.007**	**.056**	**-.114**	**.703****	**.291****	**.325****	**.483****	**.024**	**.008**	**1**

1=Team members ability	5=Apply PM method	9=Spiral	13= Resource availability
2=PM effort	6=Object - oriented	10=Management support	14=People oriented
3=Customer involvement	7=RUP	11=Cost & time oriented	15=Work oriented
4=PM experiences	8=Waterfall	12=Customer oriented	16=Planning performance

Note: ** significant at 0.001 level; * significant at 0.05 level

Based on the conceptual framework and the hypotheses developed in Chapter Four, the regression models, including Models 1, 2 and 3 are tested. Discussion of the qualitative responses obtained is incorporated with the statistical results since they add clarification to the findings.

9.5 MULTIPLE REGRESION ANALYSIS

The first technique to examine the hypotheses is multiple regression analysis. This section also checks if the hypotheses of the clasical multiple linear regression model are tenable or not and presents estimated the regression models (Model 1 – 3) and their overall fit.

9.5.1 Assumptions in multiple regression analysis

The classical multiple linear regression model supposes the linearity of the functional form, and the homokedasticity, no correlation, and normality of the error terms. These assumptions are considered for every model.

We can detect problems of autocorrelation, heteroskedasticity and nonlinerity by considering the plot of the residual values. If the pattern of the residuals seems random, we can suppose that there are no such problems. This simple verification was made and, indeed, the scatter plots of Model 1, 2, and 3, presented in Appendix C, Figures 9.1 – 9.3, don't signal any particular problem. Besides, the histograms of the standardized residual (Figures 9.4 – 9.6) suggest that the normality assumption of the error terms is also met. At least, it seems that we don't encouter any multicollinearity problem.

9.5.2 Estimating the Regression Models

This section presents the statistical significant of three regression models. The conclusions of hypotheses are drawn from the significance of the overall model and the significance of the regression coefficients.

9.5.2.1 Model 1: The relationships between planning factors and planning performance

The Model 1 expresses the relationship between planning performance (dependent variable) and human, technical and management factors (independent variables). The regression results in Table 9.3 indicate that, together the sixteen variables explain 86% of the variance in planning performance ($r^2 = .855$) and the model is statistically significant at the 0.05 level (F-test). There are 5 independent variables that have significant relationships with planning performance, including project manager effort, team members' ability, customer involvement, management support and cost and time oriented objective. The correlation coefficients are also shown in Table 9.3.

Table 9.3: Multiple Regression Results of Model 1
(Dependent variable: Planning performance - Degree of freedom: 79)

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	-1.050	0.459	-2.288	**0.025**
PM effort	0.442	0.094	4.702	**0.000**
PM Experiences	-0.049	0.062	-0.782	0.437
Team members ability	0.319	0.101	3.144	**0.003**
Customer involvement	0.134	0.063	2.119	**0.038**
Apply PM method	0.014	0.078	0.180	0.858
Object - oriented	0.052	0.071	0.725	0.471
RUP	0.072	0.079	0.971	0.335
Waterfall	-0.105	0.096	-1.092	0.279
Spiral	-0.011	0.093	-0.115	0.909
Management support	0.154	0.066	2.338	**0.023**
Cost & time oriented	0.118	0.058	2.016	**0.048**
Customer oriented	-0.019	0.105	-0.012	0.858
Resource availability	0.039	0.063	0.615	0.541
People oriented	0.011	0.049	0.224	0.823
Work oriented	0.005	0.043	0.119	0.906
$R^2 = 0.855$	Adjusted $R^2 = 0.821$	F = 25.161	Sig. F = 0.000	

9.5.2.2 Model 2: The relationships between planning performance and project success and outcomes

The effect of planning performance on project outcomes is considered by the Model 2 (including model 2a – model 2e) with the independent variable as planning performance and dependent variable as project outcomes. Hypotheses H4a – 4e are tested through the use of these five regression models with different dependent variables and planning performance (as the independent variable). The results are presented in Table 9.4.

Table 9.4: Multiple Regression Results of Model 2

Independent variables	(β)	S.E (β)	t – value	Sig.
Model 2a: Dependent variable: Project success				
(Constant)	1.239	.364	3.399	**.002**
Planning performance	.664	.106	6.385	**.000**
$R^2 = 0.545$ Adjusted $R^2 = 0.531$	F = 39.504		Sig. F = 0.000	
Model 2b: Dependent variable: Qualitative benefits				
(Constant)	2.876	.236	12.177	.000
Planning performance	.347	.066	5.270	**.000**
$R^2 = 0.263$ Adjusted $R^2 = 0.253$	F = 27.777		Sig. F = 0.000	
Model 2c: Dependent variable: Financial benefits				
(Constant)	2.191	0.322	6.813	0.000
Planning performance	0.384	0.090	4.288	**.000**
$R^2 = 0.191$ Adjusted $R^2 = 0.180$	F = 18.387		Sig. F = 0.000	
Model 2d: Dependent variable: Completion time				
(Constant)	3.753	.481	7.801	.000
Planning performance	-.695	.105	-6.631	**.000**
$R^2 = 0.360$ Adjusted $R^2 = 0.352$	F = 43.965		Sig. F = 0.001	
Model 2e: Dependent variable: Completion cost				
(Constant)	3.753	.481	7.801	.000
Planning performance	-.445	.134	-3.317	**.001**
$R^2 = 0.352$ Adjusted $R^2 = 0.124$	F = 11.003		Sig. F = 0.001	

All five models are statistically significant at the 0.05 level. This result indicates the significant relationships between all five dependent variables and planning performance. The

R^2 ranges from 0.124 to 0.531 indicate that the regression models fit to 12.4% to 53.1% of data. The regression coefficients (β) are also significant. This confirms again the relationships between planning performance and project success and outcomes.

9.5.2.3 Model 3: The relationship between project characteristics and planning performance

The model 3 is to examine the assumptions of the impacts of project characteristics on planning performance. These hypotheses are also analyzed by using multiple regression models. For testing these hypotheses, a new model is developed (Model 3) with two more independent variables to represent the project size and ownership. These are considered as dummy variables. The regression analysis is presented in Table 9.5.

Table 9.5: Multiple Regression Results of Model 3
(Dependent variables: Planning performance - Degree of freedom: 68)

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	-1.204	.467	-2.576	**.013**
Project manager effort	.424	.095	4.483	**.000**
Project manager experiences	-.044	.064	-.694	.491
Team members ability	.284	.104	2.718	**.009**
Customer involvement	.168	.068	2.463	**.017**
Apply PM method	.004	.080	.048	.962
Object - oriented	.059	.074	.801	.427
RUP	.020	.091	.217	.829
Waterfall	-.065	.098	-.660	.512
Spiral	.039	.101	.385	.702
Management support	.194	.070	2.790	**.007**
Cost and time oriented	.208	.095	2.187	**.033**
Customer oriented	-.108	.108	-1.000	.322
Resource availability	.087	.066	1.329	.190
People oriented	.015	.049	.311	.757
Work oriented	.021	.043	.493	.624
Project size	.104	.080	1.289	.203
Project ownership	.029	.096	.308	.759
R^2 = 0.875	Adjusted R^2 = 0.836	F = 22.28	Sig. F = 0.000	

The regression results in Table 9.6 indicate that, this model is statistically significant at 0.05 level of F – test. This model explains 87.5% the variance in planning performance ($r^2 = .875$). However, the project characteristic variables do not influence the planning performance (the regression coefficients are not significant).

9.6 LOGISTIC REGRESSION ANALYSIS

The type of the dependent variable of our models is principally nominal. This fact can conduct to several difficulties in the estimation. In order to take it into account, we try therefore to reestimate our models with a logistic regression approach.

To apply the logistic regression analyses for Model 1 – Model 3, the dependent variables, such as planning performance, project success, qualitative benefits, financial benefit, completion time, and completion cost were recoded as binary variables, in which 1 represents satisfaction and 0 represents dissatisfaction. The logstic regression model permits us to estimate the probability of satisfaction. The estimated parameters by the regression are not always easy to interpret. But nevertheless, we are able to test the pertinence of a model and its variables. The model is tested by a chi-square test for – 2LL (- 2 log likelihood) and the Wald statistic permits us to test individual coefficients. The estimated percentage of prediction is also used to assess the fit of the model.

9.6.1 Model 1: The relationships between planning factors and planning performance

The logistic regression analysis for Model 1 is presented in Table 9.6. The results indicate that the model is statistically significant. The value of -2LL of 18.563 indicates the good fit of overall model. However, the Wald statistic indicates that only one independent variable, i.e the manager's effort, is significant at a level of 5%.

Table 9.6: Logistic regression analysis for the model 1

Independent variables	(β)	S.E (β)	Wald	df	Sig.
(Constant)	-100.426	40.447	6.165	1	.013
Project manager effort	7.319	3.472	4.444	1	**.035**
Project manager experiences	.667	2.119	.099	1	.753

Team members ability	5.000	2.935	2.902	1	.088
Customer involvement	1.230	1.618	.578	1	.447
Apply PM method	1.697	2.285	.552	1	.458
Object - oriented	1.256	2.057	.373	1	.542
RUP	2.852	3.999	.508	1	.476
Waterfall	-.579	2.013	.083	1	.774
Spiral	-1.661	3.246	.262	1	.609
Management support	2.376	2.516	.892	1	.345
Cost and time oriented	1.368	2.329	.345	1	.557
Customer oriented	1.303	2.230	.341	1	.559
Resource availability	3.028	1.892	2.562	1	.109
People oriented	2.620	1.893	1.915	1	.166
Work oriented	1.782	1.784	.998	1	.318
-2LL= 18.563	Chi-square = 41.121	Sig. = 0.000	Percentage correct = 96.3%		

9.6.2 Model 2: The relationships between planning performance and project success and outcomes.

The logistic regression analysis for Model 2 in Table 9.7 indicates that all five models of the relationships between planning performance and the probability of satisfactory success and outcomes are statistically significant at 0.05 level. The values of -2LL of these models ranging from 34.445 to 96.162 indicate the acceptable fit of the models. The overall percentages of correct predictions of these models are from 60% to 83%. The Wald test also indicates that regression coefficients (β) are significant at 0.05 level.

Table 9.7: Logistic regression analysis for the model 2

Independent variables	(β)	S.E (β)	Wald	df	Sig.
Model 2a: Dependent variable: Project success					
(Constant)	-8.647	3.073	7.917	1	.005
Planning performance	2.291	.858	7.137	1	.008
-2LL= 34.445	Chi-square =10.559	Sig. = 0.001	Percentage correct = 82.9%		

Model 2b: Dependent variable: Qualitative benefits					
(Constant)	-2.806	1.583	3.141	1	.076
Planning performance	1.251	.485	6.650	1	.010
-2LL= 72.092	Chi-square = 7.969	Sig. = 0.005	Percentage correct = 78.8%		
Model 2c: Dependent variable: Financial benefits					
(Constant)	-4.464	1.403	10.127	1	.001
Planning performance	1.105	.381	8.422	1	.004
-2LL= 96.172	Chi-square = 9.678	Sig. = 0.002	Percentage correct = 70%		
Model 2d: Dependent variable: Completion time					
(Constant)	-9.314	2.129	19.136	1	.000
Planning performance	2.683	.610	19.350	1	.000
-2LL= 74.880	Chi-square = 35.973	Sig. = 0.000	Percentage correct = 73.8%		
Model 2e: Dependent variable: Completion cost					
(Constant)	-3.594	1.371	6.869	1	.009
Planning performance	1.190	.398	8.929	1	.003
-2LL= 95.165	Chi-square = 10.685	Sig. = 0.001	Percentage correct = 66.3%		

9.6.3 Model 3: Relationship between project characteristics and planning performance

The model 3 was also estimated by a logistic regression model. Unfortunately, the results are not significant.

9.7 THE IMPACT OF PLANNING FACTORS ON PLANNING PERFORMANCE

The impact of planning factors on planning performance is examined by Model 1. This model is statistical significant. The meanings of each relationship are discussed in following sections. Due to the complex of the meaning of coefficient in logistic regression, the relationships are mainly discussed based on the coefficients in multiple regression models.

9.7.1 The Effect Of The Human Factors On Planning Performance

Hypothesis 1a: The positive effect of Project manager effort on planning performance

It is hypothesized that planning performance is better when the project manager puts more effort on planning. The multiple regression results in Table 9.3 indicate the significant positive relationship between project manager effort and planning performance supporting hypothesis 1a. The interviews reveal that project managers usually remember the project in which they spent more efforts . The study found that the project manager spends about 18% of their effort and 22% of their time for planning. This is quite high as compared to the findings of Sauer and Cuthbertson (2003). In their study, the project managers spent about 12.3% of their time for planning. This difference could come from the variations in project size and duration. The role of the project manager's effort to planning performance supports and complements the findings of previous research, in which the role of project manager is important for project success (Callahan and Moretton, 2001; Nguyen M, 2003).

Hypothesis 1b: The positive effect of Project manager experiences on planning performance

It is assumed that project managers with more experience will produce the better planning performance. However, both multiple and logistic regression analysis shows this relationship is statistically insignificant. Project managers in this study have, on average, three years of experience in the position of project management and have managed six projects. Although the project managers highly evaluated the role of their experience for managing the project team (82.5%) or for communication with customer and defining scope and objectives of projects (71%), the project manager's experience is not related to planning performance.

However, there is a significant positive relationship between project manager's experience and project success. Appendix C, Table 9.8), demonstrates that project manager's experience is important to the overall project rather than only in planning stage.

Hypothesis 1c: The positive effect of Team member ability on planning performance

Project personnel are mostly professional team members. It is assumed that the higher the team members' capabilities are (in terms of knowledge, experience and attitude), the better the planning performance they produce. The multiple regression results in Table 9.3 indicate a significant positive relationship between team member capability and planning performance

(β = .287). The role of team members is also important in producing a good plan. Their knowledge in system development and requirement analysis contributes much to defining software specifications, which is necessary to produce an effective plan. This finding also supports previous studies (Krishnan, 1998; Belout and Gauvreau, 2003).

To achieve a good planning performance, the role of project personnel, including both project manager as well as team members, is important. With the project managers, the amounts of efforts spent for planning with team members are their capabilities.

Hypothesis 1d: The positive effect of Customer involvement on planning performance

Customers are considered as external project members. This is because of their close relationship to the software engineering process. It is assumed that the higher rate of customer involvement, the better of producing planning performance. The multiple regression results in Table 9.3 indicate a positive significant relationship between customer involvement and planning performance (β = .142). Although many project managers said their customers did not understand deeply the software engineering and sometimes could not define clearly their requirements, a better plan could be developed with the customer's involvement. Project managers explained that the involvement of the customer in the early stage of project helps the project team understand customer's needs and capture their requirements. This result is consistent with the previous studies.

9.7.2 The Effect of Technical Factors on Planning Performance

There are three popular types of methods usually applied in a software project. These are the project management methods, system development methods and life - cycle methods. This study assumes that applying the different methods influences planning performance. Many different system development and life – cycle methods are listed in the survey. The most frequent methods or techniques are included in regression model.

Hypothesis 2a: The influence of applying project management method on planning performance

It is hypothesized that a project, which applied a specific project management method has better planning performance. Both the results of multiple and logistic regression do not show a significant relationship between project management methods applied in project and planning performance. This hypothesis is not supported. A correlation test (Pearson test) presented in the Table 9.2, seems to suggest there is a minor correlation between applying project management method and planning performance (correlation coefficient r = 0.262, significant at 0.05 level). The results of the regression analyses do not support Hypothesis 2a.

The project managers in this survey indicated that software projects usually apply MS Project tools. Very few projects apply methods that are specifically designed for software project. Some companies have designed project management procedures and tools for themselves. White and Fortune (2002) studied the application of project management techniques and found that project management software is frequently used in projects. It means that most of software projects have applied a certain range of project management methods. This could be the reason why applying project management method does not influence planning performance.

Hypothesis 2b: The influence of applying a system development method on planning performance

It is assumed that, applying different system development methods influences the process of software engineering and planning performance. Theoretically, there are many kinds of system development methods. This research suggests the two most popular methods: Object – oriented (29%) and RUP (44%). The regression model (Model 1) uses two of these methods as the independent variables. The results are shown in Table 9.3. The results do not reveal a significant relationship between these variables and planning performance. Hypothesis 2b is not supported.

Hypothesis 2c: The effect of applying life – cycle method on planning performance

It is hypothesized that, applying different system development methods influence the process of software engineering and planning performance. Verner, Overmyer and McCain (1999) studied the influence of applying different life-cycle methods on project outcomes. They found that applying the wrong methodology could lead to project failure. The findings

indicate two methods most applied in software projects are Spiral (20%) and Waterfall (19%). Two methods were then used as independent variables in the Model 1. The results of both multiple and logistic regression indicate an insignificant relationship between applying life – cycle methods (both Waterfall and Spiral).

In fact, the application of project management techniques and methods (including life-cycle methods) in software companies is not very systematic, except for some big companies. The software projects usually apply basic tools for project management, meanwhile many project managers do not know about the life-cycle method. This is the reason why the application of the methods has not influenced the planning performance and project outcomes.

Not too many researches have studied the role of applying different methods of project management, while system development and life- cycle are usually used in software projects. This study does not find support for the relationship between applying these methods and planning performance.

9.7.3 The Effect of Management Factors On Planning Performance

Many previous studies considered Management as an important factor influencing the project success. From the conceptual framework, this study examined the relationships between four management factors, including management support, project objectives, resource availability and management style, and planning performance.

