UNIVERSITÉ DU QUÉBEC À RIMOUSKI

L'UTILISATION ET LA VALEUR DES OUTILS ET TECHNIQUES DE LA GESTION DE PROJET EN CHINE

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© Jie He

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Composition du jury :

Luc Desaulniers, président du jury, Université du Québec à Rimouski

Pierre Cadieux, directeur de recherche, Université du Québec à Rimouski

Daniel Gagnon, examinateur externe, Université du Québec à Chicoutimi

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RÉSUMÉ

Ce mémoire explore l'utilisation effective des outils et techniques de gestion de projet en Chine. Bien que les études actuelles aient couvert presque tous les aspects du cycle de gestion de projet, peu de recherches ont été conduites sur l'usage réel des outils et techniques de gestion de projet, particulièrement en Chine. Par conséquent, dans cette étude, nous allons nous concentrer sur l'exploration de la situation réelle de la gestion de projet dans ce pays. L'objectif de ce mémoire est de comprendre la pratique effective de la gestion de projet en Chine, en particulier l'utilisation générale des outils et techniques qui s'y rattachent, de même que l'influence de différents facteurs sur celle-ci. La population ciblée comme échantillon de cette étude est constituée de gestionnaires ou directeurs de projets et de programmes chinois. Des questionnaires ont été envoyés et une méthode de recherche quantitative a été utilisée pour analyser les résultats. Nous avons mis en avant les hypothèses suivantes: l'utilisation d'outils et techniques de gestion de projet est inégale en Chine; l'utilisation d'outils et techniques de gestion de projet varie selon le contexte; l'utilisation d'outils et techniques de gestion de projet diffère selon le type de projet; l'utilisation d'outils et techniques de gestion de projet varie selon les différentes étapes d'un projet; l'utilisation d'outils et techniques de gestion de projet est liée à l'expérience des gestionnaires de projet. L'étude permet de constater que les outils et techniques de gestion de projet auxquels on a recours en Chine sont habituellement les plus connus; outre des outils et techniques informatisés de gestion de projet, de nombreux autres outils y sont aussi largement utilisés. Les outils de gestion de projet sont plus souvent utilisés dans les organisations d'une plus grande maturité et dans des projets de plus grande envergure; l'utilisation d'outils de gestion de projet est variée selon les types et les phases de projets, les gestionnaires de projets avec un niveau d'éducation supérieur et une plus grande expérience de travail sont susceptibles d'utiliser plus souvent les outils et techniques de gestion de projet.

Mots clés : outils et techniques de gestion de projet, la Chine, la recherche quantitative.

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ABSTRACT

This thesis explores the actual usage of project management tools and techniques in China. Although present studies have covered almost all aspects of the whole cycle of project management, little research has been done in finding out the actual usage of project management tools and techniques, especially in China. Therefore, in this study, we will concentrate on the exploration of the actual situation of project management in China. The objective of the thesis is to find out the actual practice of project management in China, particularly the general usage of project management tools and techniques and the influence of different factors on it. In this study, the Chinese project managers and program managers/directors are set to be the target population for the sample. Questionnaires were sent and quantitative research methods were used to analyze them. We have put forward the following propositions: the usage of project management tools and techniques is uneven in China; the usage of project management tools and techniques is different in projects of different contexts; the usage of project management tools and techniques differs in projects of different types; the usage of project management tools and techniques changes in different project management phases; the usage of project management tools and techniques is connected with the experience of project managers. The study finds out that the most used project management tools and techniques in China are the best known; besides computerized project management tools and techniques, many other tools are also widely used in China; project management tools are used more often in organizations with higher maturity levels and in projects of larger size; the use of project management tools are different across project types and project phases; project managers with higher education levels and longer work experience use more often the project management tools and techniques.

Keywords: project management tools and techniques, China, quantitative research.

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LIST OF ACRONYMS

Code	Signification
BOC	Beijing Organizing Committee
CCPM	Critical Chain Project Management
CNCC	China National Convention Centre
CPM	Critical Path Method
CPMP	Project Management Professionals in China
ESA	Ethics, Standards and Accreditation
GERT	Graphical Evaluation and Review Techniques
IBRD	International Bank for Reconstruction and Development, commonly known as the World Bank
ICB	International Competence Baselines
IOC	International Olympic Committee
IPMA	International Project Management Association
IPMP	International Project Management Professional
MOC	Ministry of Construction
MPM	Master of Project Management
MRP	Material Requirement Planning
NASA	National Aeronautics and Space Administration
NCB	National Competence Baselines
PERT	Program Evaluation of Review Technique
PMI	Project Management Institute
PMO	Project Management Office

PMRC	Project Management Research Committee, China
PMP	Project Management Professional
PMS	Project management software

CHAPITER 1
INTRODUCTION

The history of project management can be traced back to 1945, and after years of development, it has been applied quite extensively around the world (Liviu Ilies, Emil Crisan & Ioana Natalia Muresan, 2010). At the same time, project management tools and techniques as well as PMI's project management body of knowledge got expanded.

In China, although we can trace the path of project management to more than 2,000 years ago, modern project management has developed rapidly in China in the last 20 years (Chinese Professional Manager Qualification Authentication, 2008). Since the launching of reforms in 1979, remarkable growth is seen in Chinese economy. Today, China is the second largest economic powerhouse in the world and project management is being used in every sector of industry. However, the end result is not that encouraging. Many project managers still get trouble from cost over-run, lack of resources, insufficient quality, etc. (Hubert Vaughan, 2008) The development of project management in China still stays in the early stage and compared with western countries, it has a long way to go. Therefore, it is important and significant to know the true picture of project management practice in China so that the limits of the existing practice can be identified and ways can be found to improve it.

The application of project management tools and techniques is an important part and a good indicator of the practice of project management. Although modern project management Tools and Techniques have been applied and studied for more than half a

century, the documentation of history of Tools and Techniques, especially those used in countries other than USA, is vague. Researchers in western countries like Besner & Hobbs have taken steps to study the actual practice of project management, starting from understanding the usage of project management tools and techniques. In China, comparatively, little research has been done in this aspect so far. Therefore, the present research serves as an effort to explore the actual practice of project management in China, particularly the general usage of project management tools and techniques.

This thesis, selecting Chinese project managers and program managers/directors as samples, will not only discover the general usage of project management tools and techniques in China, but also examine the influences of different factors on it. Apart from the academic analyses, this research will also provide practical suggestions to project management practitioners in China in order to expand their usage of tools. The rest of this thesis is organized as follows. After reviewing the theoretical knowledge on project management, the history of project management development in China as well as in other countries and the use of tools and techniques, we will discuss the research methods employed in this study. Then we will report our analysis results with a discussion of our findings and managerial implications of the study will be presented at last.

CHAPITER 2
REVIEW OF LITERATURE

In recent years, project management has shown great vitality in the domain of management worldwide due to its flexibility and feasibility. The bright future of project management has attracted a lot of academic researchers. Numerous methodologies and techniques have been found and developed in this field and have also been widely disseminated in relevant books and journals. Although present researches have already covered almost all aspects relative to project management, it remains a highly problematic endeavor. It's important and significant to know the actual use and value of the tools and techniques in project management, especially the situation of use in China, which has enjoyed rapid development in project management (PM Network, 2011).

This review of literature will present a number of sets of information about the tools and techniques in project management and the development of project management in China. It can be divided into five categories: a) project management theory, b) development of project management, c) use of tools and techniques in different countries, d) project management in China, e) specific tools and techniques in research.

2.1. Project Management Theory

In this part, some project management theories will be provided, such as the definition of project management, the activities of project management, the process of

project management and the meaning of tools and techniques in project management as well.

2.1.1. Project and Project Management Definition

A project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end (PMBOK Guide, 2008). Traditionally, only works in defense and construction industries were seen as projects; today, almost every activity in an organization can be viewed as a project with its unique characteristics and level of importance to the organization (Sean Maserang, 2002).

Projects can differ in size, scope, cost and time. Some mega projects, such as Beijing Olympic Stadium, took millions of dollars and four years of ongoing construction; while some small projects, like house moving, took a few hundred and a whole afternoon. Besides, the subjects and forms of projects diversify. For example, the Royal couple's visit to Canada in July, 2011 and the extension of new station on the orange line to Laval are typical projects. Meanwhile, the recent disaster recovery in Quebec and U2 world tour in Montreal are counted too. Furthermore, the Montreal firework competition and the annual Montreal street cleaning day project are good examples as well. Certainly, projects are various and not limited to the ones enumerated above.

Project management is the application of knowledge, skills, tools and techniques to project activities to meet project requirements. It is accomplished through appropriate application and integration of 42 logically grouped project management processes comprising 5 Process Groups (PMBOK Guide, 2008), which are Initialing, Planning, Executing, Monitoring and Controlling, and Closing. In general, the tasks of project management involve not only establishing the foundation for the project but also helping

the plan, organization and control for it, thus maximizing the possibility of project success (Erling S Andersen, Kristoffer V Grude & Tor Haug, 2009).

According to researchers Paul C. Dinsmore and Jeannette Cabanis-Brewin (2010), resource allocation is the critical success factor for the practice of project management compared with other factors like strategic planning, risks, etc. It has to make sure that the allocation of specific resources is sufficient yet not overcommitted and that the right resources are assigned to right tasks at right time. Due to the number of activities that can be in simultaneous process and the limitation of resources, this is not easy to accomplish without the help of project management tools, especially project management software. So the actual usage of these tools and the evaluation of their usefulness can provide great information for improvement.

2.1.2. Project Management Activities

According to PMBOK Guide (2008), the primary task of project management is to achieve all setting goals while balancing competing project constraints including Scope, Quality, Schedule, Budget, Resources and Risk. It provides an organized and well-structured way for the management of various independent, interdependent events and activities leading to a common result. These activities include (Civil Engineer, 2011):

- Analysis and design of objectives and events
- Work plan according to the objectives
- Risk assessment and control
- Resources estimation
- Resources assignment
- Work organization
- Human and material resources acquisition

- Tasks Assignment
- Activities direction
- Control of project execution
- Tracking and reporting progress
- Analyzing the results based on the facts achieved
- Defining the products of the project
- Forecast of future trends in the project
- Quality Management
- Defect prevention
- Project closure
- Communication to stakeholders

2.1.3. Project Management Process

The essence of project management is to apply knowledge, skills, tools, and techniques to project activities so that project requirements can be met. This application of knowledge is required for effective management of appropriate processes. According to the PMBOK Guide (2008) and Kathy Schwalbe (2010), project management processes are grouped into five categories known as the famous project management Process Groups:

- Initiating Process Group, which determines the project feasibility, formally authorizes the project and provides high-level project description.

- Planning Process Group, which establishes the scope of the project and establishes schedules and other plans while producing the project management plan (Robert Klein, 2000).

- Executing Process Group, which completes the work defined in the project management plan to satisfy the project specifications.

- Monitoring and Controlling Process Group, which tracks, reviews and regulates all project activities and controls all changes and aspects effecting changes.
- Closing Process Group, which finalizes all activities involved in project management Process Groups to formally close the project.