Hypothesis 3a: The positive effect of management support on planning performance

It is assumed that more management support results in better planning performance. Management support includes both top managers and functional departments. This relationship is statistically positive significant in the multiple regression only. This means more support from top management and functional departments relate to better planning performance. The important role of management support has been identified in other researches. Belout and Gauvreau (2003) found that management support is a significant predictor of project success, not only in the planning stage but also throughout the project. This hypothesis is supported and the study of Belout and Gauvreau (2003) is confirmed.

Hypothesis 3b: The effect of project objectives on planning performance

It is hypothesized that the differences in setting priority project objectives will influence the planning performance. Abdel-Hamid and Swett (1999) found that the difference in project goals focused on the "cost and schedule" or "quality and schedule" influenced the project outcomes. With the given specific software project goals, managers plan and make resource allocation choices to meet those goals. This study considers the role of planning in the influence of project objectives on project outcomes. The multiple regression analysis of Model 1 in Table 9.3 only reveals a significant relationship between the objective of cost and time orientation and planning performance. The correlation analysis (Pearson test) results in Table 9.2 show the correlations between both objectives (cost and time oriented and customer oriented) and planning performance (correlation coefficient $r = 0.291$ and $r = 0.325$ respectively, significant $p<0.05$). Project objectives only partially relate to planning performance. Hypothesis 2b is partially supported. However, the logistic regression analysis did not indicate the impact of both objectives on the probability of satisfactory planning performance.

Considering the relationship between planning factors and project outcomes by multiple regression analysis, there is the significant relationship between the customer – oriented goal and qualitative benefits (Appendix C, Table 9.9) and between cost/ time oriented goal and completion time (Appendix C, Table 9.10). The results imply that the impact of project objectives on project outcomes is clearer than that on project performance. Planning performance is not influenced by the project objectives.

Hypothesis 3c: The positive effect of resource availability on planning performance

This study assumed that the higher availability of resources, the better the project manager could use resources, that is relating to better planning performance. The results of both multiple and logistic regressions do not indicate a significant relationship between resources availability – both financial and human availability – and planning performance. The correlation analysis in Table 9.2, however, indicated a significant correlation between these variables. The correlation does not appear in the regression model when all variables are considered together. The hypothesis is not supported.

In fact, most projects are small and the constraint of resources is not a problem (only 18% and 10% projects have low availability of manpower and finance, respectively). Therefore, the availability of resources does not significantly influence the planning performance.

Hypothesis 3d: The positive effect of people – oriented leadership style on planning performance

It is hypothesized that the difference in management style of a project will influence planning performance. Management style in this study refers to the leadership styles. The two most popular leadership styles are examined, including People oriented and Work oriented. These variables are included in the regression Model 1.

In a software project, people are the main input developing software products. A people – oriented leadership style seems to be appropriate for software projects. The effect of this style considered in the regression Model 1. The analyses by both multiple and logistic, however, indicates no significant relationship between the people – oriented style and planning performance or the probability of satisfied planning performance. The relationships between work – oriented style and planning performance were also analyzed in Table 9.3 and 9.6. The results indicated no significance relationship. Hypothesis 3d is not supported.

Managers in software projects do not have a consistent management style. In some projects, they applied both the work – oriented and people - oriented styles. Some other managers could not identify their management style. This could be the reason why there is no relationship between management style and planning performance.

9.8 THE IMPACT OF PLANNING PERFORMANCE ON PROJECT OUTCOMES

The discussions of relationships between planning performance and project success and outcomes tested by models of multiple and logistic regression are presented in this section. It is assumed that planning performance significantly impacts the evaluation of overall success of all four project outcomes. The better planning performance relates to more likely project success in which both financial and qualitative benefits are better, and completion time and costs are lower. The multiple and logistic regression analyses for each hypothesis are presented in Tables 9.4 and 9.7. The impact of planning performance is also analyzed deeply

by considering planning performance composed into four items, including defining requirements and specifications, estimating time and effort, scheduling and risk analysis. The linear multiple regression is carried out for this analysis.

Hypothesis 4a: The planning performance positively effects project success

Project success is evaluated through perception from different perspectives, such as the project manager, the customer, the parent company and the sponsor. The factor analysis indicated that these items could be grouped as a uni-dimensional project success variable. The multiple and logistic regression analyses are conducted between planning and the evaluation of overall success and project results presented in Table 9.4 and 9.7. These results indicate the statistically significant relationship. This causal relationship indicates that better planning performance is related to higher project success.

The analysis for relationship between project success and four aspects of planning is presented in Table 9.8. This finding indicates two significant relationships between "well defined requirements and specifications" and "well defined schedule" with project success. The success of a project depends on these tasks of planning more than other tasks. Based on the interviews, the skills of project managers in the risk analysis of projects are not good, even in projects evaluated as the successful ones. This accounts for the insignificant relationship between project success and the risk analysis of a project.

Table 9.8: Project success and planning tasks

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	1.219	0.371	3.285	0.003
Well defined requirements and specifications	0.279	0.084	3.304	**0.002**
Well estimated time and effort	0.093	0.092	1.006	0.323
Well defined scheduling	0.169	0.078	2.182	**0.037**
Well analyzed risks	0.123	0.088	1.396	.173
$R^2 = 0.579$ Adjusted $R^2 = 0.523$	F = 0.332		Sig. F = 0.000	

Dependent variable: Project success

Hypothesis 4b: The planning performance positively effects qualitative benefits of a project

Qualitative benefits of a software project include results like meeting the product specifications, customer satisfaction, enhancing the company image and improving the team members' ability. The multiple and logistic regression analysis indicated the significant of the relationship between planning performance and qualitative benefits (Table 9.4 and 9.7) at the 0.05 level. The relationship between planning performance and qualitative benefits is positive and significant. This section considers the effects of four tasks of planning on the qualitative benefits. Multiple regression analysis is presented in Table 9.9. The results indicate that there are two major planning tasks, such as defining requirements and specifications and setting schedule, that significantly influence the qualitative benefits of a project.

Table 9.9: Qualitative benefits and planning tasks

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	2.767	.229	12.056	.000
Well defined requirements and specifications	.192	.058	3.277	**.002**
Well estimated time and effort	.102	.067	1.524	.132
Well defined scheduling	.140	.055	2.551	**.013**
Well analyzed risks	-.076	.060	-1.257	.213
$R^2 = 0.350$ Adjusted $R^2 = 0.315$	F = 10.077		Sig. F = 0.000	

Dependent variable: Qualitative benefits

Hypothesis 4c: The planning performance positively affects financial benefits of a project

The financial benefits of a project are the monetary benefits that a software project achieves for its parent company or team members. The relationship between planning performance and this outcome are significant at the 0.05 level by both multiple and logistic regression analyses. The results indicate that planning performance positively contributes to financial benefits. Considering this relationship in more detail, the regression results in Table 9.10 show that better estimates time and effort would lead to higher financial benefits. This result is very different from the qualitative benefits that were influenced by defining requirements and specifications and setting the schedule.

Table 9.10: Financial benefits and planning tasks

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	2.133	0.322	6.632	0.000
Well defined requirements and specifications	0.088	0.082	1.077	0.285
Well estimated time and effort	0.300	0.094	3.185	**0.002**
Well defined scheduling	0.038	0.077	.501	0.618
Well analyzed risks	-0.029	0.085	-.347	0.729
$R^2 = 0.244$ Adjusted $R^2 = 0.204$	F = 6.053		Sig. F = 0.000	

Dependent: Financial benefits

Hypothesis 4d: The planning performance negatively affects completion time of a project

The relationship between planning performance and the completion time of a project were analyzed by the multiple and logistic regression that presented in Table 9.4 and 9.7. The results indicate that the models are significant at the 0.05 level. Planning performance is significantly and related to completion time ($\beta_{multiple}$ = -.695; $\beta_{logistic}$ = 2.683). The better planning performances result in the quicker completion times. In logistic regression, the better planning performance relates to higher probability of project finishing on time. The in – depth analysis for different tasks of planning indicates that the better project outcome in terms of completion on time is the result of "well estimated time and effort" and "well defined scheduling". The significant negative relationship between these items and completion time (β = - .281 and - .315) in Table 9.11 supports this hypothesis.

Table 9.11: Completion time and planning tasks

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	5.017	0.376	13.346	.000
Well defined requirements and specifications	-0.027	0.096	-0.284	.777
Well estimated time and effort	-0.281	0.110	-2.549	**.013**
Well defined scheduling	-0.315	0.090	-3.507	**.001**
Well analyzed risks	-0.080	0.099	-0.806	.423
$R^2 = 0.402$ Adjusted $R^2 = 0.370$	F = 12.607		Sig. F = 0.000	

Dependent variable: Completion time

Hypothesis 4e: The planning performance negatively affects completion cost of a project

The multiple and logistic regression models of the relationship between planning performance and completion cost are significant at the 0.05 level. The negative relationship (in multiple regression model) indicates that the better the planning performance is, the lower the project costs. The logistic regression analysis indicates a similar result, that is the better planning performance increases the ratio of probability of satisfied and probability of dissatisfied project in term of cost occurring (positive relationship). The regression results in Table 9.12 clarifies this relationship by multiple regression analysis. The lower completion cost is mainly the result of the better estimation of project time and effort.

Table 9.12 Completion cost and planning tasks

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	3.736	0.472	7.921	0.000
Well defined requirements and specifications	0.089	0.120	0.746	0.458
Well estimated time and effort	-0.455	0.138	-3.295	**0.002**
Well defined scheduling	-0.002	0.113	-0.016	0.987
Well analyzed risks	-0.087	0.124	-0.700	0.486
$R^2 = 0.213$ Adjusted $R^2 = 0.171$	F = 5.085		Sig. F = 0.001	

Dependent variable: Completion cost

In brief, these results confirm the importance of planning related to the overall project outcomes. The hypotheses 4a – 4e, therefore, are fully supported. Better planning performance contributes to better outcomes like financial and qualitative benefits. The important tasks of planning are defining requirements and specifications, estimating project time and effort and scheduling. The impact of risk analysis on project outcomes is not very clear. From interviews, risk analysis in software project is evaluated being weak by most projects (67% projects assessed the risk analysis in their project as inadequate). The role of the risk analysis in planning should be analyzed more deeply. Its effects can be identified when there is a diversification of risks performance among projects.

The results of Dvir *et al*. (2002) also found a positive relationship between project planning and overall project success evaluated by four measures, including meeting planning goals,

end-user benefits, contractor benefits and overall project success. This study not only confirms, but also compliments their findings by considering more criteria of project success.

Planning performance is a major of explanatory variable in the model. It supports the influence of the project manager's effort, team member' ability, customer involvement and management support on project success through planning performance.

9.9 THE IMPACT OF PROJECT CHARACTERISTICS ON PLANNING PERFORMANCE

The project characteristics including size and ownership are assumed to influence the planning performance of a project. Projects with a different size, or ownership could vary in planning performance. These relationships are analyzed by multiple regression.

Hypothesis 5a: The negative influence of project size on planning performance

The software projects in this study are classified as of bigger and smaller size group. A dummy variable called project size was added in the model. The results in Table 9.5 indicate having no significant relationship between project size and planning performance. There is no difference in planning performance between software projects by size. Hypothesis H5a is not supported. The reason is that if the project size in this survey was mostly small, the differences in project sizes would not be sufficient enough to determine differences in managing the project or project outcomes.

Hypothesis 5b: The influence of project ownership on planning performance

Software projects are classified related to local or international software companies. The dummy variable of project ownership is included in the Model 3. The result in Table 9.5 indicates there is no relationship between project ownership and planning performance. Hypothesis H5b is not supported.

Regression analysis does not indicate any significant relationships between project characteristics and planning performance. The differences in planning performance of software projects do not relate to their characteristics. Added variables representing the

project characteristics in Model 3 do not increase the association of planning factors and planning performance as compared to Model 1. In Model 3 the significant relationships between planning factors and planning performance are similar to the Model 1.

9.10 SUMMARY

The regression analysis results are summarized in Table 9.13. These results confirm some previous findings on the role of human factors to planning and the role of planning with project outcomes. From the interviews there are indications from project managers that they have difficulty in realizing their plans. They have agreed that planning gives them a frame for project management and helps to reduce uncertainty, and increase the likelihood of project success.

The results clarify the critical factors for better planning performance. The human factor, including project manager effort, team member' capability and customer involvement, is evaluated as the most important. The analysis indicates the causal influence of the human factors, except for project manager experience on planning performance. Technical factors have no significant influence on planning performance. Among the management factors, management support and project objectives of "minimizing cost and time overrun" have a significant influence on planning performance. The result also demonstrates the explanatory power of planning performance with different project outcomes. The relationships between project characteristics, including project size, type and ownership and planning performance are not significant. The project characteristics have no influence on the planning performance.

Table 9.13: Results of hypothesis testing

Hypothesis	Content	Results of multiple regression analysis
1a	*The positive effect of project manager effort on planning performance*	Supported
1b	*The positive effect of project manager experiences on planning performance*	Not supported
1c	*The positive effect of team member ability on planning performance*	Supported

1d	*The positive effect of customer involvement on planning performance*	Supported
2a	*The effect of applying project management method on planning performance*	Not supported
2b	*The effect of applying system development method on planning performance*	Not supported
2c	*The effect of applying life – cycle method on planning performance*	Not supported
3a	*The positive effect of management support on planning performance*	Supported
3b	*The effect of project objectives on planning performance*	Partially supported
3c	*The positive effect of resource availability on planning performance*	Not supported
3d	*The positive effect of people – oriented leadership style on planning performance*	Not supported
4a	*The planning performance positively affects project success*	Supported
4b	*The planning performance positively affects qualitative benefits of a project*	Supported
4c	*The planning performance positively affects financial benefits of a project*	Supported
4d	*The planning performance negatively affects completion time of a project*	Supported
4e	*The planning performance negatively affects completion cost of a project*	Supported
5a	*The negative influence of project size on planning performance*	Not supported
5b	*The influence of project ownership on planning performance*	Not supported

10

CONCLUSIONS AND MANAGERIAL IMPLICATIONS

This chapter presents the theoretical and managerial implications of the empirical findings along with the discussions and conclusions. The chapter begins with a summary of the findings, and describes the theoretical and practical implications of the study. The suggestions for further research issues are also indicated.

10.1 SUMMARY OF FINDINGS

The first finding relating to the explanatory research described the current status of software project management in Vietnamese software companies. The second finding focused more on planning in software project management. The third finding analyzed the difference between

projects by size, type and ownership. The last finding tested the relationships that were proposed in the conceptual framework in Chapter Four.

10.1.1 Common Problems in Software Projects in Vietnam

This finding was drawn from the exploratory study that included data of 55 software projects in Hochiminh City, the large center of software engineering in Vietnam. The results indicated that companies size and projects size are small. The project manager's ability was evaluated as average. In managing the project, they spent most their time and effort managing personnel and quality, that were followed by communication and time management. The least effort was for cost management. The indicators for measuring programmer's productivity were not standardized in software companies. Therefore, it is difficult to determine the average productivity of Vietnamese programmers.

The most common problem of software projects was of poor planning. The next was of poor communication with customers. This study also suggested the common criteria that project managers have preferred and used for performance. These included, in priority order, customer satisfaction, quality, and completion on time and within budget.

The statistical analysis did not find any correlation between the project size and results. This is consistent with the discussion with project managers in the in – depth interviews and the findings of Aladwani (2002) in the relevant situation of a developing country. The reason for no relationship was due to the small size of software projects. Although projects had a range of size, they were still small. This small variation in project size did not influence the project results.

This research on the common problems of software projects confirmed an important research issue. This related to planning in software projects. It is necessary to have a better understanding of planning and its role in project outcomes. Other results such as identifying the common criteria to specify project results in practice contributed to the literature on software project management. This study has provided the foundation of the conceptual framework to assess the role of planning and performance.

10.1.2 Planning In Software Projects

The in – depth study focused on planning performance, it included 80 software projects. Data was collected in Hochiminh City and Hanoi – the two main locations of software engineering in Vietnam. The results of this research were divided into three parts. Firstly, it presented how planning was implemented in practice. Secondly, the differences between software projects by size, type and ownership were considered. Lastly, the relationships between planning factors, planning performance, and project outcomes were analyzed.

The planning in software projects was considered through three aspects: human, technical and management. Regarding the human resource issues in project planning, three main stakeholders were considered: the project manager, team members and customers. Although project managers have had, on average, only three years of experience in a project leader position, they highly appreciated this experience. The experience and knowledge of requirement definition and system development of team members were evaluated at an average level. The involvement of the customer in project planning was also average.

The technical factor was the tools and methods applied in project planning. For project management, 62% projects applied a specific method. The Rational Rose is a method applied by many projects. The typical tools were used for time management rather than risk or budget management. For system development, the common methods are RUP and Object-oriented. The life-cycle method has been a familiar approach for all project managers. About 65% of the projects applied the life-cycle method in their software development process. The Spiral and Waterfall methods were mostly used.

The management approach examined the different aspects in project planning, including support, goal and scope definition, communication, resource availability and leadership style. The results indicated that the software project team had good support from the top-manager. They also had only average support from the functional department. Only about half the projects were sponsored, but these projects also received commitment from their sponsors. Defining the goals of the project in planning related to the allocation of resources to match the goal. This study found that quality and customer satisfaction were more important than other goals. If there was a trade-off between quality and time or cost, the project managers would set a higher priority for quality. Communication in projects was also an important issue of

project management. The results indicated that email was the most commonly used method for communication with the customer and within the project team. This could be a specific characteristic of software projects. Resource availability appeared to be a minor concern for all software projects. Comparing between these resources (including manpower, time, budget, and infrastructure), the availability of manpower was the lowest one evaluated at average level.

For planning evaluation, the scheduling had the best performance followed by defining requirements and specifications. Risk analysis had the worst performance. Concerning time and effort spent for planning, there was substantial variety among projects. On average, project managers spent 22% of their time and 18% of their effort for planning. This effort was limited compared to the important role of planning.

Project results were evaluated by multiple criteria. 70% of projects were self-evaluated as successful (with no difference between the views of the parent company, project team, and customer). Only 51% of the projects were completed on time and 62% within the planned budget. The reason for this optimistic evaluation was that the evaluators emphasized the criteria of quality and customer satisfaction for success rather than more objective criteria. The results of the evaluation of software projects were consistent with the objective of customer satisfaction that the project emphasized in the software development process. The issues relating to this success were the positive assessments of qualitative outcomes, such as "Meeting designed quality", "Customer satisfaction", "Enhancing the company image" and "Improving the team member capability".

10.1.3 Differences in Software Projects By Size, Type And Ownership

The differences in size, type and ownership between projects were analyzed. The result indicated that there were only minor differences in personnel, technical and management factors and in planning performance between different projects in size. The differences were significant in terms of outcomes. The smaller projects had significantly more positive qualitative benefits than the bigger ones.

The difference between projects in foreign software companies and local software ones was mainly related to clients. The projects of foreign software companies had more overseas

clients than local companies did. This could be the reason for other differences between projects in foreign and local companies, like the level of customer involvement and using email for communication with the customer. The personnel factors in projects of international companies were perceived better than the projects of local companies, especially related to project manager effort, and the knowledge and experience of team members. The projects in international software companies emphasized the goal of "minimizing both cost and schedule" more than projects in local companies. The projects in international companies were also well performed in terms of scheduling and doing risk analysis than projects in local companies. Although there were some significant differences in human and management factors and planning performance, outcomes of local and international software projects were not significantly different.

Software projects were also compared by type. There were three types of software projects like commercial, made-to-order and outsourcing; but having only a few significant differences. The important differences related to the customer. The commercial projects had higher customer involvement, better definition of product requirements and specifications as compared to the other project types.

10.1.4 Relationship Between Planning Factors, Planning Performance And Project Outcomes

The summary of findings of the relationships between planning factors, planning performance and project outcomes is presented in Figure 10.1. The hypotheses of relationships were developed from the conceptual framework and tested through the regression models.

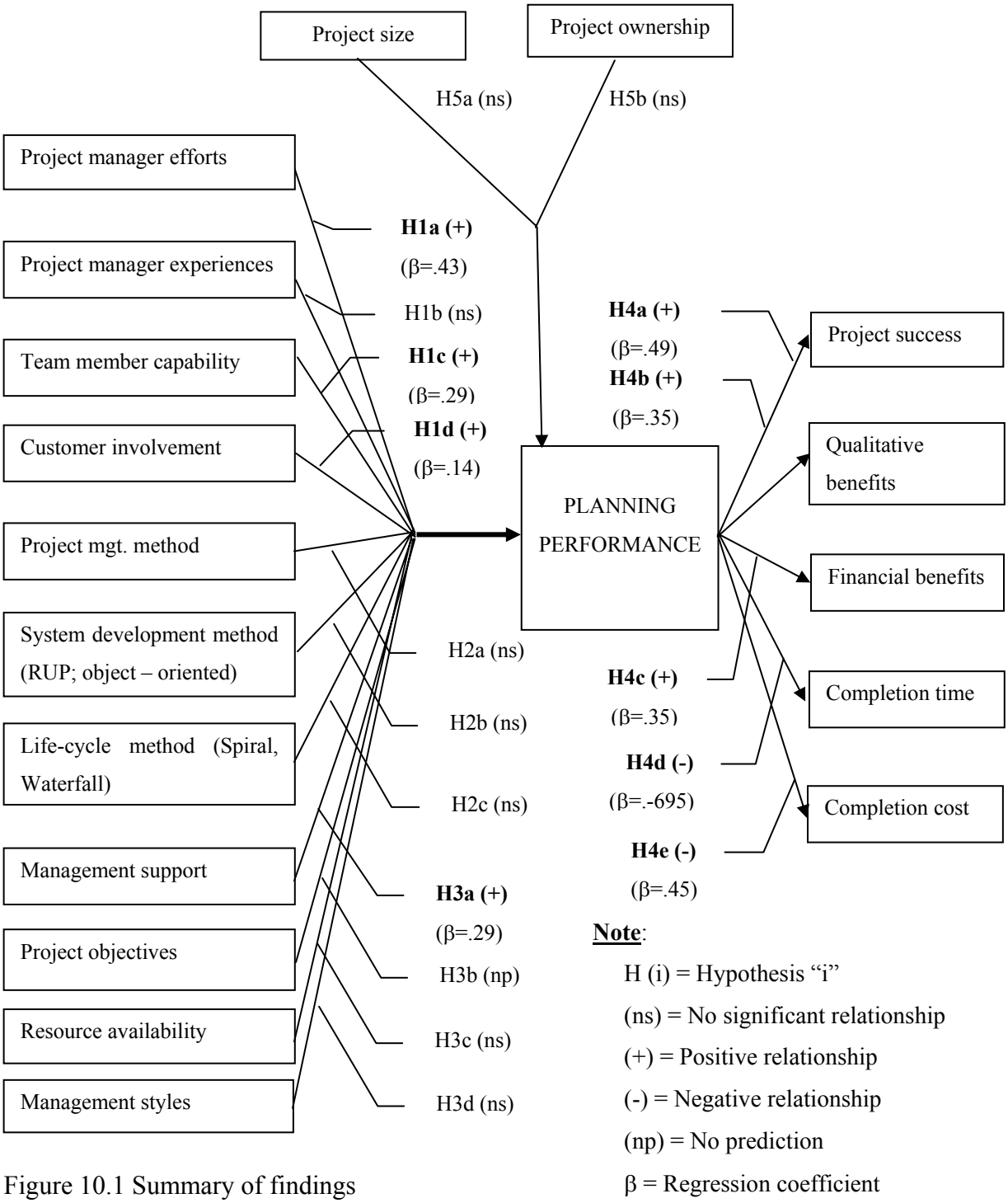

Figure 10.1 Summary of findings

10.1.4.1 Impact of planning factors on planning performance

Based on Figure 10.1, these findings suggest that all project personnel (including project manager, team members and customer) play an important role in planning performance. The effort of the project manager has a positive effect on planning performance. The project manager's experience relates to the key project outcome (project success). These results support the findings of Verner, Overmyer and McCain (1999). They found that over half of the unsuccessful projects had a project manager problem, such as "no experience"; "insufficient time and effort on planning project". The positive relationship between project manager effort for planning and planning performance explained the role of project manager related to project success. The team members' knowledge about the definition of requirements and experience in system development significantly influenced planning performance. In a previous study, Krishnan (1998) indicated the relationship between higher capability and experience of the software team, and less defects in a software product. This finding focuses on the role of team ability in planning. Planning is improved by the better definition of customer requirements and appropriate product specifications. This result emphasized the important role of team members in the early stage of the software development process. An important stakeholder of the software project is the customer. There was a significant relationship between customer involvement and planning performance: the higher involvement, the better performance. Verner *et al* (1999) also indicated how customers or users affect project failure, including "too little involvement with the user community". Kasser and Williams (1998) also ranked "failure to communicate with the customer" as a major reason of project failure. This result contributes more quantitative support for the role of customer involvement in better planning performance.

The analysis did not indicate any significant relationship between applying techniques or methods and planning performance. In practice, applying techniques in software projects is not very systematic. The software projects usually apply a few common tools for specific tasks like MS Project for scheduling or spreadsheets for resource allocation, and tracking progress. Regarding system development methods, object oriented, a basic method, is the most commonly used. Only 65% of projects applied a particular life-cycle method for managing the software development process.

Verner *et al.* (1999) found that the choice of the right life – cycle methodology was a relevant factor in successful projects. The reason for the non – significant relationship between applying methods and planning performance in this study may be because of the low level of application.

The management approach is a complex issue in project management. In this study, it was considered only in the scope of planning. There was a significant relationship between management support and planning performance. Management support included the extent of authority of project manager, the support from functional departments of the software company as well as the client. Regarding other factors like resource availability, project objectives and management style there was no significant relationship to planning performance. In previous studies, the issue of management support was essential. Verner *et al.* (1999) concluded management support is the key factor for project success. Callahan and Moretton (2001) found a negative significant relationship between sales and marketing involvement in the early development process and software development time. Procaccino *et al.* (2002), however, only confirmed the role of a committed sponsor to project success. The positive significant relationship between management support and planning performance contributes more empirical confirmation for the role of management support in the literature. Regarding the project objectives, there was no significant relationship to planning performance. However, there was evidence of the effect of project objectives on project outcomes (qualitative benefits and completion time). This result is consistent with the findings of Abdel-Hamid, Sengupta and Swett (1999).

10.1.4.2 Impact of planning performance on project outcomes

This study found a significant relationship between planning performance and all project outcomes. These results provided supports for the important role of planning. Moreover, the influence of each planning task on each project outcome was very specific. There are some important conclusions. First, better definition of requirements and specifications increases the likelihood of project success and greater qualitative benefits. Second, better scheduling relates to project success, increased qualitative benefits and a shorter completion time. Finally, better estimation of project time and effort results in shorter completion time, lower completion cost and greater financial benefits.

These findings confirm the role of planning and project success in previous research on software project management. Kasser and Williams (1998) ranked "Poor requirements" and "lack of planning" as important reasons for project failure. Aladwani (2002) also found a significant relationship between project planning and project success. These findings are supportive of previous studies.

10.1.4.3 The impact of project characteristics on planning factors and planning performance

Project characteristics were considered as a moderating variable for relationships between planning factors and planning performance. In this study three project characteristics were considered, including size, type and ownership. The regression analysis did not indicate any significant relationship between these project characteristics and planning performance. There was no moderating effect.

It was hypothesized that the differences in project type categorized as commercial, made-to-order, and outsourcing, such as the involvement of customer, the effort of project manager, the support from client' functional department, etc. would lead to more effective planning performance and more successful outcomes. However, the analysis did not find any influence of project type on planning performance. In interviews, the project managers indicated personnel involved and the management approach used in different project types varied greatly. However these projects also had a variety of characteristics. In this study no specific project type had greater chance for success than another. In the literature, this issue has not been researched and this is the potential direction for further studies.

Project size and project ownership also did not influence the planning performance of a software project. It was assumed that the big projects would have greater difficulty in managing personnel, time, customer relationships, and resource allocation. These issues would also influence planning performance. There was no evidence for this. The reason for having no significant relationship between project size and planning performance could be that there were no major differences between large and small projects. Similarly, there were very little differences between projects in international and local software companies.

10.2 IMPLICATIONS

The implications of this study are considered from both theoretical and practical perspectives. This analysis indicates the contributions of the study to the literature of software project management and to the managers in managing the software projects in practice.

10.2.1 Theoretical Implications

The literature review has shown that poor planning is one of most common problems in software project management. This could be the main cause for the large number of late and over budget software projects. However, this review also indicated that there is not much research focused on the planning of software projects or on the factors that influence planning performance. It is necessary to confirm the role of planning related to the overall success of the software project, and to specific outcomes like completion time and cost, financial and qualitative results. The first contribution of this study is the assessment of previous studies. This review summarized the criteria for project evaluation used in this research, especially software projects. The common problems in software projects were also presented through this review. The assessment indicated the problems that previous studies emphasized and the gaps in the understanding of planning performance and success. It could be a source research of idea generation for further studies.

The second contribution is the conceptual framework. The conceptual model in this study has indicated that planning factors do influence planning performance. Planning performance is a mediator between planning factors and project outcomes. The moderating effects of project characteristics on the relationship between planning factors and planning performance is supported in the model.

The influence of project characteristics, including project size, type and ownership on project planning as control variables was also considered by the conceptual model. The most important consideration of the model is to examine the direct role of planning performance to project results. The study has established a theoretical framework for assessing planning performance and outcomes. This may be used for future research in project management in other national or industrial contexts.

The third contribution is the comprehensive analysis. The results of this study have confirmed the findings of many previous studies, especially the impacts related to human resources in software projects and the importance of planning. This illustrates the similar characteristics between management of software projects in other contexts and in the context of a young industry. The findings of few minor differences between software projects in size, type and ownership contributed to the characteristics of a software projects. This study provides an understanding of software project management for both researchers and managers with different perspectives.

The new point in this study is to examine the role of planning. The result demonstrated the explanatory power of planning performance with different project outcomes.

10.2.2 Managerial Implications

This study has provided an overview of software project management in the context of an emerging software industry. This industry is chosen as a key sector for the development of the economy in Vietnam – a transitional economy because of its competitive advantages. With supportive policies from the government, software companies now are trying to improve their performance. The analysis suggests specific guidelines for project managers to improve planning and for project management in general.

The first implications are related to the role of planning. This study demonstrated the important influence of planning performance to many outcomes of successful projects. Planning should be more emphasized by software companies and project managers. Also, the risk analysis of most software projects was not adequate. Improving this emphasis in planning could result in better project outcomes. Proactive risk management instead of reacting to risk is a new concept in software projects. The change in customer requirements is a risk usually happening in a software project. Many software development methods, like the spiral or prototyping, were developed to give projects more flexibility adapting to changes in customer requirements. The new management approach for project management like Rational Unified Process also provides a guideline for risk management. The relationships between planning tasks and project outcomes help the project managers to focus on the specific planning task to get the outcome they want.

Secondly, to improve the performance of project planning, the important role of human factors should be considered. The findings indicated the influence of project manager efforts, team member capability and customer involvement in planning. It suggests that project managers should spend more effort for planning, especially for defining and controlling the product specifications. The role of team members also contributed to better planning performance. In planning, the team members should have good knowledge and experiences in defining requirements and system development. They were also required to have commitment and persistent attitudes to work in the uncertain atmosphere of the planning stage. This capability could be used for selecting team members in the planning stage and for training human resource. Customers also influenced the planning performance in terms of their involvement and knowledge. Project managers could develop better planning through managing the customer relationship, and increasing their involvement to improve the understanding of customer requirements and to limit unexpected changes. The process of customer relation building should be established to facilitate the customer relationship management.

Thirdly, planning performance also is influenced by management support. This finding suggests that software companies should provide more support to the project team, especially in planning. The support should come from the top management of the parent company and from the functional departments or specialist like sales or marketing.

Finally, although this study did not demonstrate the relationship between the application of technical methods and planning performance, but it did indicate the poor application of project management and life cycle methods in software projects. This finding should stimulate software companies and project managers to improve the application of these methods.

10.3 LIMITATIONS OF THE RESEARCH

The limitations of this study should be noted. It includes projects only in Vietnam, a developing country in a transitional economy. The software companies chosen as samples are small and young with average age of only 5.5 years and the average number of employees of about 40. The characteristics of these samples may prevent generalizing the findings to all projects of software companies in other developing countries or developed countries. For

example, the study of Loo (2002) indicated the commonly adopted leadership styles in project management, including people-oriented, participative, transformational, and situational leadership. However, the project managers in this study did not know about these styles. This issue limits the generalization of the findings on leadership styles and planning performance or project outcomes or a comparison to Loo's results.

10.4 SUGGESTIONS FOR FURTHER STUDY

This study focused on planning in software projects in a developing country. This research issues might be extended in other regions in the world. The extension of these research issues would be a better comparison with a wider range of software projects of international regional context with different characteristics like size, or type.

It is also necessary to investigate the role of other areas of project management in software projects like quality management, risk management or conflict management. The problems of other stages like analysis and design, coding, testing or deploying in software development are also the issues for further research. The results of the exploratory study also suggest the important role of communication in project management. The problem of changing customers' requirements and the poor understanding of customers' expectation are evidences for more emphasis on the impact of project communication on project success

This study failed to support some of the proposed hypotheses related to the effect of applying techniques or methods and management styles on planning performance. Hence, there is a need for further study on the influence of different techniques on project results.

This study focused on software development projects in professional software companies. However, the research issues and the approach of this study could be extended to other kind of developing organizations such as software development projects of other industries, for example like consultanting or academic one. It could be also applied to other project types, like information system project. Further researches may be conducted on the role of planning in other types of projects.

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APPENDICES

APPENDIX A: QUESTIONNAIRES

APPENDIX B: LIST OF SURVEYED COMPANIES

APPENDIX C: TABLES & FIGURES

APPENDIX A: QUESTIONNAIRES

APPENDIX A.1: QUESTIONNAIRES FOR THE EXPLORATORY RESEARCH

(For project leaders or managers in software companies)

1. In managing the project team, how much time do you spend on following works?

	Very much				Very little
1. Team management *(staffing; team structure; team communication; team building; conflict resolution; performance appraisals and training)*	5	4	3	2	1
2. Communication management *(Speed up the relationship between project team and stakeholders)*	5	4	3	2	1
3. Risk management *(Identify and avoid or mitigate the project risks throughout the life cycle of a project)*	5	4	3	2	1
4. Quality management (*Implementing the activities, techniques and strategy to ensure that all project activities and work products comply with all relevant standards, procedures and requirements)*	5	4	3	2	1
5. Time management (*Applying the processes and techniques of time management to ensure the timely completion of the project)*	5	4	3	2	1
6. Cost management (*Estimating budget; managing and controlling cost in order to ensure that the project is completed within the approved budget*)	5	4	3	2	1

2. In average, how many people involved in a project in your company?

3. Which are methods using for measuring productivity in your company? And how much productivity is?

Size metrics		*Function points (FP)*	
- KLOC/man-month	❑ _____	- FP/ man-month	❑ _____
- defects/ KLOC (thousand lines of code)	❑ _____	- defects/ FP	❑ _____
- errors/ man-month	❑ _____		
Others ..……...	_____	*Not measure*	

4. How often training courses on project management were implemented at your companies (or sent employees to outside training programs) during last year?