The five process groups describe what project managers should do and what's more, in roughly what order. All processes are all equally important for every project and no project management processes are unimportant. According to the requirements of the PMBOK Guide (2008), every process group should be used by every project. However, the tailoring and rigor applied to the implementation of each process group are based on the extent of complexity and risk for the specific project. In other words, a project manager should use his professional skills and knowledge to make evaluations for every project management process in order to tailor each one as needed for each project. This tailoring is inevitable as projects are generally perceived to be unique, thus making it impossible to foster the success of each and every project by the same set of processes and methods. In other words, there is no project management approach that can be the bible for all (Ahlemann, F., Teuteberg, F. & Vogelsang, K., 2009).

2.1.4. Tools and Techniques in Project Management

Thomas Carlyle (1795-1881), a famous historian and author, has made a classic description for the relationship between tools and man, "Man is a tool-using animal. Without tools he is nothing, with tools he is all."

Project management tools and techniques are enabling devices to help reach an objective or, to be more specific, a project deliverable (Milošević, 2003). Project management tools and techniques assist project managers and their team members in

carrying out work in all nine knowledge fields that have been classified by the Project Management Institute. For example, the tools and techniques like Gantt charts, Project Network Diagrams and Critical Path Analysis are very popular and widely used in the domain of time-management (Schwalbe, 2010). In particular, project management tools and techniques are fundamental elements for constructing a project management toolbox that helps to support standardized project management processes (Milošević, 2003).

According to the investigations and conclusions of Kathy Schwalbe (2010), with the development of world economy and the evolution of business environment, the project management field has been turning more and more complex. It is in great need for people to develop and apply tools and techniques, especially facing the management of important projects.

In order to maximize the effectiveness of project management tools and techniques, a careful and scientific selection is essential. The factors like the nature of the project, organization's policy, project management strategy, availability of the resources, understanding of the tools and techniques, etc., should all be taken into consideration in the process of selection (Dey & Ogunlana, 2004).

In this section, some basic project management theories and definitions, which have been formed during the development of project management, are introduced. In the next section, a summary of the project management history will be presented.

2.2. Development of Project Management

In the light of Kerzner (2004), for almost 30 years, project management was regarded as a possibly good process to have instead of one that is critical for the survival of a company. Companies dared not invest heavily in project management, which was viewed as a latent threat to constructed hierarchies of authorities. The companies, which have reluctantly invested in some training courses, simply provided their staff with fundamental knowledge of project management regarding planning and scheduling.

During the past three decades, excellence in project management was prevented from occurring. Little service was provided to empowerment, teamwork and trust since information control was regarded as power at that time. What's more, people held the faulty belief that time was luxury and sufficient rather than a constraint factor for companies.

Kerzner (2004) found that by the mid-1990s, this mentality was challenged and shaken largely due to the two recessions. Great competitive pressure was laid upon companies to create required products in a shorter period of time. Businesses then felt obliged to change for the better.

Today, businesses have succeeded in the change for the better and project management is not an entirely internal system to the organization any more. Specifically, it is now a powerful weapon that guarantees higher levels of quality and increases value added to the customer (Kerzner, 2004). A more detailed understanding of the development of project management is necessary to see its trends and make projections.

2.2.1. Project Management Growth

Project management has evolved from a less known management theory, which was applicable only to a few functional areas and was regarded as a good thing to have, to a sound enterprise project management system affecting all functional units of an enterprise. More and more companies have changed their concepts and found project management essential for the survival of the firm.

2.2.1.1. Project Management: 1945 – 1960

During the 1940s, projects were usually managed by line managers using the concept of over-the-fence management. Each manager would only take care of his part of a job. When his part of the project was completed, the project wasn't his business anymore. If anything went wrong, blame was placed on whoever was doing the job at that time (Kerzner, 2009).

The problem with over-the-fence management was that each line manager knew his part of the story but no one knew the whole project. If projects were easy and simple, information could be traced. But as projects grew in size and complexity, it became more difficult and costly.

Following World War II, the U.S. entered into the Cold War. To win a Cold War, one must compete in the arms race and rapidly build weapons. The arms race made it clear that the traditional use of over-the-fence management would not be sufficient to the Department of Defense concerned by major projects like the B52 Bomber, the Minuteman Intercontinental Ballistic Missile and the Polaris Submarine. The U.S. government wanted a

project manager with total accountability through all project phases. The use of project management was then introduced to some smaller weapon systems such as jet fighters, tanks, etc. Besides, NASA mandated the practice of project management to all activities involved in the space program as well (Kerzner, 2009). Under this favorable environment, several important project management tools emerged and gained good results. The Critical Path Method (CPM) which was used to predict project duration was developed by Dupont Corporation in 1957. It was so successful that it saved $1 million for the corporation just in the first year of its application. Another useful technique the Program Evaluation Review Technique (PERT) was invented by the United States Department of Defense's US Navy Special Projects Office one year after. The technique which helped to evaluate the time needed to complete each task involved in a project and calculate the minimum time needed to complete the whole project did a great job in the Polaris mobile submarine launched ballistic missile project during the cold war (Duncan Haughey, 2010).

By the late 1950s and early 1960s, not only had the aerospace and defense industries been using project management on virtually all projects, but also their suppliers. Project management was growing, yet at a relatively slow rate except for the aerospace and defense industries (Kerzner, 2009).

2.2.1.2. Project Management: 1960 – 1985

Between the middle and late 1960s, more and more executives began to look for new management techniques and organizational structures that could be quickly adapted to a changing environment. It was found that companies with complex tasks and operating in a dynamic environment were most willing to adopt project management. Such industries included aerospace, defense, construction, high-technology engineering, computers, and electronic instrumentation.

Other than these industries, the majority of companies in the 1960s maintained an informal method for project management. Under informal project management, projects were operated on an informal basis whereby the authority of project managers was minimized and functional managers still handled most projects (Kerzner, 2010).

During the 60s and the early 70s, many industries were influenced by the appearance of silicon chips and minicomputers and significant technology progress was seen. In the two years after 1969, Bell Laboratories developed programming language UNIX and Intel introduced the 4004, a 4-bit microprocessor, which is the basis of the evolution of Intel's 80386, 80486. Besides, several project management software companies like Artemis (1977), Scitor Corporation (1979) and Oracle (1977) were born (Elias G., Carayannis, Young-Hoon Kwak & Frank T. Anbari, 2005).

By the end of 1970s and the early 1980s, the environment began to change rapidly. More and more companies switched from informal project management to formalized project management processes, as they could not handle projects with ever increasing size and complexity any more. Besides, NASA and the Department of Defense forced their subcontractors into accepting project management. Therefore, in order to win contacts, many companies had to adopt it.

According to Kerzner (2009), the adoption of project management can bring in many advantages:

- Easy adaptation to an ever-changing environment
- Ability to handle a multidisciplinary activity within a specified period of time
- Horizontal as well as vertical work flow
- Better orientation toward customer problems

- Easier identification of activity responsibilities
- A multidisciplinary decision-making process
- Innovation in organizational design

Though project management had gained some extent of development during this period, it was still limited. The rate and acceptance of the change of project management were relatively slow due to the lack of tools and technologies in project management, thus making its advantages under recognized.

2.2.1.3. Project Management: 1985 –2010

By the 1990s, project management became a worldwide phenomenon not only in developed countries, such as U.S. and Japan, but also in developing countries, like China and India.

Now companies have finally recognized the benefits of project management. Previous negative views on project management, such as, it would require more people thus adding overhead costs and decreasing profit; it would create organizational instability and induce conflicts; it would only be needed by large projects, etc., have been totally changed. People realize that project management allows us to accomplish more work in less time with fewer people, thus increasing profit. What's more, it also makes operations more effective through better organizational behavior principles and provides benefit to almost all projects (Kerzner, 2009). Issues related to project management aroused great interest to the researchers and practitioners. Project organization, project risk, the project front end, external influences to projects and initial work on the development of project management standards were the most popular topics in the field in the 1980s (Lynn Crawford, Julien Pollack & David England, 2005). Under these understandings, project management has

been used extensively around the world. Project management methods evolving in guidelines and international standards are widely accepted and employed (Liviu Ilies, Emil Crisan & Ioana Natalia Muresan, 2010).

With the development of project management, many new tools and techniques helping to improve project management performance emerged as well.

2.2.2. The Expansion of Project Management Tools and Techniques

Project management tools and techniques have been practiced since early civilization. However, it was not until the 1950s that organizations started to apply project management tools and techniques to complex engineering projects systematically.

In the United States, prior to 1950s, projects were managed on an ad hoc basis using mostly Gantt charts and informal techniques and tools. Then, in 1957, the Project Evaluation and Review Technique, commonly known as PERT, was developed by Booz Allen Hamilton as part of the United States Navy's Polaris missile submarine program. The Project Evaluation and Review Technique (PERT) is a diagram of a project (Spinner, 1989), in which three probabilistic time estimations are provided to each task included. In the same year, Morgan Walker of DuPont and James Kelley of Remington Rand came up the Critical Path Method (CPM), which is an algorithm for scheduling a set of project activities and an important technique for project scheduling and control. (Liberatore, M.J., 2008) In CPM, a time-cost tradeoff is assumed which is different than the probabilistic time estimates used in PERT. However, both methods improve project management process flow by plotting the critical activities. (Dunbing Tang, Li Zheng, Zhizhong Li, Dongbo Li & Shiqi Zhang, 2000)

Between 1950 and 1979, besides CPM/PERT which have been mentioned above, several other core project management tools like Material Requirement Planning (MRP), Inventory Control were developed too. At the end of 1970s, the wide availability of project management software for PC made it more accessible for the companies to use project management techniques. (Elias G., Carayannis, Young-Hoon Kwak & Frank T. Anbari, 2005)

In the 1990s, Dr. Eli Goldratt invented Critical Chain Project Management (CCPM) based on his theory of constraints. CCPM is an alternative scheduling tool to CPM/PERT, but it provides some important differences and advantages over the more commonly used critical path methodologies. Unlike CPM and PERT which emphasize on task order and rigid scheduling, CCPM puts more weights on the resources required for projects executions. It effectively removes most conflicts in resource allocations before project starts and uses buffers for better project control. (Larry P. Leach, 1999) Thanks to the fast development of internet during this period, organizations turn to be more productive, more efficient, more flexible and more customer-oriented. The project management community also took advantage of the internet in order to be more efficient in controlling and managing projects. (Elias G., Carayannis, Young-Hoon Kwak & Frank T. Anbari, 2005)

In order to well provide instructions for the profession of project management, the PMI's project management body of knowledge came into being since 1968.