- Never ❑
- 1 – 2 times/ year ❑
- 3 – 5 times/ year ❑
- > 5 times/ year ❑

5. Please give your opinion about:

Ability of project and team management of managers in your company	Very qualified	5	4	3	2	1	Very unqualified
Teamwork ability of employees/ programmers	Very good	5	4	3	2	1	Very bad

6. Does your company forecast the risks of the project in designing (estimate time and cost) and planning stages

- Always regardless of size of the project ❑
- Sometime, depend on size of project ❑
- Never ❑

7. Which types of risk are often occurring in your projects:

	Very often				Never
- Risk of changing requirements from customer	5	4	3	2	1
- Risk of poor communication and misunderstanding customer	5	4	3	2	1
- Risk of project team management (conflict, lack of support and cooperation, poor management)	5	4	3	2	1
- Risk of technical complexity	5	4	3	2	1
- Risk of requiring additional resources (personnel, capital, etc.)	5	4	3	2	1

- Others …….....

8. Which following quality management systems/ principles are applying (or in process of development) in your company?
- None ❑ TQM (Total quality management) ❑
- ISO 9000 ❑ CMM (Capacity maturity model) ❑
- Others: ……

9. Have you ever known about applying these quality management systems/ principles in software sector?
- None ❑ TQM (Total quality management) ❑
- ISO 9000 ❑ CMM (Capacity maturity model) ❑
- Others: ……

10. Please evaluate the importance of following software quality attributes in your project.

	Very important		Average		Very unimportant
1. Reliability (*is the degree to which the product meets its functionality over a measured period of time.)*	5	4	3	2	1
2. Modifiability/ extensibility *(is the measure of ease enhancing the product; generality and flexibility of product)*	5	4	3	2	1
3. Portability (*is the measure of effort required to modify and test a product to allow that product to run in an environment other than the one for which it was developed)*	5	4	3	2	1
4. Usability (*is measure of re-usability of code*)	5	4	3	2	1
5. Friendly/ efficiency (*is measure the satisfaction of users regardless of their background, tasks performed, and needs*)	5	4	3	2	1

11. Give your opinion of the following statements

	Strongly agree		Neutral		Strongly disagree
1. The quality management system is very necessary for software engineering in my company	5	4	3	2	1
2. Current quality management systems for software engineering in the world is not suitable to small and medium size of Vietnamese software companies	5	4	3	2	1
3. Quality of software product is mainly depending on programmer's ability rather than have or not any quality management system.	5	4	3	2	1

12. Your project estimates time and cost based on:
Experiences ❑ Specific software ❑

13. For managing and controlling project time, does your project apply any following technique of time management?
- Gantt chart (bar chart) ❑ - CPM (Critical part method) ❑
- MS Project software ❑ - Others ……
- None ❑

THE SUCCESFUL FACTORS OF THE SOFTWARE PROJECT

14. Please rank the following project evaluation criteria in order of importance in your project.
- Completion on planned time
- Completion within project
- Completion at desired level of quality
- Customer satisfaction
- Capability improvement for company
- Others

15. Average time to complete a software product at your company is: …… months

16. How was the result of software projects in the past in your company? :

- Percentage of project completed on time …… %
- Percentage of project completed on budgeted cost …… %
- Percentage of project meet desired quality level ……. %
- Percentage of project met all above criteria ……. %

17. In your opinion, how do following factors influence the success or failed level of a software project?

	3	2	1	0	-1	-2	-3
	Increase successes of the project			Not influence			Increase failure of the project
1. Project management ability of project managers	3	2	1	0	-1	-2	-3
2. Capability of project team members (measured by experiences or ability to meet work requirements)	3	2	1	0	-1	-2	-3
3. Size of project (measured by number of people in a project)	3	2	1	0	-1	-2	-3
4. Complexity of technology applied in the project (complexity means new or unfamiliar)	3	2	1	0	-1	-2	-3
5. Capability to understand customer's expectation	3	2	1	0	-1	-2	-3
6. Setting up a clear working process	3	2	1	0	-1	-2	-3
7. Creating a comfortable working environment, cooperative and trust atmosphere for all employees.	3	2	1	0	-1	-2	-3

18. Give your opinion of the following statements

	Strongly disagree		Neutral		Strongly agree
1. Estimating and planning ability is weakest point of project managers at Vietnamese software companies	1	2	3	4	5
2. Most difficulty in managing software quality is lack of quality standards and quality measuring methods	1	2	3	4	5
3. Project manager lack of knowledge and skills of decision-making and lack of techniques to make project progress become visible.	1	2	3	4	5
4. Insufficient knowledge in related fields and poor communication are biggest problems of Vietnamese team leader that lead to misunderstand customers needs/ expectations	1	2	3	4	5
5. Most difficulty of Vietnamese software companies today are lacking of contracts rather than poor ability of programmers or managers	1	2	3	4	5

GENERAL INFORMATION

19. Personal information:
    - Position: …….
    - Education level: ……
    - Years of experiences:……..……..

20. Company information:
    - Company name: ……
    - Established year: ……..
    - Number of employees: …….
    - Average revenue/ year: ……..
    - Number of KLOC that your company produced in this year (until November 2002)…….

21. The main activities of your companies are (please rank in order of importance of product/ service)
    - Producing service software for local companies ____
    - Producing package software for local market ____
    - Producing package software for foreign market ____
    - Outsourcing for foreign companies ____
    - Others (please detailed)

APPENDIX A.2: QUESTIONNAIRES FOR THE IN – DEPTH RESEARCH

(For project leaders or managers in software companies)

COMPANY INFORMATION

Q1. Name of organization: ……
Address: ……..
Telephone: …… Website: …….….
Name of interviewee: …….

Q2. Enterprise ownership:
Foreign investment ❑ Private company ❑ State-owned company ❑
Year of foundation:…….....

Q3. Number of employees involved in software activities: ……

Q4. In what **sectors/fields** has your company developed software products?

Agriculture/ Forestry and Sea–food	❑	Government administration	❑
Commercial and Service	❑	Manufacturing	❑
Construction	❑	Medicine	❑
Education and Training	❑	Telecommunication	❑
Entertainment	❑	Tourism	❑
Finance & Accounting	❑	Transportation	❑
Others (please specify)	❑		

Q5. Who are your company's major clients?

Foreign organizations		*Local organizations*	
America (North)	❑	Government organizations	❑
America (South)	❑	Private organizations	❑
Asia	❑	Individuals	❑
Europe	❑		
India	❑		
Others (please specify)	❑		

PROJECT INFORMATION

Q6. What kind of project were you last involved in?

- Name of the project : ……..……...
- Software project category:

Commercial software	❑	Outsourcing	❑
Build-to-order software	❑	Others (please specify)	❑ ... ...

- In the sector/field of:

Agriculture/ Forestry and Sea–food	❑	Government administration	❑
Commercial and Service	❑	Manufacturing	❑
Construction	❑	Medicine	❑
Education and Training	❑	Telecommunication	❑
Entertainment	❑	Tourism	❑
Finance & Accounting	❑	Transportation	❑
Others (please specify)	❑		

Q7. Who is your client in this project? ……

Foreign organizations		*Local organizations*	
America (North)	❑	Government organizations	❑
America (South)	❑	Private organizations	❑
Asia	❑	Individuals	❑
Europe	❑		
India	❑	Others (please specify)	❑ ... ...

Q8. What were you responsible for? ……

Team leader/ Project manager ❑ Project team members ❑

Top manager ❑ Others (pls. specify) : ……

Q9. Project duration :

Below 3 moths ❑ 3 – <6 moths ❑ 6 – 9 moths ❑

9 – <12 moths ❑ 12 – <18 moths ❑ 18 moths – <2 years ❑

> 2 years ❑

Q10. Actual cost of project compared to planned budget (%):

Below 90% ❑ 90 – 109% ❑ 110 – 129% ❑

130 – 149% ❑ 150 – 199% ❑ ≥ 200 % ❑

Q11. Number of people involved in project team:

- In the whole project life cycle: ……
- In the planning stage: ……..
- In the analysis and design stage: …….
- In the coding stage: …….
- In the testing stage: …….
- In the deploying stage: ……
- In the maintenance stage: ……

PLANNING FACTORS

Personnel factors

Q12. a) How many years were you in the position of project managers/ leaders: …….

b) How many projects have you participated in as project managers/ leaders: ……

c) Pls. evaluate your experience level in planning this project?

	Very low				Very high	Not helpful at all
In defining the objectives and scope of the project	1	2	3	4	5	0
In estimating cost, time and effort	1	2	3	4	5	0
In scheduling	1	2	3	4	5	0
In communicating with the client	1	2	3	4	5	0
In managing the project team	1	2	3	4	5	0

Q13. Please evaluate your work (as project manager) in the planning of this project

	Very low				Very high	No opinion
a) The extent of control that you had over product specification?	1	2	3	4	5	0
	Much lower		Equal		Much higher	No opinion
b) The effort you spent for the project planning stage (compared to other stages)	1	2	3	4	5	0

Q14. Please evaluate the project team members in planning stage in the following aspects:

	Very low				Very high	No opinion
a) The theoretical and methodological knowledge in system development and requirements definition	1	2	3	4	5	0
b) The practical experiences with system development and requirements definition	1	2	3	4	5	0
c) Level of commitment and persistence of team members in planning stage	1	2	3	4	5	0

Q15. The involvement of client/ end-user in the planning stage

	Very low				Very high	No opinion
a) Level of involvement of customer/ user in planning stage	1	2	3	4	5	0

b) If this involvement is "low", pls. explain the reasons …….

……

Technical factors

Q16. The project management methodology/tools

Q16.1 Did your project team apply any project management methodology in this project?
Yes ❑ (Name of the method:……)
No ❑

Q16.2 This methodology has been formalized by:
A local company ❑ A foreign company ❑
Your company (in-house) ❑ Others ❑ ……

Q16.3 Did your project team use any software to manage this project?
Yes ❑ (Name of the software:……)
No ❑

Q16.4 This software has been developed by:
A local company ❑ A foreign company ❑
Your company (in-house) ❑ Others ❑ ……

Q16.5 What are the software features used to support project management?

	Never			Always		Not available
Work breakdown structure	1	2	3	4	5	0
Gannt chart	1	2	3	4	5	0
CPM Chart (network)	1	2	3	4	5	0
PERT Chart	1	2	3	4	5	0
Budget management	1	2	3	4	5	0
Handling conflicts	1	2	3	4	5	0
Progress tracking	1	2	3	4	5	0
Weekend modifiers	1	2	3	4	5	0
Overbooking of resources	1	2	3	4	5	0
Workforce assignment	1	2	3	4	5	0
Others	1	2	3	4	5	0

Q17. The system development method

Q17.1 Did your project team adopt any of the following system development methods in this project?
Structured approach (SDLC) ❑ Object – oriented ❑
Prototyping, interactive ❑ Rational Unified Process (RUP) ❑
Rapid application development (RAD) ❑ Agile software development processes ❑
Others (please specify) ❑ ……

Q17.2 This methodology has been formalized by:
A local company ❑ A foreign company ❑
Your company (in-house) ❑ Others ❑ ……

Q17.3 Did your project team use any tool/ software for effective application that system development method:
Yes ❑ (Name of the software:……)
No ❑

Q17.4 This software is developed by:
A local company ❑ A foreign company ❑
Your company (in-house) ❑ Others ❑ ……

Q18. Did your project team apply any of the following life-cycle methodology in project planning?
Waterfall ❑ Prototype ❑ None ❑
V-process ❑ Incremental delivery ❑
Spiral ❑ Others (pls. specify) ❑ ……

Q19. Who takes responsibility for the choice of these methodologies/tools?

Project manager	❑	Client	❑
Top manager	❑	Others (pls. specify)	❑ ……

Management factors

Q20. Please describe the management support in your project

		Strongly disagree			Strongly agree		No opinion
a)	The project manager was given full authority to manage the project	1	2	3	4	5	0
b)	The project started with a committed sponsor	1	2	3	4	5	0
c)	In the planning stage, delegates of the company functional departments (sales, marketing, networking, database, etc.) participated actively as project members	1	2	3	4	5	0
d)	In the planning stage, delegates of the client's functional departments participated actively as project members	1	2	3	4	5	0

Q21. In this project, what are the main objectives that your project team pursued?

		Very unimportant			Very important		No opinion
a)	Minimize overruns in both cost and schedule	1	2	3	4	5	0
b)	Deliver a quality product and minimize any schedule overrun	1	2	3	4	5	0
c)	Customer satisfaction	1	2	3	4	5	0
d)	Minimize cost	1	2	3	4	5	0
e)	Others	1	2	3	4	5	0

Q22. Please describe the process of goal definition in this project

		Strongly disagree			Strongly agree		No opinion
a)	In the planning stage there was no conflicting objectives between the project team and the customer.	1	2	3	4	5	0
b)	The project scope was well defined in the planning phase	1	2	3	4	5	0

Q23. The common methods used to communicate with client in this project are:

	Never	Seldom	Sometimes	Often	Always
Informal meeting	1	2	3	4	5
Formal meeting	1	2	3	4	5
Email	1	2	3	4	5
Telephone	1	2	3	4	5
Others	1	2	3	4	5

Q24. The common methods used to communicate within the project team in this project are:

	Never	Seldom	Sometimes	Often	Always
Informal meeting	1	2	3	4	5
Formal meeting	1	2	3	4	5
Email	1	2	3	4	5
Telephone	1	2	3	4	5
Others	1	2	3	4	5

Q25. The aims of formal, periodic meeting or direct communication within project team are:

	Strongly disagree			Strongly agree		No opinion
a) To report to senior manager and/ or project sponsor	1	2	3	4	5	0
b) Monitoring progress to detect problems and to indicate remedies planned or in process.	1	2	3	4	5	0
c) To have a bigger-picture awareness (meetings give team members the chance to catch up on what other members in the team have been doing, etc.)	1	2	3	4	5	0

d) To force the project team into action to be on schedule (formal meetings are held at clearly defined project milestones)	1	2	3	4	5	0
e) To create peer pressure (based on the commitment of project team members in the meeting)	1	2	3	4	5	0
f) To motivate team spirit, team work	1	2	3	4	5	0

Q26. Describe the leadership style in the project:

- Democratic, all the members participate in making decision process ❑
- To consult project team before project manager makes decision ❑
- Project manager makes all decision without consulting ❑
- People-oriented leadership ❑
- Work-oriented leadership ❑
- Others……..
- Unclear ❑

Q27. The level of resources available in the planning stage is:

	Very low				Very high	No opinion
Manpower	1	2	3	4	5	0
Time	1	2	3	4	5	0
Budget	1	2	3	4	5	0
Infrastructure	1	2	3	4	5	0
Others	1	2	3	4	5	0

PLANNING PERFORMANCE

Q28. Please evaluate the project plan

	Strongly disagree				Strongly agree	No opinion
a) The requirements and specifications were well defined in planning stage	1	2	3	4	5	0
b) Time and effort for development process were well estimated	1	2	3	4	5	0
c) The project schedule (translation of labor estimates into a calendar) was well defined in planning stage	1	2	3	4	5	0
d) The risk matter were mentioned in project plan	1	2	3	4	5	0

Q29. Time spent for planning work accounts for …… % of elapsed time

Q30. Manpower spent for planning work accounts for …… % of total employees involved in the whole project

PROJECT OUTCOMES

Q31. The completion of the project is

- Ahead of schedule ❑
- On time ❑
- Over 30% behind schedule ❑
- Over 50% behind schedule ❑

Q32. The real cost spent for the project

- Ahead of budget ❑
- Within planned budget ❑
- Over 30% cost overrun ❑
- Over 50% cost overrun ❑

Q33. Please evaluate the project outcomes in other aspects:

	Strongly disagree				Strongly agree	No opinion
a) The delivered software product met all specifications defined in planning stage	1	2	3	4	5	0
b) The project result has satisfied the customer need	1	2	3	4	5	0
c) The project has contributed to enhance your company image	1	2	3	4	5	0
d) The project has brought the financial benefits to your company	1	2	3	4	5	0

e)	The project team capability was improved thanks to participate in the project	1	2	3	4	5	0
f)	The project team satisfied with financial benefits thanks to participate in the project	1	2	3	4	5	0
g)	The project is evaluated as success by the project team	1	2	3	4	5	0
h)	The project is evaluated as success by the parent company	1	2	3	4	5	0
i)	The project is evaluated as success by the customer	1	2	3	4	5	0
j)	The project is evaluated as success by the sponsor	1	2	3	4	5	0

APPENDIX A.3: QUESTIONNAIRES FOR IN-DEPTH INTERVIEW

(For project leaders or managers in software companies)

COMPANY INFORMATION

Q1. Name of organization: ……
Address: ……..
Telephone: …… Website: ……..….

Q2. Enterprise ownership:
Foreign investment ❑ Local ❑

Q3. Number of employees in software activity: ……

Q4. What kind of software products that your company has produced?

Medicine	❑	Construction	❑
Transportation	❑	Tourism	❑
Telecommunication	❑	Agriculture/ Forestry and Sea–food	❑
Government administration	❑	Education and Training	❑
Entertainment	❑	Commercial and Service	❑
Finance & Accounting	❑	Manufacturing	❑

Q5. Who are your company' main clients?

Foreign organizations		*Local*	
America	❑	Private organizations	❑
India	❑	Government organizations	❑
Asia countries	❑	End-users	❑
Europe countries	❑		

PROJECT INFORMATION

Q6. What kind of project were you last involved in? Name: ……...
Package software ❑ Custom software ❑
Service software ❑ Others ❑ …….....

Q7. Who is your client? ……

Q8. What were you responsible for? ……

Q9. The duration of the project: ……...

Q10. The cost of project: ……

Q11. The number of people in project team: ……..

PLANNING PROCESS

Q12. Identify project scope and objectives

- What are project objectives?
- Who are stakeholders in the project?
- How to modify the objectives in the light of stakeholder analysis?
- How to measure for meeting the objectives?
- What is extent of project leader' power?
- How does objectives defining effect on time and effort for setting the project plan?
- Does the project leader satisfy with his power in product specifications? Why?
- How many years were you in the position of project managers/ leaders?
- How many projects have you participated in as project managers/ leaders?
- How do these experiences help you in handle the planning of this project?

Q13. Identifying project infrastructure

- How did the project select the team members?
- Please evaluate the performance of these team members in planning. What their knowledge/ experiences are important for planning?
- How were the communication procedures with customers and within project team established?
- Did the personnel of sale and marketing department participate in project team? How are their roles in planning?
- Please evaluate the effectiveness of these communication methods.

Q14. Analyze project characteristics

- What was life-cycle method selected to apply in the development process? Why or Why not?
- How did the customer' requirements identified? (how to gather data, examine data, or test whether the data is enough)
- What is involvement of customer in the planning stage? How did it impact on the defining their requirements?
- How did the project define the constraint of resources (such as time, cost, manpower)?

Q15. Identify the project products and activities

- What are project products? What are their quality criteria? How are they identified?
- How to define the activities and their relationship involved in the whole product development process?
- Did the project use any planning techniques/ method/ software for defining the project activities? Why or Why not?
- Please evaluate the effectiveness of these techniques

Q16. Estimate effort for each activity

- How was effort defined for each activity?
- Did the project use any estimation methods/ software? Why or Why not?
- Please evaluate the effectiveness of these methods/ techniques.

Q17. Identify activity risks

- Were the risks matter mentioned in the planning and for every activity? How?
- Did the project apply any risk assessment analysis techniques? What is its effectiveness?
- How did risks analysis use to revise the estimation effort/ time of each activity and the whole project?

Q18. Allocate resources
- How were resources allocated for project activities?
- Did resource constraints effect on this allocation

Q19. Planning revising
- Is project plan reviewed and revised during the development process? Why or Why not? How?
- How this revision affect on performance of the project?

Q20. How is your evaluation of the planning performance (requirements defining, time and efforts estimating, scheduling, etc) of this project?

Q21. Time spent for planning work accounts for …… % of elapsed time

Q22. Manpower spent for planning work accounts for …… % of total employees involved in the whole project

Q23. What are the roles of following factors to produce a good project plan? Rank in order of their important in this project.

- Customer/ user involvement in planning stage
- Experiences of project manager
- Effort that project manager spent for planning
- Experience of team members with system development and with establishing requirements
- Technical ability of team members
- The using of methods/ techniques/ software in planning
- The support of top management
- The commitment of sponsor (if available)
- The involvement of sales and marketing department in planning
- Defining of project objectives
- Communication with customer
- Communication within the project team members
- The level of resource available

Q24. What is the role of planning to the project outcomes?

PROJECT OUTCOMES

Q25. The completion time of the project

Q26 The real cost spent for the project

Q27. Please evaluation the project outcomes in other aspects:
- Quality of products delivered
- Customer satisfactions
- Organization benefits
- Project team satisfaction

APPENDIX B: LIST OF SURVEYED COMPANIES

Appendix B1: LIST OF SURVEYED COMPANIES – EXPLORATORY RESEARH

	Company	Address/ Website	Year of establishment	Number of employees	Scope of activities
1	Tuong Minh Agency – TMA	111 Nguyen Dinh Chinh St., Dist. Phu nhuan HCM City www.tmasolutions.com	1997	135	Software outsourcing services
2	Telecommunication Institute 2		1998	214	Training, Telecommunication, Providing internet – intranet service
3	International Informatics Center – Kent – CBAM		1997	52	Training, Consultancy, Development software
4	Glass Egg Digital Media	E-town, 7th floor, 364 Cong Hoa St., Dist. Tan binh, HCM City www.glassegg.com	1995	80	Game, coding, programming
5	IMD Company				Developing Database, Developing software in Housing management
6	Vietnam Yellowpages LTD.	5- QuangTrung Software Part, Dist. 12 HCM City www.yellowpages.com.vn	2000	10	Developing software; Consultancy; Providing total solutions; Publishing
7	New millennium	72/4 Phan Dang Lun St., Dist. Phu Nhuan. HCM City www.ttnkvn.com	1999	40	Developing software, Internet – E-commerce development, Maintenance and Upgrading
8	Mekong Software Development Co. Ltd. MEKONGSOFT	29 Cach mang thang 8 St., Cantho City www.mekongsoft.com	2002	7	Developing software, Providing Internet – Intranet services
9	ELCA Informatics Technology LTD	65 Nguyen Du St., Dist. 1, HCM City www.elca.ch	2000	25	Developing software
10	FPT Hanoi	89 Lang Ha St., Dist. Dong da, Hanoi www.fpt.com.vn	1988	570	Trading Equipment; Maintenance; Trading Software; Development software
11	Computer Science Center – Hochiminh City University of Natural Science	227 Nguyen Van Cu St., Dist.5, HCM. City www.hcmuns.edu.vn/csc00001	1986	97	Developing software; High education; Consultancy; Providing total solutions
12	Vietnam Datacommunication Company – VDC 1	292 Tay Son St., Dist. Dong Da; Hanoi www.home.vnn.vn	1989	941	Trading equipment; Developing software; Basic training; Consultancy
13	VASC – Software development company	Saigon Tower, 29 Le Duan St., Dist.1, HCM City	2001	250	Developing software; Consultancy; Providing total solutions;
14	Saigon Institute of Information Technology – SAIGONTECH	6 – Quang trung Software Part; Dist.12; HCM City www.saigontech.net	2001	39	Developing software; High education; Consultancy; Providing total solutions

15	Shipment Co. 2				
16	New Business Informatics				
17	Harmony Company	37 Ho Xuan Huong St., Dist.3; HCM. City www.harmony.com.vn	1994	90	Trading equipment; Maintenance; Trading software; Development software
18	Hathi Software Company				
19	Diginet Technologies Inc.	5 Ton Duc Thang St.; Dist.1; HCM City	1996	60	Trading equipment; Maintenance; Trading software; Development software
20	Saigon Software Park - SSP	123 Truong Dinh St.; Dist.3; HCM City www.ssp.com.vn	2000	94	Trading equipment; Maintenance; Development software; High Education
21	Information Processing & Statistics Center – COSIS	47 Le Duc Ke St., Dist. 1, HCM City	1988	150	Trading equipment; Maintenance; Trading software; Development software
22	Dan Phong Software Solutions Company Ltd.	4 Nam Quoc Cang St., Dist.1, HCM. City www.danphong.com	2001	25	Trading software; Development software; Consultancy; Providing internet – intranet service
23	GenSoft				
24	Knowledge Software Development Co., Ltd.	Suite #312, Saigon Software Park 123 Truong Dinh St., Dist. 3 Ho Chi Minh City www.knowledgesoftwares.com	1999		E-Commerce websites; Developing application software; Integrated networks design and building services - Art graphic design for digital and print media services
25	Acecom Indochine Company Ltd.	65 Nguyen Du St., Dist.1, HCM City www.acecom-indochine.com	2002	22	Trading equipment; Maintenance; Trading software; Development software
26	AZ Company Ltd.	169 Vo Van Tan St., Dist.3, HCM City	1998	54	Trading equipment; Maintenance; Development software; Consultancy
27	SOFPRO				
28	HPT Vietnam Company Ltd.	165 Pasteur St., Dist.3, HCM City www.hptvietnam.com.vn	1995	126	Trading equipment; Maintenance; Trading software; Development software
29	American Technologies Inc.	122/15 Pham Van Hai St, Tan Binh Dist., www.bvom.com			Information Services, B2B, Web Development
30	KTC	384 Nguyen Thi Minh Khai St., Dist.3, HCMC www.ktc.com.vn		7 (in software activities)	Consulting and supplying for packed solutions about IT application in business. Designing and installing the Executive Information System. Designing Website, building E-commerce system.

31	Vietnam Network Company	29 Hoang Sa St., Dist. 1, HCM City www.vietnam-network.com	1999		Website development, software development and database
32	Quang Trung Software City Development	Dist.12, HCM City www.quangtrungsoft.com.vn	2001	114	Developing software; Consultancy; Providing intranet – internet service
33	GolBeld				
34	Paragon Solution VietNam – PSV	26 – 28 Dong Du St., Dist.1, HCM City www.psv.com.vn	1995		Software Application Development and Interactive Integration.
35	SCC Technologies	36 Ly Tu Trong, Dist.1, HCM City www.sccsoft.com	1996		Internet based training, administrative software,
36	InterSoft	www.intersoft.com.vn			
37	VIETCAD	9 Ngo Van Nam St., Dist.1, HCM City www.vietcad.com	1998	25	Trading equipment; Maintenance; Trading software; Development software
38	Minh Giang Company				
39	Macro Automation – MCA	3 - C3 Quang Trung Software Part, Dist. 12, HCM City www.mcavn.com	2000	10	Manufacturing, Developing software, Providing internet – intranet services
40	Delta Solutions Company	199 Nguyen Van Thu, Dist.1, HCM. City www.delta.com.vn	2001	20	Developing software; Consultancy; Providing total solutions
41	Viet Khang JSC	155 – B4 To Hien Thanh St., Dist.10, HCM City www.vietkey.net	2001	35	Trading equipment; Trading software; Development software; Consultancy
42	ASoft				
43	FPT – HCMC	41 Suong Nguyet Anh St. District 1 www.fpt-soft.com			Full life-cycle application development, from specification to tested software Management and operation of dedicated offshore development centers Technology research and development partnerships
44	Electronic Informatics Co. ELICOM	20 Vo Thi Sau, Hanoi	2000	20	Publishing, providing content
45	Cyber Soft	HCMC			Software development
46	Thaisimex	HCMC			Software development

Appendix B2: LIST OF SURVEYED COMPANIES – IN-DEPTH RESEARH

No	Organization	Address	**Telephone**	**Website**	**Enterprise ownership**	**Year of foundation**
1	Công ty Cổ phần Phần mềm ITI	180 Lê Lai Street, District 1, HCM City.	(84) 832-5365	www.itivn.com	Private company	2001
2	Terminal C Việt Nam	124/D2 Cộng Hòa Street, Ward 4, Tân Bình District, HCM City.	(84) 811-9599	www.terminalcvncom	Foreign investment	2002
3	ASIA SOFT	546 Nguyễn Oanh Street, Ward 17, Gò Vấp District, HCM City	(84) 989-2737	www.asiasoft.com.vn	Private company	
4	INT Vision	2nd Building, Quang Trung Software Industrial Park, Tân Chánh Hiệp Ward, District 12	(84) 715-5093		Foreign investment	2003
5	ELCA Information Technology LTD (Việt Nam)	65 Nguyễn Du Street, District 1	(84) 823-6481	www.elca.ch	Foreign investment	
6	AN THỊNH LTD	HCMC			Private company	2001
7	DS Co., LTD (Quest 1)	28 Trần Quang Khải Street, District 1, HCM City	(84) 848-2878		Private company	2003
8	FPT - HCMC (F Soft HCMC)	41 Sương Nguyệt Anh Street,			Private company	
9	HPT	Nguyễn Văn Trỗi Street, Phú Nhuận District, HCM City			Private company	1995
10	Sáng Tạo 2	HCM City			Foreign investment	
11	IFI	Hà Nội			Foreign investment	1995
12	ELCOM	18 Nguyễn Chí Thanh Street, Hà Nội			LTD	1995
13	CybeSoft	HCMC			HCMC	

14	Quiet Solution (Việt Nam)	.	(8490) 817-4955	www.quietsolution.net	Private company	1999
15	KHANH NHÂN 2 Co., LTD	16/69 Lữ Gia Quarters, Ward 15, District 11, HCMC	(84) 863-8855		Private company	
16	Công Nghệ Cao Co, LTD (CNC)	HCMC			Private company	2003
17	LẠC VIỆT 2	Phú Nhuận District, HCMC			Private company	1994
18	Sở Khoa Học Công Nghệ HCMC	244 Điện Biên Phủ Street, Ward 3, HCMC		www.hochiminhcity.gov.vn	State-owned company	1975
19	Quang Tú	134/109/50 Lý chính Thắng Street, Ward 7, District 3, HCMC	(84) 848-1344		Private company	
20	SCITEC	52 Bùi Thị Xuân Street, District 1, HCMC	(84) 925-4084	www.scitec.com.vn	Private company	1989
21	Trung Tâm Kỹ Thuật Điện Tóan-ĐHBK HCMC	A3 Building, 268 Lý Thường Kiệt Street, District 10, HCMC	(84) 863-8689		State-owned company	1976
22	Khoa CNTT-Trường Đại Học Bách Khoa 2 HCMC	268 Lý Thường Kiệt Street, District 10, HCMC	(84) 863-8689	www.dit.hcmut.edu.vn	State-owned company	1993
23	Sài Gòn Liên Phương Co. LTD	2nd Building, Quang Trung Software Industrial Park, Tân Chánh Hiệp Ward, District 12	(84) 715-5016	www.bancanbiet.com	Private company	1998
24	Tư Vấn Và Chuyển Giao Công Nghệ VANET	198/30/6 Phan Văn Trị Street, Ward 12, Bình Thạnh District, HCMC	(84) 995-0724		Private company	
25	Trung Tâm UNESCO Phát triển CNTT	103B Phan Xích Long Street, Ward 2, Phú Nhuận District, HCMC	(84) 995-0723		Private company	1999
26	ĐẠI GIA Co., LTD	108 Bùi Thị Xuân Street, District 1, HCMC	(84) 925-2539	daigiatrade@hcm.vnn.vn	Private company	1999

27	Công ty Công nghệ và Phát triển (Techvn)	88 Lương Hữu Khánh Street, District 1, HCMC	(84) 925-2601	www.techvn.com	State-owned company	
28	TTN Co.,LTD	Quang Trung Software Industrial Park, PTCH (Nhà CP)	(84) 715-5075	www.vn-portan.com	Private company	2000
29	Cổ phần Phần Mềm Đại Lộ (Boulesfi Company)	172 C Điện Biên Phủ Street, Ward 17, Bình Thạnh District, HCMC	845106928 845123313	www.bso.com.vn	Private company	2001
30	Cổ phần Phần Mềm Đại Lộ (Boulesfi Company)	172 C Điện Biên Phủ Street, Ward 17, Bình Thạnh District, HCMC	845106928 845123313	www.bso.com.vn	Private company	2001
31	Silk Road	364 Cộng Hòa Street, Tân Bình District, HCMC	(84) 810-6200	www.silkroad-net.com	Foreign investment	1995
32	Gia Hào Co.,LTD	47/3 Võ Văn Ngân Street, Thủ Đức District, HCMC	(84) 897-0634	www.giahao.com		2003
33	Công ty Điện Toán Và Truyền Số liệu (VDC)	292 Tây Sơn Street, Hà Nội	(8404) 537-2841	www.vdc.com.vn	State-owned company	1989
34	Giải Pháp Tin Học BÁCH KHOA Co., LTD	214 Nguyễn Trãi Street (2nd Floor), Nguyễn Cư Trinh Ward, District 1, HCMC	(84) 837-9081			
35	Phát Triển Phần Mềm MEKONG Co.,LTD	232/5 30-4 Street, Hưng Lợi Ward, Cần Thơ City	(8407) 184-0364		Private company	2001
36	Việt Nam Network Co., LTD	2nd Building, Quang Trung Software Industrial Park, District 12, HCMC	849102268 849103909	www.vietnam-network.com	Private company	2000
37	FPT-HN	89 Láng Hạ Street, Hà Nội	(8404) 833-6742	www.fpt-soft.com	Private company	1988
38	QUANTIC LTD.	104 Điện Biên Phủ Street, Đa Kao Ward, District 1, HCMC	(84) 820-4308	www.quantic.com.vn	Private company	1991
39	SaiGonCTT	123 Trương Định Street, Ward 3, HCMC	(84) 932-1044	www.saigonctt.com	Private company	2000

40	Tin Học PT Co.,LTD	36 Nguyễn Văn Lối Street, Phú Nhuận District, HCMC	(84) 845-4431	www.pt-software.com	Foreign investment	2000
41	ÁnhMinh Co., LTD	10 Đinh Tiên Hoàng Street, District 1, HCMC	(84) 910-3446	www.amicomp.com.vn	Foreign investment	
42	Công Ty Cổ Phần Công Nghệ Khang Phú Thành	10 Đinh Tiên Hoàng Street, District 1, HCMC	(84) 910-3443	www.kptt.com	Private company	
43	IT Solution	71AB Nguyễn Đình Chiểu Street, Distreet 3, HCMC	(84) 404-0949	www.itsolution2b.com	Foreign investment	2001
44	Synsai Solution	97/222 Nguyễn Văn Vỹ Street, Ward 12, Tân Bình District, HCMC	(84) 949-0118		Foreign investment	2002
45	PSD	Quang Trung Software City, 6th Bulding	(848) 715-5048	www.psdus.com	Foreign investment	1991
46	Sáng Tạo Inc	20F Lam Sơn Street, Ward 12, Tân Bình District, HCMC	(84) 848-5723	www.sangtao.net	Private company	
47	GlassEgg digital media Company	E-Town 7th floor, 364 Cộng Hòa Street, Tân Bình District, HCMC	(84) 810-9018	www.glassegg.com	Foreign investment	1999
48	Công ty Phần Mềm Và Truyền Thông VASC	29 Lê Duẩn Street, District 1, HCMC	(84) 825-6525	www.vnn.vn	State-owned company	1997
49	Công Ty Cổ Phần Ứng Dụng Công Nghệ Toàn Cầu-GLTEC	2th floor, Tranco Building, 83 A Lý Thường Kiệt Street, Hà Nội	(8404) 942-1995	www.gltec.com	Private company	2002
50	Thương Mại TH &DL Đoàn Kết Co., LTD	5B Nguyễn Siêu Street, Bến Nghé Ward, District 1, HCMC	(84) 829-3655	www.union.com.vn	Private company	2000
51	VietSoftware Co.	01 Yết Kiêu Street, Hoàn Kiếm District, Hà Nội	(8404) 942-0708	www.vietsoftware.com	Private company	2000
52	Công Ty Cổ Phần Tin Học Lạc Việt	191A Hoàng Văn Thụ Street, Ward 8, Phú Nhuận District, HCMC	(84) 842-3333	www.lacviet.com.vn	Private company	1994