2.2.3. PMI's Project Management Body of Knowledge, 1968 – 2008

The PMBOK Guide is the standard for managing most projects most of time across many types of industries. This standard describes project management processes, tools and techniques used to manage a project towards successful outcome. (PMBOK Guide, 2008)

The Project Management Institute (PMI) was founded in 1969 on the premise that many management practices were common to projects in application areas ranging from construction to pharmaceuticals. On PMI Montreal Seminars/Symposium in 1976, the idea that such common practices might be documented as standards began to be widely discussed. (PMBOK Guide, 2008)

In 1981, the PMI Board of Directors approved a project to develop procedures and concepts necessary for the progress of project management profession. Since this project focused on Ethics, Standards, and Accreditation (ESA), the project team came to be known as ESA Management Group. Results of the ESA Project were published in a Special Report in the Project Management Journal of August 1983. (PMBOK Guide, 2008)

In 1984, the PMI Board of Directors approved a second standard-related project based on the existing framework of ESA. Six committees were required to address each of the six Knowledge Areas identified. Two years later, a revised document was approved in principle by the PMI Board of Directors and was published for comments in the Project Management Journal. In August 1987, PMI published The Project Management Body of Knowledge. (PMBOK Guide, 2008)

Four years later, PMI began a project to update its 1987 edition of PMBOK. After several years of draft modifications and wide discussions at the PMI Seminars/Symposia, *A Guild to the Project Management Body of Knowledge* was successfully published in 1996. The previous edition of PMBOK was superseded after then. (PMBOK Guide, 2008)

Again in 2000, PMI published a new edition of PMBOK Guide which replaced the 1996 edition. In this new PMBOK Guide, many new materials and features were introduced in order to reflect the fast developing phase of project management. In particular, a few tools and techniques were firstly added, such as Project Time Management, Project Communications Management, etc. (PMBOK Guide, 2000)

The third edition of PMBOK Guide came out in 2004, which took the place of the 2000 edition. One of its most pronounced changes to the Third Edition was the structure, as the new edition laid emphasis on the importance of Process Groups. Besides, in the new edition, seven processes were added, thirteen were renamed and two were deleted, which brought in a net gain of five processes. (PMBOK Guide, 2004)

In 2008, PMI published its latest edition of PMBOK Guide. This newest edition of PMBOK Guide enjoys a higher level of consistency and clarity by refining processes, standardizing inputs and outputs where possible and implementing a global approach of inputs and outputs documentation. (PMBOK Guide, 2008)

With constant development of PMI, project management methodologies and tools are introduced to different countries in varying degrees.

2.3. Use of Tools and Techniques in Different Countries

Although modern project management tools and techniques have been applied and studied for more than half a century, the documentation of history of Tools and Techniques, especially those used in countries other than USA, is vague. According to one article published in the International Journal of Project Management (Jonas & Sylvain, 2010), "This lack of historical knowledge on project management raised several problems. First, the existing literature on project history is biased toward large US military and space project. Hence, we need to broaden the perspective to other industrial sectors and national contexts. The history of projects and project management is accordingly a global phenomenon and variations exist across the globe, however, we know very little, for example, about the most influential projects in Scandinavian history, in English history, in South American history and in Asian history, and their impact on management capabilities, management practice and subsequent projects."

2.3.1. North America

Great many research has been provided on project management tools and techniques, however, the vast majority of which focuses on particular project management tools or specific project management practice (Besner, Claude & Hobbs, Brian, 2008). For example, the study made by Fox and Spence in 1998 mainly involved in computerized project management tools.

The research paper was based on a survey sent out to nearly 1,000 project managers and a total of 159 results were collected, representing a response rate of 16.3% (Fox & Spence, 1998). Table 1 summarizes the top 10 most popular computerized project

management tools found and their relative percentage of use (Data source: Fox & Spence, 1998).

PM Tool (Developer)	Percentage of Respondents Listing Tool
Microsoft Project *(Microsoft Corporation)*	48.4%
Primavera Project Planner *(Primavera* Systems)	13.8%
Microsoft Excel *(Microsoft Corporation)*	8.5%
Project Workbench *(Applied Business Technology)*	8.1%
Time Une *(Time Line Solutions)*	6.1%
SureTrak *(Primavera* Systems)	5.3%
CA-SuperProject *(Computer Associates, int'i.)*	2.8%
Project Scheduler *(Scitor)*	2.8%
Artemis Prestige (Lucas *Management* Systems)	2.0%
FasTracs *(Applied Microsystems)*	2.0%

Table 1: Top 10 Project Management Tools

From Table 1, we can easily tell that Microsoft Project was no doubt the most frequently applied computerized project management tool. Though Levine (1995), who had got the same result in a previous survey, contributed this leading position greatly to Microsoft Corporation's superior marketing and leveraging skills and regarded Microsoft Project as a project management software package "far from being perfect", it remained the most popular. The Primavera Project Planner, which was from Primavera systems, took the second place. Compared with low-end tools like Microsoft Project, the Primavera Project Planner was a high-end tool costing several thousand dollars and providing more capability.

The use percentages of the rest computerized project management tools listed were scattered and much lesser than the first two.

The research also provided findings on how these top 10 popular computerized project management tools were used, as is shown below in Table 2 (Data source: Fox & Spence, 1998).

PM Tool	Primary Use(s)
Artemis Prestige	Multiproject planning and tracking; scheduling resources; cost analysis
CA-SuperProject	Small and large projects; scheduling; tracking and planning; training
FasTracs	Small projects; presentations; quick Gantt charts; scheduling analysis
Microsoft Excel	Budgeting; cost analysis; variance analysis; tracking and reporting; work breakdown structures (WBS)
Microsoft Project	Small, medium, and large projects; control and tracking; detailed scheduling; early project planning; communication; high-level planning; Gantt, CPM and PERT; planning, analyzing, tracking, reporting; total project management; "everything"
Primavera Project Planner	Large, complex multiproject environments; planning, scheduling, resource allocation, control; build overall detailed project plan; critical path analysis; client requested, corporate standard
Primavera SureTrak	Single and multiple projects—small, medium, and large; project scheduling, resource allocation, control
Project Scheduler	Multiprojects; scheduling, resource management, budgeting, tracking
Project Workbench	Small, medium, and large projects; planning, estimating, scheduling, analyzing, tracking, reporting; WBS, Gantt, resource utilization

Table 2: Primary Use(s) Made of Project Management Tools

From the table above, we can clearly figure out that Microsoft Project was widely used in small or medium projects while Primavera Project Planner was mainly used in large, complex multi-project environments. What's more, it seems that the basic functions of project management like planning, scheduling, tracking and controlling were the main purposes of computerized project management tools usage for project managers. Besides, project managers also used the tools to help in budgeting and analysis.

Similarly, the research of Muriel Mignerat & Suzanne Rivard in 2006 focused on the identification of project management practices of Information Systems which were institutionalized now. The tools and techniques used as suggested by project managers of Information Systems were listed and categorized into 8 knowledge areas, with time management and cost management combined. Raz, T., & Michael, E. had conducted a survey in 2001 to find out the tools that were widely used in the practice of project risk management. Four hundred project managers from the software and high-tech sectors in Israel were asked to rate the contribution of each tool (38 in total) to the project risk management process. Winches, G. M., & Kelsey, J. (2005) were interested in the construction projects, especially its planning process. Eighteen construction planners from five leading UK firms were interviewed on their daily practice. Their use of decision support tools was examined and compared.

Thanks to the efforts of Prof. Besner and Prof. Hobbs, a research which tended to identify general use and usefulness of project management practices came around in 2008. Around 753 practitioners, most of who were PMPs from North America and had an average of 7 to 8 years' experience as project or program managers, participated in the web-based survey. Their general findings are displayed in Table 3 (Data source: Besner & Hobbs, 2008).

From Limited to Extensive Use	From Very Limited to Limited Use	Less than Very Limited Use
Progress report	Contingency plans	Life Cycle Cost ("LCC")
Kick-off meeting	Re-baselining	Database of contractual communication data
PM software for task scheduling	Cost/benefit analysis	Probabilistic duration estimate (PERT)
Gantt chart	Critical path method and analysis	Quality function deployment
Scope statement	Bottom-up estimating	Value analysis
Milestone planning	Team member performance appraisal	Database of risks
Change request	Team building event	Trend chart or S-Curve
Requirements analysis	Work authorization	Control charts
Work Breakdown Structure	Self directed work teams	Decision tree
Statement of work	Ranking of risks	Cause and effect diagram
Activity list	Financial measurement tools	Critical chain method and analysis
PM software for monitoring of schedule	Quality plan	Pareto diagram
Lesson learned/post-mortem	Bid documents	PM software for simulation
Baseline plan	Feasibility study	Monte-Carlo analysis
Client acceptance form	Configuration review	
Quality inspection	Stakeholders analysis	
PM software for resources scheduling	PM software for resources leveling	
Project charter	PM software for monitoring of cost	
Responsibility assignment matrix	Network diagram	
Customer satisfaction surveys	Project communication room (war room)	
Communication plan	Project Web site	
Top-down estimating	Bid/seller evaluation	
Risk management documents	Database of historical data	
	PM software multi-project scheduling/leveling	
	Earned value	
	PM software for cost estimating	
	Database for cost estimating	
	Database of lessons learned	
	Product Breakdown Structure	
	Bidders conferences	
	Learning curve	
	Parametric estimating	
	Graphic presentation of risk information	

Table 3: The 70 Tools in Decreasing Order of Average Use

Unlike the research made by Fox and Spence in 1998, tools investigated here were more generic approaches including computer-based tools as well as non-computer-based tools. Great differences have shown in the use of tools in practice. Compared with tools like progress report and kick-off meeting which were used quite extensively, the tools such as Monte-Carlo analysis and Pareto Diagram were used quite seldom. According to the researchers' analysis, the most used tools (the progress report and the kick-off meeting) located in the communication knowledge area and the knowledge areas of scope and time included the most tools with extensive use. Besides, the risk knowledge area was considered to be an area where greater developments in practice were strongly needed.

Based on the data collected, Prof. Besner and Prof. Hobbs have also drawn some other related conclusions regarding the practical use of project management tools in North America. They found that the level of use of tools was greatly influenced by the maturity of the project management processes in the respondents' organizations and the size of projects involved. Differences showed when comparing the use of tools within the three types of projects investigated by the survey (engineering & construction, IT and business services) as well. Furthermore, the two researchers have also discovered that the use of tools did vary significantly from one phase of project management to the next.

2.3.2. Europe & Australia

Though introductions on the use of project management tools in Europe are rarely found, little information regarding the situation of UK is caught. A research conducted by Fortune, White, Jugdey & Walker in 2011 has made a comparison on the use of project management tools in UK, Australia and Canada. Since UK is the second largest economy in Europe, it might be somewhat representative; moreover, the research has also filled the void for Australia.

The three countries selected are all English speaking and comparable regarding level of development, educational standards and international reach. Besides, they also share many cultural similarities. As was decided in advance, fifty responses from each of the three countries were used for data analysis, thus a total of 150 responses were included. Findings are shown below in Table 4 (Data source: Fortune, White, Jugdey & Walker, 2011).