53	Công Ty Cổ Phần Phát Triển Đầu Tư Công Nghệ FPT-Trung tâm Xuất khẩu Phần mềm FSOFT	6th floor, HITC Building, 239 Xuân Thủy Street, Cầu Giấy Ward, Hà Nội	(8404) 833-6742	www.fpt-soft.com	Private company	1998
54	Paragon Solutions Việt Nam (PSV)	26-28 Đồng Du Street, District 1, HCMC	(84) 825-1250	www.psv.com.vn	Foreign investment	1995
55	Dan phong Software Solutions	04 Nam Quốc Cang Street, District 1, HCMC	(84) 925-3421	www.danphong.com	Private company	2001
56	LE MINH Information Co. KT-ACC Accounting Software	529/99 Huỳnh Văn Bánh Street, Ward 14, Phú Nhuận District, HCMC	(84) 844-4828	www.imccom.com	Private company	2003
57	Công Ty Cổ Phần Hỗ Trợ Phát Triển Tin Học-HIPT	79 Bà Triệu Street, Hà Nội	(8404) 943-3880	www.hipt.com.vn	Private company	1994
58	New Century Soft	3th floor, 777 Building Giải Phóng Street, Hà Nội	(8404) 664-3110	www.newcenturysoft.com	Private company	2001
59	Công Ty Tin Học DOLSOFT	261 Nguyễn Văn Trỗi Street, Phú Nhuận District, HCMC		www.dolsoft.com	Private company	1995
60	Công Ty Phát Triển Công Nghệ Thông Tin (AIC)-Bộ QP	23 Phan Bội Châu Street, Hà Nội	(8404) 942-1039		State-owned company	1993
61	Công ty Điện Toán Và Truyền Số liệu (VDC)	292 Tây Sơn Street, Hà Nội	(8404) 537-2765	www.home.vnn.vn	State-owned company	1989
62	Phát Triển Phần Mềm XD AURSOLE Co., LTD	9th floor, 115 Nguyễn Huệ Street, District 9, HCMC	(84) 821-9381		Foreign investment	
63	SDC	10 Cô Giang Street, District 1, HCMC	(84) 404-0555	www.sdcgrp.com	Foreign investment	1998
64	Globaleis. Inc	123 Trương Định Street, Ward 3, HCMC	(84) 932-1001	www.globaleis.com	Private company	1993

65	TMA Solutions	111 Nguyễn Đình Chính, Phú Nhuận District, HCMC	(84) 990-2621	www.tmasolutions.com	State-owned company	1997
66	Công ty Máy tính truyền thông CMC	29A Hàn Thuyên Street, Hanoi	(84) 972-1135	www.CMC.com.vn	State-owned company	
67	CMC	29A Hàn Thuyên Street, Hanoi	(84) 972-1135	www.CMC.com.vn	State-owned company	1993
68	FPT	41 Sương Nguyệt Anh Street, District 1, HCMC	(84) 925-2545	www.fpt.com.vn	State-owned company	1988
69	Trường Kỹ Thuật Tin Học Sài Gòn- SaiGonTech	6th Building, Quang Trung Software Industrial Park, District 12, HCMC.	(84) 715-5033	www.saigontech.net	State-owned company	2001
70	Paragon Solutions Việt Nam (PSV)	26-28 Dong Du Street, District 1, HCMC	(84) 825-1250	www.psv.com.vn	Private company	1995
71	Trung tâm Tin học Bưu điện Hà Nội	75 Đinh Tiên Hoàng Street, Hoàn Kiếm District, Hanoi	(84) 814-7999	www.ptic.com.vn	State-owned company	1996
72	Công ty TNHH Tin học Phương Bắc	386 Bà Hạt Street, District 10, HCMC	(84) 853-4307		Private company	1998

APPENDIX C: TABLES & FIGURES

Table 4.1 Construct measurements

Construct	Items	Measurements
Project manager		
	Experience of project manager	- The level of experiences in different functions of planning 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high
	Effort of project manager	- The extent of control that the project leader felt he had over product specification 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high
		- Effort spent in planning stage compare to other stages 1 = much lower; 2 = lower; 3 = equal; 4 = higher; 5 = much higher
Team members capability		
	Knowledge	- Knowledge of system development and requirements analysis 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high
	Experience	- Experience with system development and requirements analysis 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high
	Commitment and persistence	- The level of commitment and persistence of team members in the planning stage 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high
Customers/ Users		
	Involvement of customer/ user in planning stage	The level of involvement of customer/ user in the planning stage 1= very low; 2 = low; 3 = average; 4 = high; 5 = very high

Technical factors		
Project management methods	Use of project management methods	- YES/ NO
	Use of planning tools/ techniques (WBS, Gantt chart, CPM, PERT, Budget management, Handling conflicts, Progress tracking, Weekend modifiers, Overbooking of resources, Workforce assignment, others)	The use level of following tools/ techniques: 1= never; 2 = sometimes; 3 = average; 4 = frequent; 5 = very frequent
System development methods	Use of system development methods in planning (Structure approach, Object – oriented, Interactive, Rapid application development, Rational unified process, Agile software development process, others)	- YES/ NO
Life-cycle methodology	Use of life-cycle methodology for planning: (waterfall, V-process, spiral, prototype, incremental delivery, others)	- YES/ NO
Management support		
	Top management support in planning stage	- The project manager was given full authority to manage the project 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Commitment sponsor	- The project started with a committed sponsor 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Involvement of sale and marketing department in planning stage	- Active participation of the sales and marketing department in planning stage 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Involvement of client' functional department	- Actively participation of client's functional departments in the planning stage 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree

Objectives of project		
Objective/ scope define	Project objectives: o Minimize overruns in both cost and schedule o Deliver a quality product o Customer satisfaction o Minimize cost	- The importance of objectives in the software project: 1 = very unimportant; 2 = unimportant; 3 = neutral; 4 = important; 5 = very important
	Project team objective and customer objective	- The project team' objectives and customer' objectives were not in any conflict in the planning stage. 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Project scope	- The project scope was well defined in the planning phase 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Available of the resource		
	Resources available in planning stage (manpower, time, cost, infrastructure)	- The level of resources available 1= very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Management style		
	- Democratic, all members participate in making decision process - To consult project team before making decision - Project manager makes all decision without consulting - People oriented leadership - Work-oriented leadership	Applying level of management style 1= very low; 2 = low; 3 = medium; 4 = high; 5 = very high
Planning performance		
	Time for planning	% of elapsed time
	Effort for planning	% of total involved in the whole project
	Requirements and specifications defining	- The requirements and specifications were well defined in the planning stage 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
		- The good requirements definition is very important to have a qualify product 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree

	Timeline and effort estimating	- Time and effort for the development process were well estimated 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
		- The good estimation of cost is very important to complete the project within budget 1= very disagree; 3 = neutral; 5 = very agree
	Scheduling	The scheduling was well defined in the planning stage 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Risk analyzing (identification, estimation and evaluation)	- The risks of the project were well analyzed in the project plan 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Project outcomes		
Project results	Time	The completion time of the project on planned time 1 = ahead of schedule; 2 = On time; 3 = Over 30% behind schedule; 4 = Over 50% behind schedule
	Cost	- The real cost spent for the project 1 = ahead of budget; 2 = Within planned budget; 3 = Over 30% cost overrun; 4 = Over 50% cost overrun
	Quality	- The software product met all specifications defined in the planning stage 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Customer satisfaction	- The project has satisfied the customer need 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Project success	In project team point of view	- The project is evaluated as a success by the project team 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	In customer point of view	- The project is evaluated as a success by the customer 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	In parent company point of view	- The project is evaluated as a success by the parent company - 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree

	In the sponsor point of view	- The project is evaluated as a success by the sponsor 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Organization benefits	Experience benefits	- The project has enhanced the company image 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Financial benefits	- The project has brought financial benefits to the company 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Project team satisfaction	Capability	- The project team capability was improved from participating in the project 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
	Financial benefits	- The project team was satisfied with financial benefits from the project 1 = very disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = very agree
Project characteristics		
	Project duration	1 = < 6 months 2 = 6 – <12 months 3 = 12 – <18 months 4 = 18 – <24 months 5 = > 24 months
	Project type - Commercial - Made to order - Outsourcing	- YES/ NO
	Project ownership - Foreign - Local	- YES/ NO

Table 6.1: Correlation between using software for planning and percentage of projects completed on time

Correlations

			MS project	On planned time
Spearman's rho	MS project	Correlation Coefficient	1.000	.313*
		Sig. (2-tailed)	.	.039
		N	55	44
	On planned time	Correlation Coefficient	.313*	1.000
		Sig. (2-tailed)	.039	.
		N	44	44

*. Correlation is significant at the .05 level (2-tailed).

Table 6.2: Correlation between project size and percentage of project success

Correlations

			Project size	All of three criteria
Spearman's rho	Project size	Correlation Coefficient	1.000	.274
		Sig. (2-tailed)	.	.091
		N	47	39
	All of three criteria	Correlation Coefficient	.274	1.000
		Sig. (2-tailed)	.091	.
		N	39	42

Table 6.3: Correlation between project manager' capability and percentage of project success

Correlations

			Project & Team mgt capability	All of three criteria
Spearman's rho	Project & Team mgt capability	Correlation Coefficient	1.000	.670**
		Sig. (2-tailed)	.	.000
		N	55	42
	All of three criteria	Correlation Coefficient	.670**	1.000
		Sig. (2-tailed)	.000	.
		N	42	42

**. Correlation is significant at the .01 level (2-tailed).

Table 8.1: Company ownership, age and size of projects by size

		N	Means	Std Deviation	T - value	Significant
Ownership	Smaller	38	1.89	.65	1.454	.153
	Bigger	20	1.65	.59		
Age (years)	Smaller	29	5.76	5.67	.349	.729
	Bigger	18	5.28	3.77		

Number of employees (persons)	Smaller	37	35.5	46.6	-1.621	.118
	Bigger	20	70.3	89.4		

Table 8.2: Project types by size

		N	Means	Std Deviation	T - value	Significant
Project types *	Smaller	47	2.02	.68	1.292	.202
	Bigger	24	1.79	.72		

(*) Note: 1 = commercial software, 2 = build to order, 3 = outsourcing

Table 8.3: Project clients by size

Clients *		N	Means	Std Deviation	T - value	Significant
North America	Smaller	46	.22	.42	-.657	.514
	Bigger	24	.29	.46		
South America	Smaller	46	.02	.15	-.424	.674
	Bigger	24	.04	.20		
Asia	Smaller	46	.09	.28	-.471	.640
	Bigger	24	.13	.34		
Europe	Smaller	46	.09	.28	-1.985	**.050**
	Bigger	24	.29	.46		
Government organization	Smaller	46	.46	.50	-1.000	.322
	Bigger	24	.58	.50		
Private organization	Smaller	46	.22	.42	-.657	.514
	Bigger	24	.29	.46		
Individuals	Smaller	46	.04	.21	.035	.972
	Bigger	24	.04	.20		

(*) Note: 1 = North America, 2 = South America, 3 = Asian – Pacific, 4 = Europe, 5 = India, 6 = Government org., 7 = Private org., 8 = Individuals

Table 8.4: Human factors of projects by size

Items		N	Means	Std Deviation	T - value	Significant
Project manager experiences (in years)	Smaller	39	2.68	1.68	-1.591	.117
	Bigger	19	3.39	1.44		
Project manager experiences (in number of projects)	Smaller	47	6.30	5.09	1.359	.179
	Bigger	25	4.88	3.67		
Role of experience of Project manager (*)	Smaller	47	3.82	.63	2.033	**.047**
	Bigger	25	3.53	.57		
Technical ability - team members (*)	Smaller	47	3.70	.66	1.331	.189
	Bigger	25	3.50	.59		
Project manager effort (*)	Smaller	47	3.75	.72	.430	.669
	Bigger	25	3.68	.54		
Customer involvement (*)	Smaller	47	3.75	.74	.370	.713
	Bigger	25	3.68	.69		

(*) Highest score is 5

Table 8.5: Application of technical methods in planning of projects by size

Items		N	Means	Std Deviation	T - value	Significant
Apply project management method	Smaller	47	.60	.50	-.363	.718
	Bigger	25	.64	.49		
Using software for project management	Smaller	46	.61	.49	-.951	.346
	Bigger	25	.72	.46		
Apply system development method	Smaller	47	.94	.25	.245	.808
	Bigger	25	.92	.28		
Tools or techniques for system development	Smaller	47	.40	.50	.705	.484
	Bigger	25	.32	.48		
Apply life – cycle method	Smaller	47	.70	.46	.522	.604
	Bigger	25	.64	.49		

Table 8.6: Management factors in projects by size

Factors		N	Means	Std Deviation	T - value	Significant
Management support						
Top-down support	Smaller	47	4.13	.74	-.176	.861
	Bigger	25	4.16	.75		
Functional support	Smaller	47	3.72	.77	.650	.518
	Bigger	25	3.60	.76		
Project objectives						
Cost and time oriented	Smaller	47	3.58	.76	1.906	.062
	Bigger	25	3.26	.65		
Customer oriented	Smaller	47	4.37	.71	.083	.934
	Bigger	25	4.36	.53		
Communication methods						
Formal meeting	Smaller	47	3.52	.91	.770	.444
	Bigger	25	3.36	.81		
Email	Smaller	47	4.16	1.08	-.815	.418
	Bigger	25	4.36	.94		
Resource availability						
Human resource and time availability	Smaller	47	3.46	.74	.281	.780
	Bigger	25	3.40	.87		
Financial availability	Smaller	47	3.71	.76	.185	.854
	Bigger	25	3.68	.69		
Management style:						
People oriented	Smaller	47	2.47	1.06	-.475	.637
	Bigger	25	2.60	1.15		
Work oriented	Smaller	47	3.40	1.17	-.879	.384
	Bigger	25	3.68	1.31		
Participative	Smaller	47	2.09	1.12	-.434	.666
	Bigger	25	2.20	1.04		
Consultative	Smaller	47	3.87	1.23	-.028	.978
	Bigger	25	3.88	1.05		

Table 8.7: Company ownership, age and size of projects by ownership

		N	Means	Std Deviation	T - value	Significant
Age (years)	International	15	4.47	3.23	-1.314	.196
	Local	39	6.03	5.28		
Number of employees (persons)	International	17	2.59	2.35	-.414	.681
	Local	46	2.89	3.13		

Table 8.8: Project types by ownership

		N	Means	Std Deviation	T - value	Significant
Types *	International	23	1.87	.81	-.596	.555
	Local	56	1.98	.62		

(*) Note: 1 = commercial software, 2 = build to order, 3 = outsourcing

Table 8.9: Project duration and cost of projects by ownership

		N	Means	Std Deviation	T - value	Sig.
Duration *	International	23	3.61	2.06	.711	.482
	Local	57	3.26	1.72		
Cost ** (compared to budget)	International	21	2.19	1.17	-.868	.391
	Local	57	2.46	1.28		
Number of people participated in the whole project	International	22	11.00	5.42	1.423	.162
	Local	50	9.02	5.47		

(*) 1 = < 3 month, 2 = 3 - <6 months, 3 = 6 – <9 months, 4 = 9 – <12 months, 5 = 12 – <18 months, 6 = 18 – <24 months, 7 = > 24 months

(**) 1 = < 90%, 2 = 90 – 109%, 3 = 110 – 129%, 4 = 130 – 149%, 5 = 150 – 199%, 6 = > 200%

Table 8.10: Application of technical methods in planning of projects by ownership

Items		N	Means	Std Deviation	T - value	Sig.
Apply project management method	International	23	.65	.49	1.180	.245
	Local	57	.51	.50		
Using software for	International	23	.91	.29	3.994	.000

project management	Local	56	.55	.50		
Apply system development method	International	22	.96	.21	.132	.896
	Local	57	.95	.23		
Tools or techniques for system development	International	23	.35	.49	-.171	.865
	Local	57	.37	.49		
Apply life – cycle method	International	23	.74	.45	1.097	.278
	Local	57	.61	.49		

Table 8.11: Selection of technical methods in projects by ownership

Selecting technical methods in the project		N	Means	Std Deviation	T - value	Significant
By Project manager	International	23	.70	.47	-1.511	.140
	Local	57	.86	.35		
By Top manager	International	23	.35	.49	1.518	.138
	Local	57	.18	.38		
By Client	International	23	.39	.50	1.225	.228
	Local	57	.25	.43		

Table 8.12: Management factors in projects by ownership

Factors		N	Means	Std Deviation	T - value	Sig.
Management support						
Top-down support	International	23	4.00	.85	-.886	.382
	Local	57	4.15	.66		
Functional support	International	23	3.83	.78	.909	.368
	Local	57	3.65	.81		
Project objectives						
Cost and time oriented	International	23	3.72	.58	2.333	.023
	Local	57	3.352	.76		
Customer oriented	International	23	4.44	.63	.800	.428
	Local	57	4.31	.69		
Communication methods						

Formal meeting	International	23	3.22	.85	-1.395	.170
	Local	57	3.52	.92		
Email	International	23	4.59	.58	2.650	.010
	Local	57	4.09	1.09		
Resource availability						
Human resource and time availability	International	23	3.48	.76	.297	.768
	Local	57	3.42	.82		
Financial availability	International	23	3.63	.64	-.635	.528
	Local	57	3.74	.76		
Management style						
People oriented	International	23	2.44	1.04	-.550	.585
	Local	57	2.58	1.12		
Work oriented	International	23	3.70	1.22	1.019	.314
	Local	57	3.39	1.25		
Participative	International	23	2.39	1.16	1.268	.212
	Local	57	2.04	1.08		
Consultative	International	23	3.74	1.10	-.751	.457
	Local	57	3.95	1.19		

Table 8.13: Project outcomes of projects by ownership

Project outcomes		N	Means	Std Deviation	T – value	Sig.
Project result in term of time (*)	International	23	2.26	.69	-1.748	.087
	Local	57	2.58	.84		
Project result in term of cost (**)	International	23	2.13	.81	-.383	.704
	Local	57	2.21	.92		
Project success	International	23	3.71	.44	-.540	.591
	Local	57	3.78	.64		
Meet all specifications defined in plan stage	International	23	3.96	.71	-.151	.881
	Local	57	3.98	.67		
Satisfied customer need	International	23	4.00	.60	.352	.727
	Local	57	3.95	.61		
Enhance company image	International	23	4.17	.65	.428	.671

	Local	57	4.11	.65		
Improve project team capability	International	23	4.30	.56	-.199	.843
	Local	57	4.33	.66		
Financial benefits to company	International	23	3.65	.83	-.341	.735
	Local	57	3.72	.70		
Financial benefits to team members	International	23	3.39	.72	.031	.975
	Local	57	3.39	.62		

(*): 1 = under planned time, 2 = on planned time, 3 = over 30%, 4 = over 50%

(**): 1 = under planned budget, 2 = on planned budget, 3 = over 30%, 4 = over 50%

Table 8.14: Project clients of projects by type

Project clients		N	Means	Std Deviation	Significant		
					C – M	M – O	C – O
North America	Commercial	18	.39	.50	.023		
	Made to order	48	.08	.28		.035	
	Outsourcing	10	.50	.53			.593
South America	Commercial	18	.11	.32	.019		
	Made to order	48	.00	.00			
	Outsourcing	10	.00	.00			.163
Asia	Commercial	18	.17	.38	.203		
	Made to order	48	.04	.20		.273	
	Outsourcing	10	.20	.42			.838
Europe	Commercial	18	.33	.49	.050		
	Made to order	48	.08	.28		.880	
	Outsourcing	10	.10	.32			.137
India	Commercial	18	.00	.00			
	Made to order	48	.00	.00			
	Outsourcing	10	.00	.00			
Government organization	Commercial	18	.56	.51	.731		
	Made to order	48	.60	.49		.018	
	Outsourcing	10	.20	.42			.061
Private organization	Commercial	18	.39	.50	.137		
	Made to order	48	.19	.39		.504	

	Outsourcing	10	.30	.48			.651
Individuals	Commercial	18	.05	.24	.564		
	Made to order	48	.02	.14		.457	
	Outsourcing	10	.10	.32			.703

Table 8.15: Project duration, cost and size of projects by type

		N	Means	Std Deviation	Significant		
					C – M	M – O	C – O
Project duration (*)	Commercial	18	3.83	1.69	.345		
	Made to order	49	3.37	1.95		.356	
	Outsourcing	10	2.90	1.29			.115
Project cost (**)	Commercial	17	3.00	1.54	**.042**		
	Made to order	48	2.13	1.06		.341	
	Outsourcing	10	2.60	1.43			.503
Project size (number of people in project team)	Commercial	17	10.44	5.24	.128		
	Made to order	43	8.6	5.14		**.050**	
	Outsourcing	9	12.44	6.17			.544

(*) 1 = < 3 month, 2 = 3 - <6 months, 3 = 6 – <9 months, 4 = 9 – <12 months, 5 = 12 – <18 months, 6 = 18 – <24 months, 7 = > 24 months

(**) 1 = < 90%, 2 = 90 – 109%, 3 = 110 – 129%, 4 = 130 – 149%, 5 = 150 – 199%, 6 = > 200%

Table 8.16: Human factors in projects by type

Human factors		N	Means	Std Deviation	Significant		
					C - M	M - O	C - O
Project manager experiences (in years)	Commercial	13	3.62	1.45	.069		
	Made to order	39	2.68	1.79		.208	
	Outsourcing	9	3.44	1.51			.794
Project manager experiences (in number of projects)	Commercial	18	6.17	5.52	.792		
	Made to order	49	5.78	4.78		.424	
	Outsourcing	10	7.5	6.20			.579
Role of experience of	Commercial	18	3.83	.57	.320		
	Made to order	49	3.67	.59		.783	

Project manager	Outsourcing	10	3.60	.78			.418
Technical ability - team members	Commercial	18	3.76	.64	.287		
	Made to order	49	3.57	.61		.448	
	Outsourcing	10	3.67	.78			.191
Project manager effort	Commercial	18	3.97	.61	.046		
	Made to order	49	3.62	.63		.497	
	Outsourcing	10	3.45	.73			.050
Customer involvement	Commercial	18	4.17	.78	.009		
	Made to order	49	3.57	.70		.719	
	Outsourcing	10	3.50	.53			.013

Table 8.17: Technical factors in projects by type

Technical factors		N	Means	Std Deviation	Significant		
					C - M	M - O	C - O
Apply project management method	Commercial	18	.56	.51	.974		
	Made to order	49	.55	.50		.788	
	Outsourcing	10	.60	.52			.829
Using software for project management	Commercial	18	.83	.38	.024		
	Made to order	48	.56	.50		.430	
	Outsourcing	10	.70	.48			.464
Apply system development method	Commercial	18	.94	.24	.800		
	Made to order	49	.96	.20		.159	
	Outsourcing	9	1.00	.00			.331
Tools or techniques for system development	Commercial	18	.28	.46	.493		
	Made to order	49	.37	.49		.119	
	Outsourcing	10	.60	.52			.214
Apply life – cycle method	Commercial	18	.50	.52	.199		
	Made to order	49	.67	.47		.412	
	Outsourcing	10	.80	.42			.110

Table 8.18 Selection of technical tools and methods in projects by type

	N	Means	Std	Significant

				Deviation	C - M	M - O	C - O
By project manager	Commercial	18	.72	.46	.448		
	Made to order	49	.82	.39		.476	
	Outsourcing	10	.90	.32			.240
By top manager	Commercial	18	.17	.38	.379		
	Made to order	49	.27	.45		.666	
	Outsourcing	10	.20	.42			.838
By clients	Commercial	18	.17	.38	.293		
	Made to order	49	.27	.46		.099	
	Outsourcing	10	.60	.52			.035

Table 8.19: Management factors in projects by type

Human factors		N	Means	Std Deviation	Significant		
					C - M	M - O	C - O
Management support							
Top – down support	Commercial	18	4.17	.86	.917		
	Made to order	49	4.14	.71		.256	
	Outsourcing	10	3.90	.57			.333
Functional support	Commercial	18	3.89	.76	.369		
	Made to order	49	3.69	.82		.713	
	Outsourcing	10	3.60	.70			.322
Project objectives							
Cost and time oriented	Commercial	18	3.39	.76	.630		
	Made to order	49	3.49	.73		.248	
	Outsourcing	10	3.25	.54			.579
Customer oriented	Commercial	18	4.36	.66	.973		
	Made to order	49	4.37	.68		.310	
	Outsourcing	10	4.10	.74			.365
Communication methods							
Formal meeting	Commercial	18	3.19	.93	.287		
	Made to order	49	3.48	.97		.901	

	Outsourcing	10	3.45	.60			.385
Email	Commercial	18	4.31	.89	.582		
	Made to order	49	4.16	.77		.830	
	Outsourcing	10	4.35	.99			.780
Resource availability							
Human resource and time availability	Commercial	18	3.56	.86	.445		
	Made to order	49	3.38	.77		.830	
	Outsourcing	10	3.45	.99			.780
Financial availability	Commercial	18	3.78	.71	.950		
	Made to order	49	3.77	.74		.233	
	Outsourcing	10	3.45	.73			.263
Management styles							
People oriented	Commercial	18	2.72	.75	.545		
	Made to order	49	2.57	1.21		.632	
	Outsourcing	10	2.40	.97			.376
Work oriented	Commercial	18	3.61	1.38	.515		
	Made to order	49	3.37	1.24		.735	
	Outsourcing	10	3.50	1.08			.816
Participative	Commercial	18	2.50	1.43	.314		
	Made to order	49	2.12	1.03		.120	
	Outsourcing	10	1.70	.68			.055
Consultative	Commercial	18	3.50	1.15	.199		
	Made to order	49	3.92	1.17		.325	
	Outsourcing	10	4.30	1.06			.078

Table 8.20: Project outcomes of projects by type

		N	Means	Std Deviation	Significant		
					C - M	M - O	C - O
Project result in term of time (*)	Commercial	18	2.50	.86	.892		
	Made to order	49	2.45	.82		.395	
	Outsourcing	10	2.70	.82			.551
Project result in term of cost (**)	Commercial	18	2.33	1.08	.506		
	Made to order	49	2.14	.84		.624	
	Outsourcing	10	2.00	.82			.368
Project success	Commercial	18	3.74	.57	.961		
	Made to order	49	3.75	.55		.858	
	Outsourcing	10	3.70	.79			.888
Meet all specs. defined in plan stage	Commercial	18	4.11	.58	.442		
	Made to order	49	3.98	.69		.025	
	Outsourcing	10	3.50	.53			.010
Satisfied customer need	Commercial	18	3.94	.54	.924		
	Made to order	49	3.96	.61		.816	
	Outsourcing	10	3.90	.74			.869
Enhance company image	Commercial	18	4.22	.65	.655		
	Made to order	49	4.14	.61		.220	
	Outsourcing	10	3.80	.92			.168
Improve project team capability	Commercial	18	4.22	.88	.580		
	Made to order	49	4.35	.56		.789	
	Outsourcing	10	3.20	.79			.765
Financial benefits to company	Commercial	18	3.67	.69	.972		
	Made to order	49	3.67	.75		.690	
	Outsourcing	10	4.30	.48			.694
Financial benefits to team members	Commercial	18	3.44	.70	.848		
	Made to order	49	3.41	.61		.447	
	Outsourcing	10	3.70	.67			.426

(*): 1 = under planned time, 2 = on planned time, 3 = over 30%, 4 = over 50%

(**): 1 = under planned budget, 2 = on planned budget, 3 = over 30%, 4 = over 50%

Table 9.1: Summary of Variables and measures

Dependent variables	Variable description
Planning performance	Evaluations the planning performance in terms of: Requirements and technical specifications definition; Timeline and effort estimation; Scheduling and Risk analysis.
Success of the project	Evaluations success of the project by customer; parent company and by customer
Project outcome in term of time	Level of completion on time of project
Project outcome in term of cost	Level of completion within budget of project
Non-financial benefit of the project	Evaluations project outcomes in terms of: quality delivery; customer satisfaction; company image enhancement; team member capability improvement.
Financial benefits of the project	Evaluations project outcomes in terms of: financial benefits to company and to team members
Independent variables	**Variable description**
Human factors	
- Project managers experiences	Level of PM's experiences in different functions of planning
- Project manager effort	Level of effort spent; extent of control over product specification
- Team members capability	Knowledge – Experience of team members on system development and requirement analysis; commitment and persistence
- Customer involvement	Level of customer involvement in planning
Technical factors: Applying	
- Project management method	
- System Development method	2 most frequent methods: Object-oriented & RUP
- Life-cycle method	2 most frequent methods: Waterfall & Spiral
Management factors	
- Management support	Level of authority of Project manager; level of participation of functional department in planning

- Project objectives	Time & cost oriented; customer oriented
- Leadership and decision making styles	Levels of adopted styles in project management (People oriented, customer oriented, consulting before making decision)
- Availability of resources	Level of availability of human resource & time; level of availability of budget and infrastructure.

Table 9.2. PARAMETER ESTIMATES BY FACTOR ANALYSIS

Variable	Description	Loading estimate	Eigenvalue	Cumulative	% of total variance	KMO
Project manager effort	Extent of control in specification of project manager	900	1.622	81.00%	81.00%	.767
	Effort that project manager spent for planning	.900				
Project manager experiences	Experiences in objectives & scope defining	.661	2.407	48.25%	48.25%	.697
	Experiences in estimation of cost, time & effort	.772				
	Experiences in scheduling	.747				
	Experiences in communication with clients	.503				
	Experiences in managing project team	.750				
Team member's capability	Knowledge in system development and requirement definition of team	.875	2.234	74.46%	74.46%	.828
	Experiences with system development and requirement definition of team	.859				
	Commitment and persistence	.855				
Management support	PM was given full authority	.852	1.553	51.76%	51.76%	.690
	Functional dept. participated	.873				
	Client FD participated	.554				
Project objectives						
Cost and time oriented	Minimize both cost and schedule	.860	1.803	36.06%	36.06%	.835
	Minimize cost	.860				
Customer oriented	Quality and minimize overrun	.906	1.717	34.34%	70.39%	.834
	Customer satisfaction	.899				

Resource availability						
Resource availability	Manpower	.870	1.807	36.15%	36.14%	.720
	Time	.890				
	Budget	.879	1.636	32.72%	68.86%	.872
	Infrastructure	.928				
Planning performance	Well defined requirement and specification	.757	2.373	59.33%	59.33%	.761
	Well estimated time & effort	.810				
	Well defined scheduling	.717				
	Well analyzed risks	.794				
Project outcomes						
Qualitative benefits	Met all specifications defined in plan stage	.834	2.204	36.74%	36.74%	.729
	Satisfied customer need	.675				
	Enhance company image	.822				
	Improve project team capability	.582				
Financial benefits	Financial benefits to company	.908	1.659	27.64%	64.38%	.741
	Financial benefits to team members	.847				
Project success	Success (by project team)	.741	2.353	58.83%	58.83%	.751
	Success (by parent company)	.819				
	Success (by customer)	.773				
	Success (by sponsor)	.732				