	Australia	**Canada**	**UK**
Project management methodologies			
"Methodology developed 'in house'"	37	41	22
"Projects in controlled environments 2 (PRINCE2)"	8	0	28
Other project management methodologies	6	2	6
PMBOK	6	4	1
Agile	0	3	3
"Projects in controlled environments (PRINCE)"	1	1	2
Managing successful programmes	0	0	3
Rationale unified process	0	1	1
"Structured systems analysis and design methodology (SSADM)"	2	0	0
Wysocki's adaptive project framework (APF)	0	2	0
Total	60	54	66
Project management software			
"Microsoft project"	35	27	32
Other project management software	14	11	3
"Primavera"	12	12	3
MS excel	5	4	4
Project management software developed in house	3	4	2
Visio	4	3	0
Open plan professional	3	0	0
SAP	0	1	2
"@task"	1	0	1
CA clarity	2	0	0
Project place	0	0	2
Powerpoint	0	1	1
Oracle	0	1	0
Total	79	64	50

	Australia	Canada	UK
Project management tools			
"GANTT bar charts"	36	29	38
"Work breakdown structure (WBS)"	40	35	26
"Lessons learnt (also known as project reviews/ project audits)"	32	28	31
"Critical path method (CPM)"	26	19	18
"Strengths weaknesses, opportunities and threats (SWOT)"	8	14	18
"Cash flow analysis (CFA)"	13	12	6
"Programme evaluation and review technique (PERT)"	10	8	9
Other project management tools	10	11	5
"Monte Carlo"	3	4	2
In house project management tools	4	0	4
Earned value management	1	3	1
Delphi method	2	0	2
Agile board	0	1	1
Project goals charter	0	0	2
Total	185	164	163
Decision-making techniques			
"Cost-benefit analysis (CBA)"	27	23	26
"Decision analysis (DA)"	10	11	10
"Sensitivity analysis (SA)"	11	8	8
"Expressed preferences"	6	9	7
"Implied/revealed preferences"	5	6	2
Other decision-making techniques	5	4	2
In house decision-making techniques	1	4	2
Decision trees	1	1	0
Stakeholder analysis	1	0	1
Total	67	66	58
Risk assessment tools			
"Probability analysis"	16	14	16
"Life-cycle cost analysis (LCC)"	11	5	11
"Failure modes and effect analysis (FMEA)"	8	3	5
"Reliability analysis"	6	5	5
"Hazard and operability studies (HAZOP)"	4	8	3
In house risk assessment tools	9	0	4
"Fault tree analysis (FTA)"	5	3	3
Other risk assessment tools	4	6	1
"Hazard analysis (HAZAN)"	5	3	2
Risk analysis using ASNZS 4360_2004	5	0	0
Risk register	1	0	4

	Australia	Canada	UK
Delphi method	2	0	0
Risk assessment	0	2	0
Total	76	49	54
Information communication technology support tools			
"Integrated groupware (e-mail, collaborative tools, shared access to web portals, etc.)"	24	24	29
"Groupware (e-mail only)"	20	29	20
"Video conferencing"	11	16	24
"Voice over internet protocol"	11	11	9
"Virtual environments"	9	9	5
Other information communication technology support tools	5	8	4
In house communication and reporting system	5	4	6
"Communities of practice enabling tools"	5	3	3
Total	90	104	100
Grand total	557	501	491

Table 4: Project Management Methods, Methodologies, Tools and Techniques - Extent of Use

The tools listed in Table 4 include not only computer-based ones but also non-computer-based ones and are grouped into 6 categories, which are PM methodologies, PM software, PM tools, decision-making techniques, risk assessment tools and information communication technology support tools. In the light of the analysis results, the level of use of tools varied among the three countries. In Canada, a single respondent used 41 methods, methodologies tools or techniques in maximum, the mode was 9 and the mean was 10. While, for Australia the corresponding figures were 33, 8 and 11 and for UK the numbers were 26, 6 and 10. From the figures of "grand total", we can tell that the total number of tools used in Australia was higher than those of Canada and UK, meanwhile, the situation was slightly better in Canada than in UK. Work breakdown structure (WBS), Methodology developed 'in house' and Gantt bar charts were the most used tools in Australia, Canada and UK respectively. The most uneven usage showed in the case of PRINCE2, which was

used so widely in the UK, to a much more limited extent in Australia and not at all in Canada.

2.3.3. Africa

In order to know the applicability of project management tools and techniques in developing and emerging economies rather than developed western economies, Ndiritu Muriithi & Lynn Crawford used Africa as a case study in 2003. Instead of providing the exact amount of use for the tools as was the case in the above-mentioned studies, they found out which tools and techniques worked in Africa and which didn't.

According to their conclusions, in general, most project management tools and techniques relating to international administration of organizations and projects were applied in African organizations. Management by Objectives (BMO), Zero Based Budgeting (ZBB), the Planning, Programming and Budgeting System (PPBS), Process Analysis, the Critical Path Method, PERT and the logical framework method were the typical examples.

In terms of reward and recognition systems, due to the different work values hold, the tools that originated from western theories of motivation didn't work in Africa. Besides, as family/community networks were thought more effective in guaranteeing contract compliance than did commercial law, project managers in Africa preferred using such networks than dropping it. Meanwhile, local resources were thought quite efficient in ensuring sustainability of project operations as well. In such circumstances, procurement processes that set cost minimization or other similar "neutral" requirements as standards for awarding contracts didn't work in Africa too.

In order to enable techniques like brainstorming to work, careful attention should be paid to who participated. Compared with western countries, subordinates in Africa were more likely to be muffled when supervisors were present.

2.4. Project Management in China

Although we can trace the path of project management in China to more than 2,000 years ago, modern project management has developed rapidly in China in the last 20 years (Chinese Professional Manager Qualification Authentication, 2008). Today, China is the second largest economic powerhouse in the world and project management is being used in every sector of industry. China certificates more PMP/IPMP holders each year than any other countries. It is predicted that China will be the largest market for project management in the near future (Bai, Si Jun, 2003).

2.4.1. History of Project Management in China

The history of project management in China can be dated back to 220-206 BC, when the first Chinese Emperor, ShiHuang Qin, forced more than 1 million people to build the Great Wall. The Great Wall, with all of its branches, stretches for 8,851 km. (Chen, Xue Ying, 2007) Although there was no such project management concept back then, it is believed that some practices similar to project management were used in finishing such huge and complex project. (Lin, Yun Jian & Wu, Zhi Ming, 2005)

The Forbidden City is another example showing China has a long history of project management. Built from 1406 to 1420, it was the Chinese imperial palace for almost 500 years. One hundred thousand skilled artisans and nearly one million laborers were employed during the construction. It is also believed that some practices similar to project

management were used in order to well organize the construction of this largest palace in the world. (Tian, Yi, 2005)

Modern history of project management in China does not emerge until 60s. The Great Chinese Mathematician, Hua Luogeng, introduced his famous theory, *Overall Planning Method* in 1964 and began to use it in projects in China. (Resources of Project Management, 2006) In the following year, he published his famous book, Overall Planning Method and Supplement. The book was a milestone in Chinese project management history as it introduced, for the first time, some Modern PM concepts including Critical Path Method (CPM), Program Evaluation and Review Techniques (PERT) and Graphical Evaluation and Review Techniques (GERT). These tools and techniques played an important role in the process of economic growth and social development (Yang, Ming, 2010).

Professor Qian Xuesen, well known as father of Chinese Rocketry, was another person who brought modern project management into China, especially in aerospace and defense industries. Qian, formal director of the Jet Propulsion Lab in California Institute of Technology, promoted the application of the system engineering theory in China and developed it further as a new R&D field: the Engineering Controlling. He then applied it to the missile and aerospace programs in China. (Shao, Zhi Guang, 2009)

During the 80's, PM had evolved fast in China, but its major applications were still in defense and construction industries and its main task was to balance the scope triangle: time, cost and quality. In 1980, China resumed its membership of IBRD (International Bank for Reconstruction and Development, commonly known as the World Bank) and two years later, the Lubuge Hydro construction project was started. It was Chinese first project to use

World Bank loan, during which project management was mandatory under the agreement. (Si, Da, 2006) It began with an international bidding for its division tunnel project. The Japanese Construction Company, Taisei, won the bidding and took charge of the tunnel project. To everyone's surprise, the first thing Taisei did was project management training. Taisei required all managers to attend a two months' project management training. After that, Taisei only assigned tasks to those managers who passed the training. The result turned out to be an enormous success. The Hydro Project was finished four months before the deadline within budget and passed the quality inspection.

The experience of Lubuge has had a profound impact on the future Chinese projects. In the past, almost all projects as well as staffs were managed by the government due to its state control economics. Efficiency and effectiveness were not forced in most projects. Staffs were government employees and held permanent jobs as long as they made no big mistakes. Things began to change after the Lubuge Hydro Project.

Based on Lubuge's experience, in 1987, Ministry of Construction (MOC) began a pilot project to promote project management in China and began to set up Project Manager Certificate System. During the following four years, MOC expanded project management to all of its projects in the industry. *Three Gorges Hydro Project*, which was one of the mega projects, was the biggest project in Modern Chinese history. *Three Gorges Hydro Project* began in 1994 with a total investment of $22 billion. It was so complex that an average of 18,000 staffs was put on the site every day. More than 100 companies were involved to provide materials, equipment, IT and logistical supports. In order to achieve the project goal on time and within budget, the *Three Gorges Hydro Project Committee* used a series of project management tools and techniques, such as Cost Management, Quality Management and Risk Management, etc. Dozens of domestic and international project management experts were recruited as consultants. (Gou, Bo Rang, 2005)

In June 1991, led by Northwest Industry University, the first Chinese project management academic committee, Project Management Research Committee China (PMRC) was born. The membership of the Committee encompasses individuals and bodies involved in project management, both academically and industrially. In 1996, PMRC became a national member of International Project Management Association (IPMA). IPMA, which was founded in 1965, is the world's first and leading project management association. It has spread its influence from Europe to Asia, Africa, the Middle East, Australia, South and North America. (International Project Management Association, 2012) Then, during the following ten years, PMRC made effort to promote Chinese project management and became a bridge between Chinese project management and western project management organizations, like IPMA. (Project Management China Online, 2010)

PMRC published its PMBOK, *C-PMBOK* in 2001 and in the same year, PMRC was authorized by IPMA to introduce IPMP exams into China. The committee also localized the ICB (International Competence Baselines) by producing the NCB (National Competence Baselines) for China. PMRC celebrates its 20th anniversary in 2011.

In addition, PMI, another project management powerhouse, also entered China by teaming with State Administration of Foreign Experts Affairs (SAFEA) and its subsidiary, the BMMTEC International Education Group in 1998. One year later, the BMMTEC became the first and now one of the largest Registered Education Provider in China certified by PMI to provide Project Management Professional (PMP) certification training and examination services as well as other training and education on project management (Lu, You Jie & Wang, Shou Qing, 2004).

Today, project management is being used in almost all industry sectors, not only in defense, aerospace and construction industry, but also in IT, engineering, energy, transportation, manufacturing, auto industry and academic area as well. For example, in 2000, when Lenovo (the Chinese company which bought IBM PC sector in years later) wanted to develop a new series of laptop, Tianqi Series, it employed project management all through the project. It even set up a PMO (Project Management Office) to coordinate all the divisions. In the end, it only took 8 months to finish the task, which was 6 months shorter than its last Tianyang Series. (Project Management Institute, 2011)

In 2008, the Olympic Game was held in Beijing, China. Building or renewing Olympic venues was a huge and complex project, with which enormous risk was associated due to tight time schedule, high technical and functional standards. For the first time in Olympic history, the IOC (International Olympic Committee) specifically required risk assessment for all venue projects. The BOC (Beijing Organizing Committee) was required to report to IOC the risk level (high/medium/low) of each venue project every three months. (Fang, Dongping, Zhu, Difei & Wang, ShouQing, 2008) This is a good proof to show how project management plays an important role in modern construction project. At the end, all Olympic venues were finished on time and passed the inspection from IOC. Beijing Olympic Game becomes the most successful Olympic Game in Game's history.

The 2010 Shanghai World Expo is another showcase for the application of project management. The Expo itself is a mega project, which has more than 200 pavilions with an investment of CNY 18 billion and each pavilion represents a country or an organization. Lynda Bourne, a PMP, commented on Expo after she visited it, "The Expo is not only a triumph for project management from the Shanghai region and the Chinese construction industry, but also from all of the nations that built and fitted out their pavilions. The design, construction and management of the World Expo projects went beyond the

traditional iron triangle of time, cost and quality, to include sustainability and safety." (Lynda Bourne, 2010)

2.4.2. Characteristics of Project Management in China

After more than 40 years of development, project management has been successfully introduced and widely promoted in China, making more and more organizations realize its advantages (Project Management Institute, 2011). It's known to all that China is the largest developing country in the world and the condition of the country is quite different from the western world. Thus, there is no wonder that project management here has its own characteristics. After reviewing various documentations on project management practice in China, we summarize three representative points which describe the situation of China well.

- Globalization

Thanks to the development of economy and information technology, almost "everything" feels like "globalizing" nowadays, and the practice of project management is no exception. According to the research of Du, Chuang (2011), today, project management in China becomes much more globalized than any time before. The trend of globalization is primarily shown in the following three aspects.

First of all, more and more international co-operations exist between China and other countries nowadays. Most co-operations are executed in real projects. During the construction of Beijing Olympic Stadium, *the Bird's Nest*, experts from more than dozens of countries have been invited to participate. Thanks to the communications during co-

operations, Chinese project management practitioners have benefited a lot in the sharing of the latest management knowledge, methods and ideas.

The more and more international conferences and seminars held yearly in China help Chinese project management involve more into the world profession too. These conferences and seminars attract project management experts around the world to share their expertise and make new friends in China. PMI (China) Congress 2011 hosted by Project Management Institute (PMI) China has just been successfully held in Beijing at the China National Convention Centre (CNCC) on September 16th, 2011. What's more, by teaming with Project Management Research Committee, China (PMRC), the IPMA has successfully held its 10th International Forum on PM in Xi'an, China in June 2011.

Last but not least, the greater amount of information sharing through Internet fastens the globalization efficiently. Thanks to the technology progress in internet, nowadays people can find almost everything he/she wants to know about every corner of the world on line. All project management organizations in China, the PMI, IPMA, and PMRC (Project Management Research Committee, China) take advantage of the net and post the latest project management information and study materials like new standards, regulations, etc. on their official website. This has provided great convenience for Chinese students and professionals to study online.

- Combination of degree education and non-degree certification

Apart from the emergence of globalization, the combination of degree education of project management and non-degree certification of project management is well worth

mentioned as well. In China, daytime classes are regarded as degree education while evening and weekend classes are regarded as non-degree education or certification. Both of these two types of education exist in China.

For degree education of project management, China is far behind western countries. In U.S., Western Carolina University began to release courses on Master of Project Management (MPM) in 1983. It was the first time that such type of master degree was granted at a nationally accredited institution and it was also the first one accredited by PMI. Whereas, in China, the Degree education did not start until 2003 when five universities, including Tsinghua University, Tongji University, Huazhong University of Science and Technology, Harbin University of Technology and Xi'an Jiaotong University began to grant Degree of Project Management. Several foreign universities also try to enter Chinese educational market. In order to be qualified for Degree Education in China, a foreign university needs to sign a collaboration agreement or create a joint venture with a local university and get approval in advance from the Minister of Education. Due to these obstacles and the relatively high tuition fees, most of these joint ventures are so far unsuccessful. (Lu, You Jie & Wang, Shou Qing, 2004) However, UQAC (University of Quebec at Chicoutimi), which has successfully collaborated with Tianjing University of Technology to launch project management, is an exception. Up to now, more than 1000 Chinese student have already participated in their program and the number is increasing year by year. (Matriculation Project Group of Quebec Canada, 2008)

Usually it takes 4 years to complete a formal Degree education. However, due to the fast booming economy in China, there is an urgent need for many qualified Project Managers (Zhou, Guo Dong, 2006). Statistics indicate that around 600,000 trained project management practitioners and nearly 100,000 certified project management professionals will be needed in the coming three years to meet the huge demand (Bin Pan, Lin Fu &

Stockholm Lund, 2008). To bridge this gap, some institutions began to grant non-degree project management certification within which courses can be taken in evenings or at weekends.

With respect to non-degree certification, in 1999, PMI began to cooperate with the State Administration of Foreign Experts Affairs (SAFEA) to promote its project management knowledge and its certification exam PMP. One year later, PMP was officially held in China. After then, the first representative office of PMI was established in 2004 and it was not until 2008 that PMI (China) was established in order to better promote project management in China and to improve value of awareness and recognition of project management.

According to the report of State Bureau of Foreign Experts Affairs, China (2010), up to March 2010, around 600,000 people had joined the trainings of PM knowledge and more than 52000 people had involved in PMP tests. China has had the most PMP credential holders in single country outside of US.

While PMI is in cooperation with SAFEA, IPMA teams with PMRC to promote its business in China. In 2001, one year after PMP held in China, IPMA officially launched IPMP in China. So far, it has established 53 Authorized Certification Agents and more than 10,000 IPMP certificates have been issued since 2001. (Lu, You Jie & Wang, Shou Qing, 2004)

Since PMP and IPMP certifications are all based on foreign project management standards or guides and are not officially recognised in China, it is necessary to establish

native certification system for project management professionals in China. In 2002, the Ministry of Labour and Social Security published the National Standards for Project Management Professionals in China (CPMP) which formally established the basis for CPMP certification. The first National Exam was held in December 2003. Though PMI, IPMA and their affiliates are leaders in this field, the National Project Management Exam in China is catching up. (Lu, You Jie & Wang, Shou Qing, 2004)

- Early stage of development

Globalization and the combination of degree education and non-degree certification are both good news for the development of project management in China, which help to create more opportunities for communication and learning.

As the open and reform goes further and the market economic system improves constantly, the current status of project management practice in China is encouraging with the support of government and the advance of information technology. (Zhou, Guo Dong, 2006) However, the end result is not that encouraging. Many project managers still get trouble from cost over-run, resources lack, quality insufficiency, etc. (Hubert Vaughan, 2008) The main problems involved in project management in China are enumerated as follows.

First of all, the existence of improper administrative system is a big factor. In China, the redundancy of administrative organizations is always a problem, which causes many conflicts and brings down the efficiency. For example, in the construction industry, the State Develop and Reform Committee (the former State Planning Commission) has the

approving power, which takes charge of the administration of project initiation including feasibility study, investment decision, projects evaluation, etc. The administration of project exploration, design, construction and supervising are the responsibilities of the Ministry of Construction, whereas, the consulting services for international projects are supervised by the Ministry of Commerce. Multiple administrative "bosses" lead to frequent contradictions. (Bosen He, 2003)

Secondly, apart from the illogical administrative system, the simplicity of project management systems in China also brings about failures. New modes and theories of project management have been generated and developed rather rapidly internationally. However, more than 95% of Chinese domestic projects still adopt the traditional simple project management approach so far and new project management approaches are seldom introduced in. (Bosen He, 2003)

Then, in China, relevant laws and regularities are incomplete. Though relevant laws and rules are already established in the field of project management, a constructive discipline in the project management practice is still unavailable, thus making the profession disordered. (Lu Yan & Qu Rong, 2004) In some mega projects in China, time and cost were achieved at the expense of project quality, which led to horrible results. The big traffic accident on the Yong Wen railway was just the case. Thirty five people died and 192 hurt due to the poor design of the signal system of the train. (Xu Xiao & Shi Yu Xiang. 2011)

Last but not least, project management practitioners in China have generally low qualifications, which can't be neglected too. As mentioned before, the research and practice of project management started late in China and the first Chinese project management

academic committee, Project Management Research Committee, China (PMRC) was not born until 1991. Up to now, there is no official project management publication existing in China. Besides, as a branch of management science, project management hasn't yet been put on the subject directory by the Ministry of Education in China, thus making the training of project management professionals insufficient. (Lu Yan & Qu Rong, 2004)

Based on the facts shown above, we can affirm that the development of project management in China still stays in the early stage and compared with western countries, it has a long way to go.

Actually, China is not the only one that facing the problems and shortcomings, to be more specific, many developing countries encounter chaos in the practice of project management too.

About 25 years ago, in 1987, M G Korgaonker had discovered serious problems in India's public sector which was based on some of the most complicated and major projects India had undertaken. Constant time and cost overruns had become a rule instead of the exception in project management. Statistics showed that in a large public sector project, the time delay was of the order of nearly 3 years on a scheduled project duration of about 3.7 years; meanwhile, cost overrun was great too, which was about 40% higher than the projected cost. Recently, Raju Rao, the owner and principal consultant for Xtraplus Solutions, Chennai, India said in the interview (Project Management Institute, 2012) that there was abundant manpower in India, however, there was still a shortage of skilled professionals. Moreover, according to him, by now in India, project management has not yet been recognized as a discipline to apply in any kind of thing, though it is indeed used in some fields, either through practice or through established processes.

In Mauritius, which is also a developing country, great improvement is needed in the practice of project management as well, especially regarding software project management. In 2004, a group of researchers: Sukhoo, A., Barnard, A., Eloff, M.M., & Van der Poll, J.A. studied the application of tools, techniques and methodologies in software project management in Mauritius. Sixty two point five percent (62.5%) of the completed questionnaires received came from Mauritius companies while the rest came from other regional developing countries like South Africa, India, Kenya and Zimbabwe, thus making Mauritius the focus of the paper. Regarding the question of methodology used, more than half, 60%, of the respondents mentioned that they didn't use any methodology during the software development process. Besides, the researchers also found that, in terms of failure to meet set deadlines, 20% of companies sampled claimed that more than 75% of their projects time overrun annually; 30% of samples claimed that 50% to 75% of their projects failed to meet deadline annually and only 20% of the companies claimed that less than 50% of the projects time overrun annually. The situation regarding budget overrun was quite alarming as well. There is no doubt that much improvement should be brought about.