Figure 9.1: The scatter diagram of Model 1

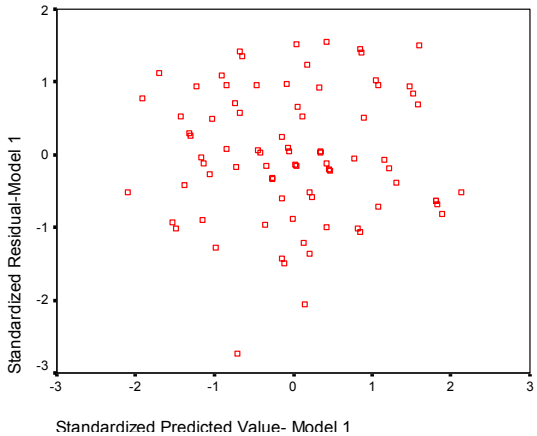

Figure 9.2 (a): The scatter diagram of Model 2a

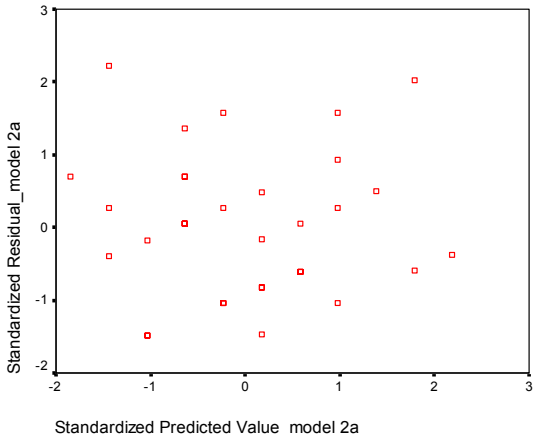

Figure 9.2 (b): The scatter diagram of Model 2b

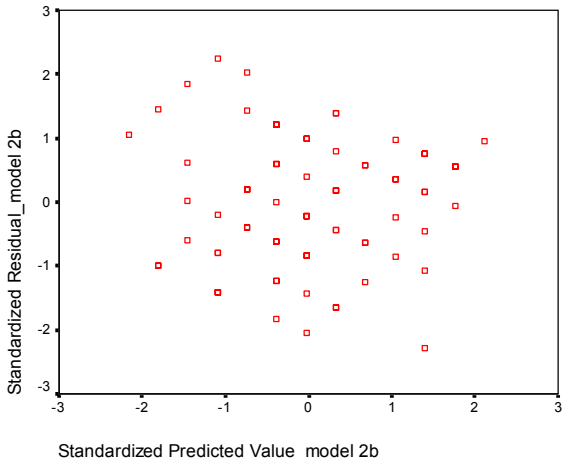

Figure 9.2 (c): The scatter diagram of Model 2c

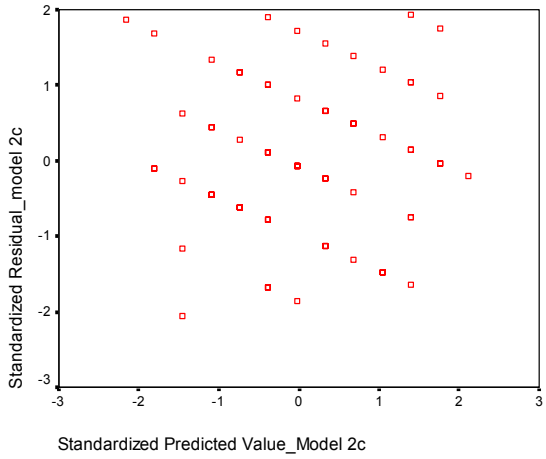

Figure 9.2 (d): The scatter diagram of Model 2d

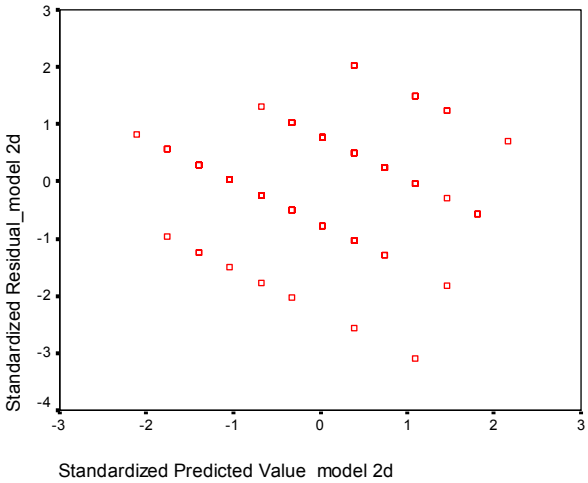

Figure 9.2 (e): The scatter diagram of Model 2e

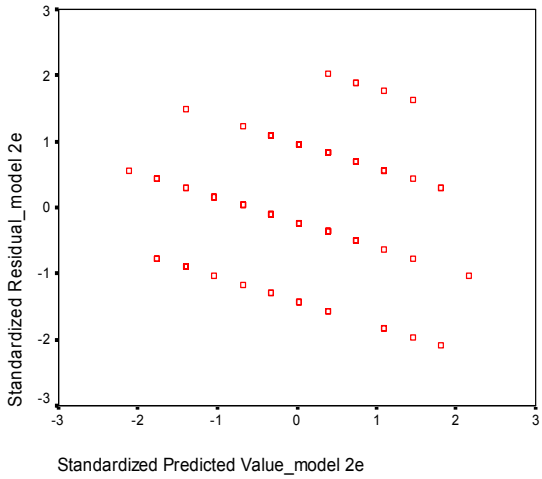

Figure 9.3: The scatter diagram of Model 3

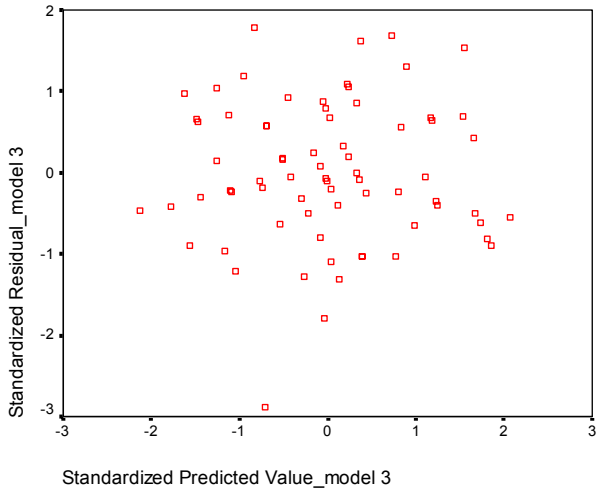

Table 9.3: Spearman Correlation testing for Model 1

Correlation between ABS residual of Model 1 and …	Spearman's rho Correlation	Sig. (2-tailed)	N
ABS residual of Model 1	1.000		80
Project manager effort	.046	.920	
Project manager experiences	.061	.720	
Team members ability	.044	.696	
Customer involvement	.029	.796	
Apply PM method	-.001	.992	
Object - oriented	.063	.580	
RUP	-.053	.639	
Waterfall	-.073	.521	
Spiral	.122	.282	
Management support	.016	.886	
Cost and time oriented	.022	.849	
Customer oriented	.018	.876	
Resource availability	.096	.395	
People oriented	.204	.069	
Work oriented	-.225	**.044**	

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Table 9.4: Spearman Correlation testing for Model 2

Correlation between ABS residual of …	Spearman's rho Correlation	Sig. (2-tailed)	N
ABS residual of Model 2a	1.000		80
Planning performance	.176	.117	

ABS residual of Model 2b	1.000	
Planning performance	-.048	.673
ABS residual of Model 2c	1.000	
Planning performance	-.048	.673
ABS residual of Model 2d	1.000	
Planning performance	-.048	.673
ABS residual of Model 2e	1.000	
Planning performance	-.048	.673

Table 9.5: Spearman Correlation testing for Model 3

Correlation between ABS residual of Model 3 and …	Spearman's rho Correlation	Sig. (2-tailed)	N
ABS residual of Model 3	1.000		72
Project manager effort	.040	.739	
Project manager experiences	.012	.921	
Team members ability	.043	.723	
Customer involvement	-.050	.678	
Apply PM method	-.140	.241	
Object - oriented	.120	.317	
RUP	-.110	.358	
Waterfall	-.007	.951	
Spiral	.052	.662	
Management support	-.005	.964	
Cost and time oriented	.050	.675	
Customer oriented	.100	.402	
Resource availability	.020	.866	
People oriented	.279	**.017**	
Work oriented	-.289	**.014**	
Project size	.211	.075	
Project ownership	-.022	.856	

Figure 9.4 Histogram of standardized residual Model 1

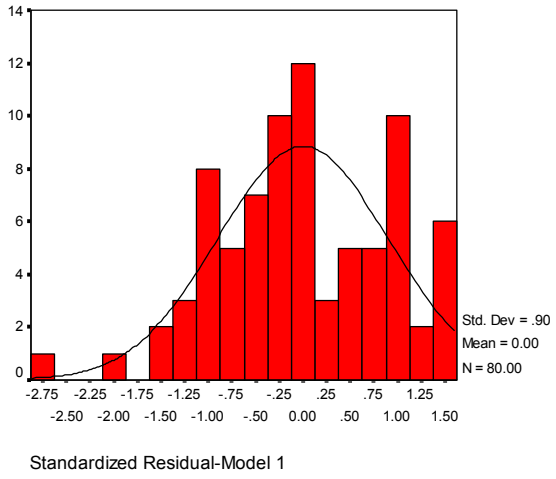

Figure 9.5 Histogram of standardized residual - Model 3

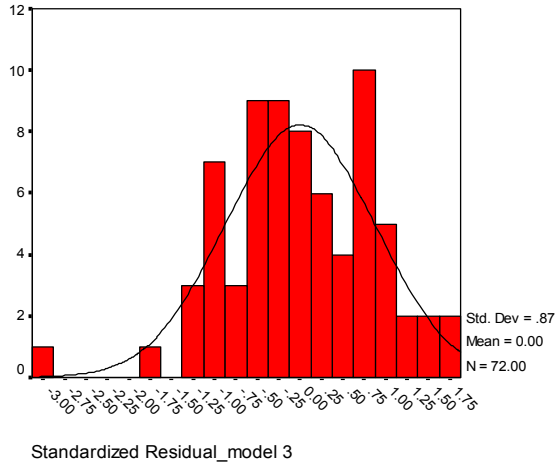

Figure 9.6 (a) Histogram of standardized residual - Model 2a

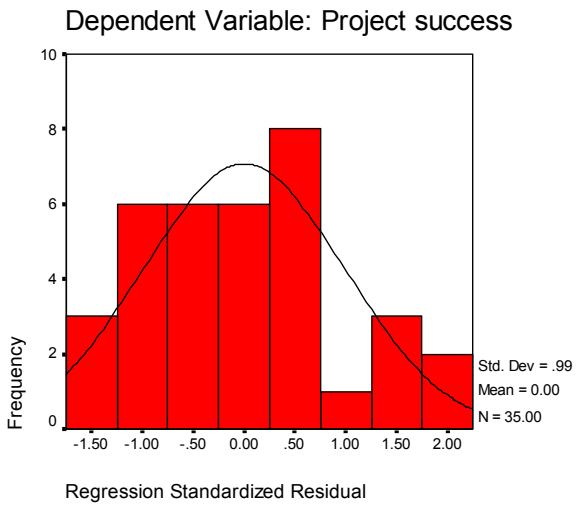

Figure 9.6 (b) Histogram of standardized residual - Model 2b

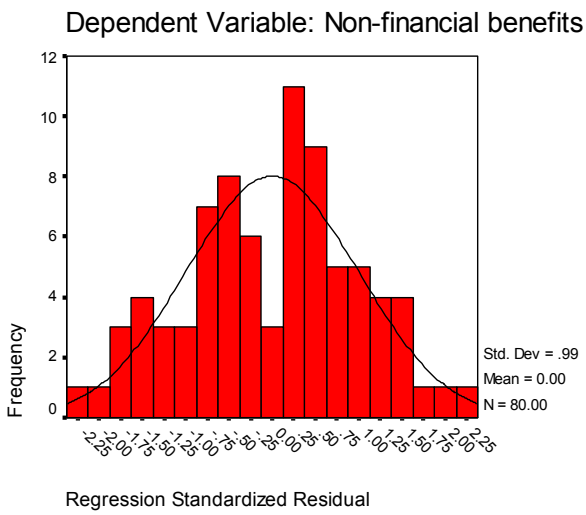

Figure 9.6 (c) Histogram of standardized residual - Model 2c

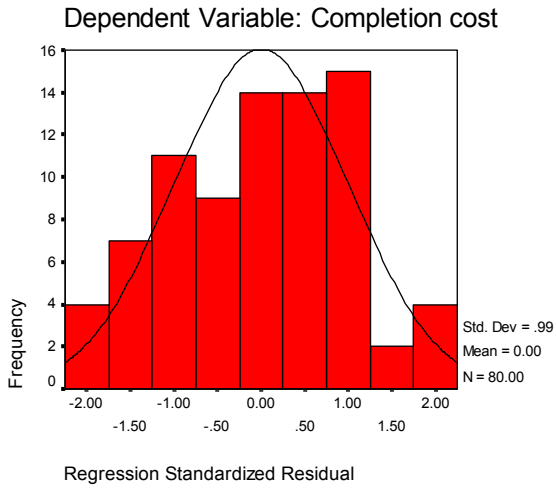

Figure 9.6 (d) Histogram of standardized residual - Model 2d

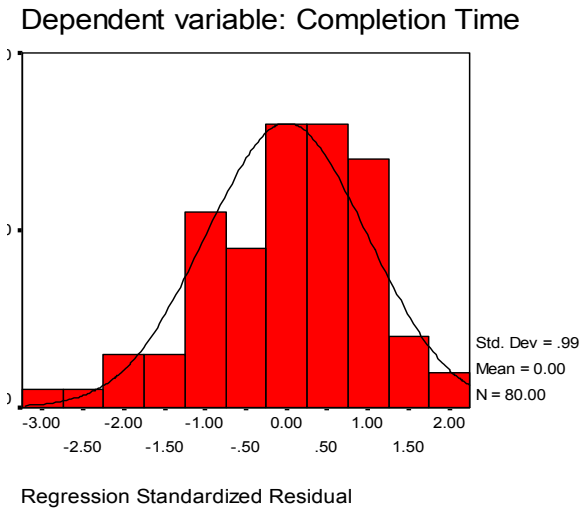

Figure 9.6 (c) Histogram of standardized residual – Model 2e

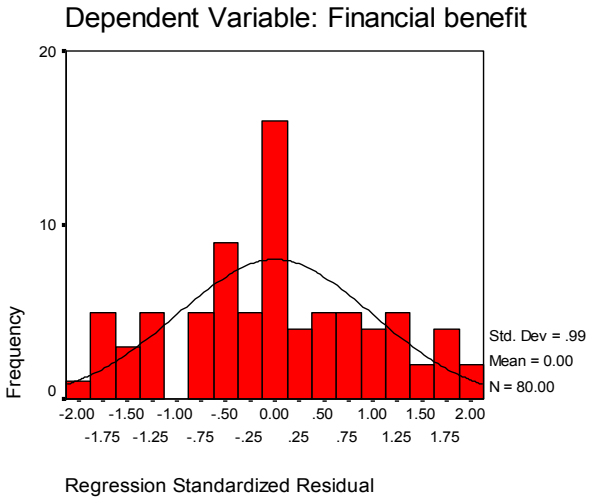

Table 9.6: Durbin – Watson test

Model	Dependent variable	Independent variable	Durbin – Watson value
Model 1	Planning performance	Planning factors	2.077
Model 2a	Project success	Planning performance	1.682
Model 2b	Non - financial benefits	Planning performance	2.244
Model 2c	Financial benefit	Planning performance	1.951
Model 2d	Completion time	Planning performance	1.652
Model 2e	Completion cost	Planning performance	1.783
Model 3	Planning performance	Planning factors and Project characteristics	2.103

Table 9.7: Collinearity Diagnostic for Model 1 and 3

Variables	Model 1		Model 3	
	Tolerance	VIF	Tolerance	VIF
Project manager effort	.295	3.392	.294	3.400
Project manager experiences	.767	1.304	.725	1.380
Team members ability	.267	3.742	.259	3.868
Customer involvement	.518	1.932	.482	2.075
Apply PM method	.763	1.310	.738	1.355
Object - oriented	.876	1.142	.842	1.188
RUP	.850	1.176	.696	1.437
Waterfall	.784	1.275	.709	1.410
Spiral	.798	1.253	.707	1.415
Management support	.523	1.912	.519	1.925
Cost and time oriented	.508	1.969	.501	1.995
Customer oriented	.541	1.849	.515	1.940
Resource availability	.655	1.527	.625	1.600

People oriented	.398	2.512	.404	2.473
Work oriented	.387	2.587	.413	2.424
Project size			.770	1.299
Project ownership			.584	1.714

Table 9.8: Planning factors and Project success

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	0.637	0.731	0.871	0.387
Apply PM method	0.165	0.126	1.305	0.197
Object - oriented	0.120	0.117	1.025	0.309
RUP	-0.106	0.129	-0.823	0.414
Waterfall	0.192	0.151	1.276	0.207
Spiral	0.069	0.154	0.447	0.657
Team members ability	0.126	0.165	0.763	0.449
PM effort	0.195	0.150	1.302	0.198
Customer involvement	-0.126	0.104	-1.203	0.234
PM's Experiences	**0.029**	**0.012**	**2.366**	**0.021**
Cost & time oriented	0.081	0.092	0.883	0.381
Customer oriented	0.115	0.102	1.125	0.265
HR & time availability	0.087	0.090	0.968	0.337
Financial availability	0.116	0.097	1.205	0.233
Management support	0.075	0.106	0.709	0.481
Leadership style: People oriented	-0.066	0.077	-0.085	0.932
Leadership style: Work oriented	0.111	0.070	1.590	0.117
Decision making style: Consulting	-0.026	0.051	-0.511	0.611
$R^2 = 0.492$ Adjusted $R^2 = 0.352$		F = 3.527	Sig. F = 0.000	

Dependent: Planning performance

Table 9.9: Regression Results: Planning factors and Qualitative benefits

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	1.418	.567	2.502	.015
Technical ability - team members	-0.032	.128	-.251	.803
PM effort	0.229	.116	1.972	.053
Customer involvement	0.038	.081	.465	.644
PM's Experiences	-0.006	.009	-.649	.519
Apply PM method	0.039	.098	.406	.686
Object - oriented	-0.074	.091	-.819	.416
RUP	-0.025	.100	-.251	.803
Waterfall	0.042	.117	.344	.732
Spiral	.0233	.120	1.947	.056
Management support	0.033	.082	.406	.686
Cost & time oriented	0.057	.071	.792	.431
Customer oriented	0.300	.079	3.788	.000
HR & time availability	0.000	.069	-.010	.992
Financial availability	0.124	.075	1.661	.102
Leadership style: People oriented	-0.022	.060	-.369	.713
Leadership style: Work oriented	-0.009	.054	-.172	.864
Decision making style: Consulting	-0.049	.040	-1.226	.225
R2 = 0.729 Adjusted R2 = 0.532		F = 4.138		Sig. F = 0.000

Dependent: Qualitative benefits

Table 9.10: Regression Results: Planning factors and Completion time

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	6.305	1.033	6.105	0.000
Team member's ability	-0.457	0.233	-1.957	0.055
PM effort	0.013	0.212	0.063	0.950
Customer involvement	0.097	0.147	0.658	0.513
PM's Experiences	-0.007	0.017	-0.429	0.669
Apply PM method	-0.177	0.179	-0.990	0.326
Object - oriented	0.035	0.165	0.214	0.832
RUP	-0.017	0.182	-0.095	0.924
Waterfall	0.276	0.213	1.295	0.200
Spiral	0.261	0.218	1.199	0.235
Management support	-0.126	0.149	-0.843	0.403
Cost & time oriented	-0.473	0.130	-3.634	0.001
Customer oriented	-0.101	0.144	-0.699	0.487
HR & time availability	-0.038	0.127	-0.298	0.766
Financial availability	0.082	0.136	0.601	0.550
Leadership style: People oriented	-0.066	0.109	-0.600	0.551
Leadership style: Work oriented	-0.047	0.098	-0.479	0.633
Decision making style: Consulting	0.041	0.073	0.569	0.571
$R^2 = 0.683$ Adjusted $R^2 = 0.497$		F = 3.193	Sig. F = 0.000	

Dependent: Completion time