2.4.3. Usage of Tools and Techniques in China

Although Grant Chart, PERT and CPM were introduced to China in the early 60s, project management was only limited to defense and aerospace industries. During the years 1966-76, well known as Culture Revaluation, project management was declared as an experience, not a science. The Lubuge Hydro project for the first time in Modern Chinese history made project management used. After Lubuge project, the Department of Construction began to apply project management tools and techniques to several related projects. However, due to some economic and politics reasons, project management was developed slowly in China until the information technology boomed. Today, project management begins to grow rapidly in China, however, since project management development in China still stays in the early stage, certain areas enjoy higher development

speed, while some fall behind, thus making the application of tools and techniques of project management quite unbalanced. Project management software is being widely applied and almost dominates the project management tools in China, while other tools and techniques of project management are seldom mentioned and rarely touched. (Yu, Run Zhong & Zu, Li Juan. 2008)

Among all the project management tools and techniques used in China, project management software (PMS) plays the most important role and was most widely used. Even today, many people in China take project management as PMS and haven't even heard of the other ones. Normally, PMS is divided into two simple groups. One is mainly used in construction and building industries which need multi-projects management and complex resources controlling. The other is focused on team members' working cooperation function, which is commonly used on new products design, research and development in the industries of manufacturing, telecommunication, IT, financial, etc. According to research, PMS accounts for 80% of the usage of project management tools in China. (Yu, Run Zhong & Zu, Li Juan, 2008) The most widely used PMS in China includes Primavera System, CA Clarity, Microsoft Project, Oracle and eProject. (Wu Jie & Peng, Qi Yuan. 2004)

The unbalanced economic development levels in different regions of China lead to unbalanced PMS usage too. As suggested by the survey, East China accounts for 31% of the PMS usage; North China takes 25% and South China uses 21%. Among the cities, Beijing, Shanghai and Guangdong are the top three to use PMS. Recently, the use of PMS is also increasing quickly in Northwest of China, as the government has issued new policies to accelerate the economic development there. It is predicted that by 2020, the usage of PMS will be much more balanced in China. (Wu Jie & Peng, Qi Yuan, 2004)

Researchers in western countries like Besner & Hobbs have taken steps to study the actual practice of project management, starting from understanding the usage of project management tools and techniques. In China, comparatively, little research has been done in this aspect so far. However, the understanding of the true picture of project management practice and the actual usage of project management tools is necessary and essential for future improvement and development.

2.5. Summary of the Literature Review

Theoretically, a project can be defined as a temporary endeavor undertaken to create a unique product, service or result (PMBOK Guide, 2008), and the forms of projects are quite diversified rather than fixed. In order to well manage projects, the famous project management process groups and many project management tools were invented and discovered gradually.

The history of project management can be traced back to 1945, and after years of development, it has been applied quite extensively around the world (Liviu Ilies, Emil Crisan & Ioana Natalia Muresan, 2010). At the same time, project management tools and techniques as well as PMI's project management body of knowledge get expanded.

Although project management tools and techniques have been applied and researched for more than half a century, the documentation of history of tools and techniques, especially those used in countries other than America, is few. Besides, vast majority of the research focuses on particular project management tools or specific project management practice, rather than the general usage of the tools (Besner, Claude & Hobbs, Brian, 2008). Thanks to the efforts of Besner & Hobbs (2008), Fortune, White, Jugdey & Walker (2011),

Ndiritu Muriithi & Lynn Turner Turner (2003), we get some idea on the usage of project management tools and techniques in North America, Europe & Australia and Arica.

In terms of China, while the undocumented project management could be dated back to thousands of years ago when Chinese built the Great Wall and Egyptian built the Pyramid, the modern history of project management did not emerge until the cold war when it was mainly used in the military. Today, project management is used everywhere, ranging from mega project to daily community plan, and it has become the core stone for the project.

Although there is no universal standard for project management, two organizations are leading the way. The PMI of US, publisher of the PMBOK, becomes the worldwide standard of project management code; while IPMA, with its main influence in Europe, is also a well-recognized standard. In China, the third part organization named PMRC represented China as a national member of IPMA in 1996.

While the tools and techniques used in different countries can be varied, computer-based project management software is extensively used in every country. For example, tools and techniques are used differently in Australia, Canada and UK which are all English-speaking commonwealth counties. However, project management software plays an important role for all. In China, project management software accounts for 80% usage of project management tools and technologies. The unbalanced economic development level results in unbalanced usage of project management tools and techniques.

In conclusion, project management was introduced late in China and still stays in the early stage of development. Though it has enjoyed rapid growth in recent years, it still has a long way to go compared with western countries. Researchers in western countries like Besner & Hobbs have taken steps to study the actual practice of project management, starting from understanding the usage of project management tools and techniques. In China, comparatively, little research has been done in this aspect so far. A review of previous literature indicates that Chinese researchers and practitioners have focused their attention on the usage of project management Software and little attention was paid to the usage of other tools, needless to say the whole picture of the usage of project management tools in China. However, knowhow about the actual usage of tools is quite essential to realize the actual effectiveness of all kinds of tools and discover the weaknesses, thus providing reliable information for project management improvement in the future. Therefore, this research aims to partly fill this gap by providing empirical researches to the actual usage of tools and techniques of project management in China. The focus of this research is to find out the most used often project management tools in China and the areas where the tools are not efficient in order to provide some first-hand information for future research.

CHAPITER 3
RESEARCH CONCEPTION

3.1. Problems of the Research Formulation

Nowadays, as the benefits of project management gradually got recognized by people, project management has been used extensively around world. Project management methods evolving in guidelines and international standards are also widely accepted and applied (Liviu Ilies, Emil Crisan & Ioana Natalia Muresan, 2010).

Many new tools and techniques emerge during the process of project management development, which help to improve effectiveness and efficiency in the management. The Guide PMBOK has summarized common practices in project management and provided general methods for project treatment. According to Diana White & Joyce Fortune (2002), the professional methods and techniques, which are offered in the Guide PMBOK, are widely used in the practice. Issues related to project management are of great interest to the researchers and practitioners. For example, the topics of project organization, project risk, the project front end, external influences to projects and initial work on the development of project management standards were the most ones in project management in the 1980s (Lynn Crawford, Julien Pollack & David England, 2005).

However, the guide of PMBOK and the existing project management tools and techniques haven't prevented problems from happening in the practice. From the statistics in the survey of Willcocks L, & Griffiths C (1994), we can find that more than half of IT

projects were facing problems like budget overrun, missed deadline or failing to attain other project objectives.

It is true that all aspects of the whole cycle of project management have been covered in existing researches, whereas, with respect to the use of project management tools and techniques, the research is not enough. Among the great many study provided on project management tools and techniques, the vast majority focuses on particular project management tools or specific project management practice (Besner, Claude & Hobbs, Brian, 2008). In fact, it's quite essential and meaningful to know more about the general actual usage of project management tools and techniques. Based on the understanding, project managers can know which tools and techniques are used more or less in the profession, thus getting some inspirations; professionals can know the actual situation of project management tools and techniques usage, thus identifying existing limits in the practice and making improvements.

In western countries, few attempts have been made to get the general idea of project management tools and techniques usage. As mentioned in the literature review, the work of Prof. Besner and Prof. Hobbs in 2008 and the work of Fortune, White, Jugdey & Walker in 2011 are quite noticeable. While in the case of China, which is the world's largest developing country, little research has been provided in this aspect so far. In China, most attention of researchers is paid to computerized project management tools which are widely applied in China, while the usage of other tools and techniques of project management are seldom mentioned and rarely touched (Yu, Run Zhong & Zu, Li Juan. 2008). However, the understanding of the actual situation of project management practice and the actual usage of project management tools is instructive and indispensible for future development and improvement in project management of China.

In this part of review, the actual situation of project management in China, especially the general usage of project management tools and techniques which are not limited only to the computerized ones, will be explored.

3.2. Research Objectives

Due to the insufficiency in the research of Chinese project management tools and techniques, this research aims to find out the actual situation of project management in China, especially the general usage of project management tools and techniques. Since there are so many project management tools and techniques available to practitioners, it's highly significant to know their actual performance.

Furthermore, this research also offers a chance to examine factors that may influence the usage of project management tools and techniques in China. Besides, by comparing the usage of tools and techniques in China from the usage of tools and techniques in western countries, differences will also be identified.

3.3. Research Question and Proposition

3.3.1. Research Questions

Since there are few literature on the usage of project management tools and techniques in China and there is few information on introducing the factors that may influence the usage of project management tools and techniques in China, this study will focus on the following questions:

1. What's the situation of the usage of project management tools and techniques in China?

2. In China, is the usage of project management tools and techniques similar in projects of different contexts and of different types?

3. In China, is the usage of project management tools and techniques comparable in different phases of projects?

4. Is there any relation between the usage of project management tools and techniques and the experience of project managers?

3.3.2. Research Propositions

Proposition 1: The usage of project management tools and techniques is uneven in China.

Proposition 1A: The most used project management tools and techniques in China are the best known.

Nowadays, China has enjoyed rapid development in project management (PM Network, 2011). Project management is being applied in almost all industry sectors ranging from defense, aerospace and construction industry, to IT, engineering, energy, transportation, etc. Some best known project management tools like Grant Chart, PERT and

CPM were introduced to China in the early 60s. Many researchers have set these tools and techniques as their topics, like Yang, Xiao Di (2004), who studied the application of PERT in estimating project durations; Liu, Shi Xin, Song Jian Hai & Tang Jia Fu (2003), who were interested in the tool of CPM, etc. Due to the early introduction and the efforts of researchers, the best known project management tools and techniques are better understood and recognized by Chinese project management practitioners. Therefore it's reasonable to propose that the most used project management tools and techniques in China are the best known.

Proposition 1B: Computerized project management tools and techniques dominate the project management tools and techniques used in China.

As we have stated previously, the development level of project management in China still stays in the early stage and it has a large gap in compared with western countries. Factors like the existence of improper administrative system, the simplicity of project management systems in China, the incompleteness of relevant laws and regularities, etc., are all causes that impede the development of project management in China.

The early stage of development has made the application of project management tools and techniques quite unbalanced in China. Although some best known project management tools like Grant chart, PERT and CPM were brought in China in the early 60s, it is the computerized project management tools and techniques (project management software) that dominate the project management tools and techniques used in China. According to Yu, Run Zhong & Zu, Li Juan (2008), apart from computerized project management tools, other tools and techniques of project management are seldom mentioned and rarely touched in China. They also confirmed that the application of project management software accounts for 80% of the usage of project management tools.

Proposition 2: In China, the usage of project management tools and techniques is different in projects of different contexts.

Proposition 2A: The level of maturity of project management systems exerts influence on the usage of project management tools and techniques in China.

The research made by Besner & Hobbs in 2008 revealed that the usage of project management tools and techniques in North America is influenced by the organizational project management maturity. According to the two professors, mature organizations have their own characteristics. Generally, mature organizations tend to have larger projects and tend to be of greater size as well. Furthermore, mature organizations are expected to have better defined projects. Although there is few relevant document provided in China, since maturity organizations in China enjoy the same characteristics, it's reasonable to propose that the usage of project management tools and techniques in China differs in project management systems of various maturity levels.

Proposition 2B: The usage of project management tools and techniques is not same in projects of various sizes in China.

The size of projects is also a contextual factor that may lead to different usage of project management tools and techniques, which has also been verified by the research of Besner & Hobbs in 2008. Projects of larger size tend to have greater investment, accumulate more resources and get greater attention from the management, which is also the case in China. Therefore, it's possible to expect that the usage of project management

tools and techniques is not same in projects of different sizes in China, like the situation of North America.

Proposition 3: In China, the usage of project management tools and techniques differs in projects of different types.

Recently, variations in project practice across different types of projects and different contexts have aroused increasing interest among researchers. According to the research of Payne and Turner (1999) and Shenhar (1998), project management practices do vary greatly from one type of project to the other. Furthermore, the research of Crawford, Hobbs, and Turner (2005, 2006) have found out that organizations divide their projects into categories so that different tools, techniques, and approaches can be applied to different types of projects. One of the primary motivations to create systems for categorizing projects into different types is to adapt the project management methods to the specific requirements of each type of project. Therefore, the recognition of the variability of project management practice by project type is widely spread. This understanding also applies to the situation of China.

Proposition 4: In China, the usage of project management tools and techniques changes in different project phases.

Rather than project management phases which we have explained before, project phases will be used in the following study due to its simplicity. The two phases are similar and the major difference is that under project phases, there are four phases, which are initiation phase, planning phase, execution phase and finalization phase, while under

project management phases, there are five phases including the initiating phase, the planning phase, the executing phase, the monitoring and controlling phase and the closing phase (PMBOK, 2008; Kathy Schwalbe, 2010). Same as project management phases, each project phase has its own characteristics, objectives and project activities, thus making the choice of project management tools and techniques different.

Proposition 5: In China, the usage of project management tools and techniques is connected with the experience of project managers.

Proposition 5A: In China, project managers with higher education level use project management tools and techniques more often.

In China, as reviewed before, degree education of project management started late in compared with western countries. It was not until 2003 that five universities, including Tsinghua University, Tongji University, Huazhong University of Science and Technology, Harbin University of Technology and Xi'an Jiaotong University began to award Degree of Project Management. In order to adapt to the fast booming economy in China, many qualified project managers are demanded (Zhou, Guo Dong, 2006). According to the statistics, around 600,000 trained project management practitioners and nearly 100,000 certified project management professionals will be needed in the coming three years (Bin Pan, Lin Fu & Stockholm Lund, 2008). Better educated and trained project managers are provided with systematic project management knowledge and more familiar with kinds of project management tools and techniques. Besides, project managers with higher education level tend to use different tools and techniques according to the requirement of various tasks, since they know better which tools and techniques help most.

Proposition 5B: In China, project managers with longer work experience have more frequent use of project management tools and techniques.

Work experience is an indispensable factor in accumulating knowledge and gaining expertise of the profession. Apart from the education and training received, project managers also get their capability increased via the process of practical working. Project managers who have longer work experience have to solve more problems and face more complicated situations, thus making it necessary to get in touch with more project management tools and techniques. Furthermore, longer work experience enables project managers to be more sophisticated in applying tools and techniques.

3.4. Reference frame

With the above four propositions in mind, we are now building a research framework to present an overall picture of steps of the research. As can be seen from Figure 1, it uses a diagram to expound the connections among the propositions. First of all, the general situation of project management tools and techniques in China will be studied to verify that the best known project management tools and techniques and computerized project management tools and techniques are used more. Afterwards, the application of project management tools and techniques in projects of different contexts will be analyzed, with maturity of project management systems and size of projects as the two key context factors. Similarly, we will then try to find out the usage of tools and techniques in various project types and phases. Finally, since the connection between the experience of project managers (mainly their education level and working experience) and the application of project management tools and techniques is of our interest, once the above issues are figured out, analysis will be provided to this aspect.

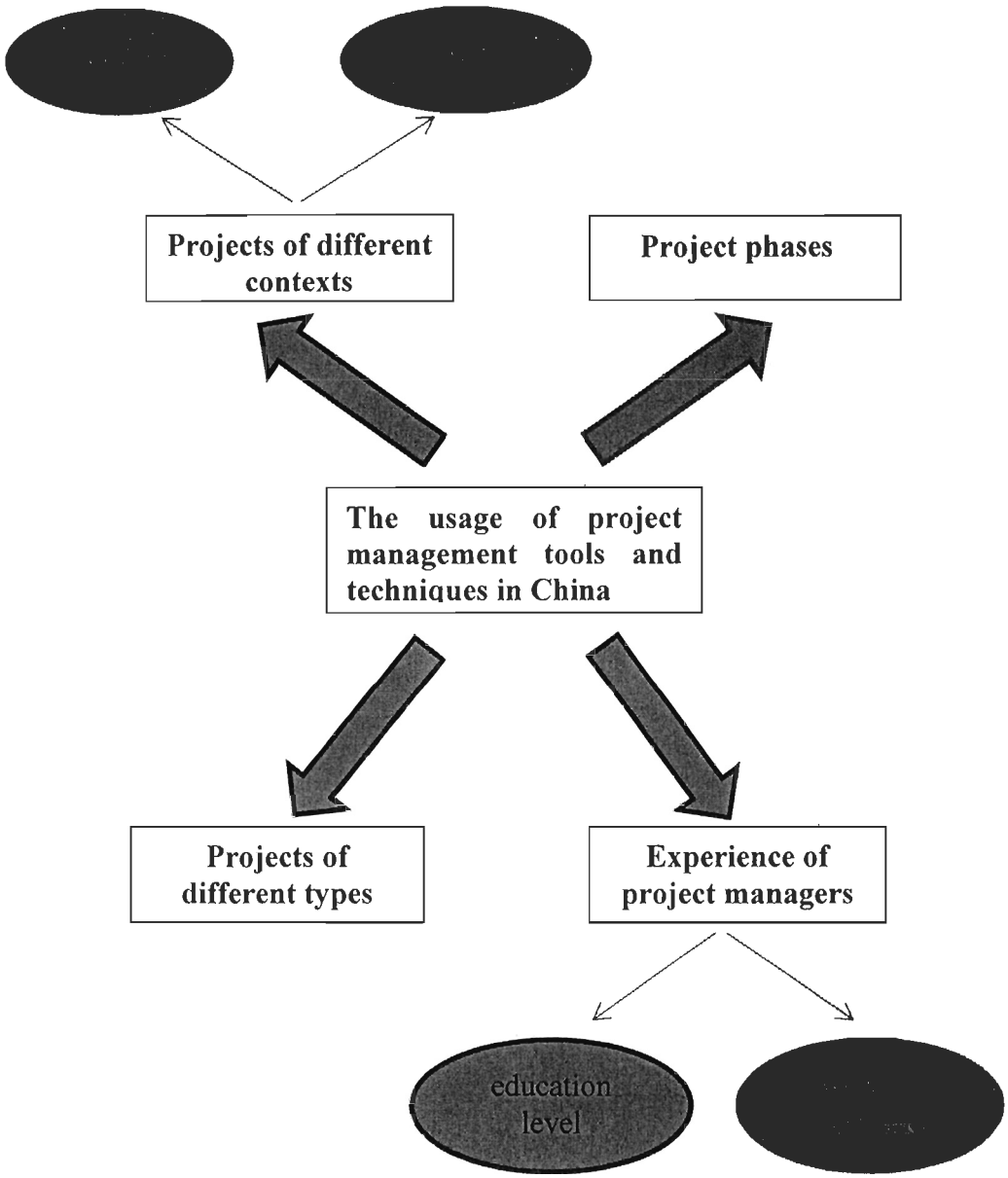


Figure 1: Schematic Articulation of the Concepts

CHAPITER 4
REASEARCH METHODOLOGY

4.1. Research Method

In this study, the quantitative research method is used. According to Cormack (1991), quantitative method came into being from the scientific method applied in the physical sciences. It offers an unbiased, formal and systematic process to quantify or measure phenomena and produce findings by using numerical data, besides, it also helps to describe, test and examine cause and effect relationships (Burns N & Grove S K, 1987). Different from qualitative researchers who are guided by certain ideas, perspectives or hunches related to the subject to be investigated, quantitative methodologies test theory deductively from existing knowledge by developing hypothesized relationships and suggested outcomes for research (Cormack, 1991).

The quantitative method has loads of advantages. Under this method, the investigators can hold a detached and unbiased view in understanding the facts (Duffy, 1986). Bryman (1988) stated that no direct contact with subjects may be required at all as in questionnaires posted and even in interview surveys, the researchers were required to have little, if any contact with respondents, especially when hired staff complete most of all the interviews. Objectivity can be ensured thanks to the avoidance of researcher involvement. Furthermore, quantitative research is thought to be more reliable than the qualitative investigation. The reason is that the goal of quantitative method is to control or kick out extraneous variables within the internal structure of the research. At the same time, the data generated can also be evaluated by standardized testing (Duffy, 1985).

In the quantitative method, a sample should be identified, which is representative to a larger portion of people or objects (Carr L.T., 1994). The sampling procedures should follow the criteria of randomness. Duffy (1985) stated that quantitative research required for random selection of the sample from the population studied and random allocation of the sample to the various study groups. With respect to the research processes used in quantitative approach, descriptive research, correlational research, quasi-experimental research and experimental research are often used (Cormack, 1991). The strong points of such methods are clear. Both true experiments and quasi-experiments offer abundant information on the relationship between the variables investigated so that prediction and control over coming results can be enabled (Carr L.T., 1994).

The purpose of this study is to find out the current situation of project management tools and techniques usage in China. Besides, it is also interested in how project contextual factors like project maturity and project size, project phases, project types and project management experience influence the choice and usage of project management tools and techniques in China. Among the previous similar studies, most of which were performed by using quantitative approaches and used the questionnaires as the instrument. Since the previous findings were highly direct, objective and reliable and the analysis derives from quantitative method well satisfy our purpose, the quantitative method is selected to be used in this research as well.

4.2. Research Setting and Sampling Selection

In this study, the Chinese project managers and program managers/directors are set to be the target population for the sample. This sample selection is based on two main reasons. For one thing, the relationship between Chinese project managers' experience and their usage of project management tools and techniques is of our interest and is one of our

research objectives. For another, project managers and program managers/directors are considered to have deeper understanding of the profession of project management. They can get the knowledge needed either from what they have learned at school, or via their long term working practice. Therefore, with respect to the application of project management tools and techniques, they tend to be more sophisticated and have sounder opinions thanks to their experience, which help us to know more about the value of project management tools and techniques in Chinese project management practitioners' eyes.

After the determination of the aim of the survey, suitable approaches should be found in order to secure the information needed. In this research, project managers and program managers/directors who engage in projects of various sizes, maturity levels and types were solicited. Besides, the respondents also participate in different project phases and enjoy different "background". As a consequence, it is easier to study and analyze the relationships between various factors such as project contextual factors (maturity level and project size), project phase, project type, practitioners' experience and the usage of project management tools and techniques, thus making the research objectives realizable.

Ninety-seven (97) answers were received from 283 questionnaires that were sent to project managers and program managers/directors in China, resulting in a responding rate of 34.28%. Among the answers received, all of the questions were answered in nearly every case, except that one respondent failed to answer the question on project type; one respondent forgot to define project phase and six respondents failed to evaluate the usage of some project management tools. Therefore, a total of 89 useful and meaningful responses were received.

4.3. Data Collection

As we have mentioned in the previous part, the questionnaire designed was sent in order to collect the quantitative data needed. The questionnaire can be generally divided into three parts (APPENDICES).

The first part gathers basic demographic information on the respondents, including education level, experience level and current position. The second part involves questions on project environment. In this section, respondents were required to provide information on project type, organizational context (mainly project size and the level of project system maturity) and the project phases they participate in. After that, in the last part, two series of questions concerning each tool were designed to investigate the usage of tools. Respondents were asked to give opinions both on the extent of use of the tool and the potential improvement in project performance that would be brought in from a more extensive use of the same tool. The 70 project management tools and techniques used in this study were same to the ones investigated by Prof. Besner and Prof. Hobbs (2008). The reason for studying the same project management tools and techniques is that the 70 tools they choose are identified with the practice of project management. They investigated only the tools and techniques project-specific and well known, excluding the general processes. Focusing the investigation on well-known tools and techniques specific to project management guarantees that the practitioners can well understand the questionnaire. Besides, using the same list of tools and techniques facilitates the comparison between the usage of project management tools and techniques in Northern America and China. As defined by PMBOK Guide (2004), there are nine knowledge areas in project management which are Scope, Time, Communication, Cost, Quality, Risk, Integration, HR and Procurement. In order to classify the 70 tools, the nine knowledge areas from PMBOK Guide as well as one more category of "Learning" were used. Some tools related to organizational learning didn't fit easily into the 9 knowledge areas, thus making the addition

of the category of "Learning" necessary. Although there is no single best way to classify project management tools into knowledge areas, the analysis results will be provided for each specific tool, thus making the exact classification of tools less important. With respect to measures, each tool is evaluated on a 5-point Likert scale from no use or improvement to very extensive use or improvement.

To assemble the data, we got help from the Changeway Project Management Training Center in Shanghai, who provided us a contact list of part of project managers trained in the organization in 2011. Thus, we send out the questionnaires by emails. Besides, with the help of friends, we manage to put the questionnaire on different organizations' Local Area Internet in order to attract more responses. It took around 7 weeks to get the information collected. Once the replies on hand, we analyzed the responses. This research is mainly to find out the actual usage of project management tools and techniques in China. After we collected the information from the questionnaires, we analyzed the information for each tool and technique. From the three parts of the questionnaire, we found out the relationships between various factors such as project contextual factors (maturity level and project size), project phase, project type and practitioners' experience and the usage of project management tools and techniques in China.

4.4. Data Analysis

In the quantitative data analysis, information is effectively presented in forms of tables with numbers and percentages. The statistical analysis will be adopted in this research as well. The tools will be ranked based on average levels of use not only for the entire sample but also for subpopulations divided using project characteristics and contextual variables. In this way, project management tools and techniques with the most usage and the least usage can be figured out quite easily.

Furthermore, the method of T-test will be used to verify differences between means and confirm the necessity of independent variables. And the relationship between different independent variables will be checked by using Chi-square statistics. Pie charts, bar charts and various other diagrams will be used to make explanations and comparisons when necessary.

With the analysis results gained from quantitative analysis, some reliable and persuasive evidence can be found to support my propositions.

CHAPITER 5
PRESENTATION AND ANALYSIS OF THE RESULTS

In this chapter, data analysis and the results of the thesis will be provided. General situation of project management tools and techniques usage in China will be analyzed in the first part and a brief introduction to the tools investigated will be included as well. In the second part, the relationships between contextual factors (maturity levels of project management systems and project size), project characteristics (project phase and project type) and the usage of project management tools and techniques in China will be examined respectively. Then in the last part, the link between practitioners' experience factors (education level, working experience) and the usage of project management tools and techniques will also be checked.

The samples given by this study were selected from project managers and program managers/directors in China, who enjoy different "background", engage in projects of various sizes, maturity levels and types and also participate in different project phases. The samples size of this study is 89 and the demographic information on the samples is shown below:

- Male (83.15%)
- Current primary role:
  - Project manager (91.01%)
  - Program manager/director (8.99%)
- Location:
  - Shanghai, China (41.5%)
  - Nanjing, China (33.7%)
  - Suzhou, China (19.2%)

- Other (5.6%)

As can be seen from the data above, the primary sauce of information of this thesis is male project managers from Shanghai, Nanjing and Suzhou, China. Since some demographic information like working experience is connected closely to research objectives, they will be analyzed afterwards.

5.1. Usage of Project Management Tools and Techniques in China

5.1.1. General Situation of Usage

In this section, quantitative data analysis will be provided to the information gathered from the samples. The general situation of usage of the 70 popular project management tools and techniques investigated in China are presented in Table 5.

MEASURES / TOOLS		N/A	0	1	2	3	4	Average Usage
Scope	Scope Statement	0%	7%	4%	10%	19%	60%	3.20
	Change Request	0%	2%	2%	8%	19%	69%	3.49
	Requirements Analysis	2%	6%	2%	8%	22%	60%	3.24
	Work Breakdown Structure	7%	10%	12%	18%	22%	30%	2.37
	Statement of Work	4%	8%	10%	17%	25%	36%	2.62
	Activity List	0%	6%	8%	16%	26%	45%	2.97
	Baseline Plan	6%	30%	24%	17%	12%	11%	1.39
	Re-baselining	4%	38%	21%	13%	11%	11%	1.27
	Product Breakdown Structure	0%	63%	20%	8%	4%	4%	0.67
	Value Analysis	0%	65%	17%	4%	7%	7%	0.73

Time	PM Software for Task Scheduling	0%	12%	7%	6%	2%	73%	3.17
	Gantt chart	0%	3%	9%	9%	2%	76%	3.39
	Milestone Planning	7%	10%	12%	18%	22%	30%	2.37
	PM Software for Monitoring of Schedule	0%	4%	7%	13%	26%	49%	3.09
	Critical Path Method & Analysis	7%	19%	19%	19%	18%	18%	1.83
	Network Diagram	6%	30%	24%	17%	12%	11%	1.39
	PM Software for Multi-project Scheduling/Leveling	6%	36%	22%	13%	11%	11%	1.28
	Learning Curve	1%	61%	11%	7%	10%	10%	0.96
	Critical Chain Method & Analysis	0%	67%	15%	3%	8%	7%	0.72
Communication	Progress Report	0%	4%	4%	4%	7%	80%	3.53
	Kick-off Meeting	7%	20%	20%	19%	17%	17%	1.76
	Communication Plan	2%	51%	22%	11%	7%	7%	0.92
	Work Authorization	7%	15%	17%	19%	20%	22%	2.06
	Project Communication Room (war room)	6%	30%	24%	17%	12%	11%	1.39
	Project website	3%	46%	24%	11%	8%	8%	1.01
	Earned Value	1%	54%	22%	9%	7%	7%	0.88
	Trend Chart or S-curve	0%	65%	17%	4%	7%	7%	0.73
Learning	Lesson Learned/ Post-mortem	6%	22%	21%	20%	16%	15%	1.67
	Customer Satisfaction Surveys	7%	20%	20%	19%	17%	17%	1.76
	Database of Historical Data	2%	51%	22%	11%	7%	7%	0.92
	Database of Lessons Learned	0%	53%	21%	7%	10%	9%	1.01
Quality	Client Acceptance Form	6%	22%	21%	19%	17%	15%	1.69
	Quality Inspection	8%	13%	17%	19%	20%	22%	2.06
	Quality Plan	8%	16%	19%	19%	19%	19%	1.91
	Control Charts	0%	61%	13%	2%	18%	6%	0.94
	Cause and Effect Diagram	0%	74%	11%	6%	7%	2%	0.52

	Pareto Diagram	0%	79%	12%	2%	4%	2%	0.39
Integration	Project Charter	0%	4%	7%	13%	26%	49%	3.09
	Responsibility Assignment Matrix	4%	9%	12%	18%	25%	31%	2.48
	Financial Measurement Tools	7%	10%	12%	18%	22%	30%	2.37
	Feasibility Study	7%	16%	17%	19%	20%	21%	2.01
	Configuration Review	3%	46%	24%	11%	8%	8%	1.01
	Stakeholders Analysis	2%	53%	12%	9%	12%	11%	1.12
	Quality Function Deployment	0%	60%	18%	6%	13%	3%	0.83
HR	PM Software for Resource Scheduling	7%	10%	12%	18%	22%	30%	2.37
	Team Member Performance Appraisal	0%	2%	7%	12%	27%	52%	3.19
	Team Building Event	7%	10%	13%	17%	24%	29%	2.35
	Self-directed Work Teams	3%	64%	2%	12%	9%	9%	0.90
	PM Software for Resources Leveling	3%	46%	24%	11%	8%	8%	1.01
Cost	Top-down Estimating	3%	57%	12%	11%	8%	8%	0.90
	Cost/Benefit Analysis	6%	11%	13%	18%	24%	28%	2.33
	Bottom-up Estimating	2%	45%	22%	12%	9%	9%	1.10
	PM Software for Monitoring of cost	6%	35%	22%	16%	9%	12%	1.30
	PM Software for Cost estimating	3%	49%	12%	10%	9%	16%	1.22
	Database for Cost Estimating	0%	70%	9%	3%	12%	6%	0.75
	Parametric Estimating	0%	79%	6%	2%	10%	3%	0.54
	Life Cycle Cost ("LCC")	0%	63%	15%	6%	13%	3%	0.80
Risk	Risk Management Documents	6%	36%	21%	15%	11%	11%	1.29
	Contingency Plans	4%	43%	22%	12%	9%	9%	1.10
	Ranking of Risks	7%	15%	18%	20%	20%	20%	2.00
	Graphic Presentation of Risk Information	4%	39%	22%	13%	10%	10%	1.20
	Probabilistic Duration Estimate (PERT Analysis)	0%	74%	12%	8%	3%	2%	0.47

	Database of risks	0%	69%	8%	6%	9%	9%	0.82
	Decision Tree	0%	80%	6%	2%	9%	3%	0.51
	PM Software for Simulation	0%	73%	6%	2%	9%	10%	0.78
	Monte-Carlo Analysis	0%	81%	12%	2%	2%	2%	0.33
Procurement	Bid Documents	4%	38%	22%	13%	3%	18%	1.31
	Bid/Seller Evaluation	4%	39%	22%	12%	16%	6%	1.17
	Bidders Conferences	4%	48%	12%	10%	12%	12%	1.19
	Database or Spreadsheet of Contractual Commitment Data	2%	66%	8%	6%	9%	9%	0.82

Note. N/A=Not Applicable; 0: No Use; 1: Very Limited Use; 2: Limited Use; 3: Extensive Use; 4: Very Extensive Use

Table 5: Levels of Project Management Tools and Techniques Use by Knowledge Area

It can be easily seen from the table above that there are large variations in the use levels among different tools investigated in China, that is to say, the usage of project management tools and techniques is quite uneven in China. The interpretation of this table will be presented as follows and the definitions of the tools studied derive primarily from the PMBOK Guide (2008), Wideman, M (2003) and the explanation of tools provided by Besner, Claude & Hobbs, Brian (2008) in their survey annex.

- Scope Statement

Scope Statement is a document which describes the project's outputs or deliverables (PMBOK Guide, 2008). Seven percent (7%) of the respondents affirmed that they don't use this tool in the practice, 4% of the respondents use it quite rarely, 10% of the respondents have limited use to it, 19% of the respondents use it extensively and 60% of the respondents have very extensive use to it. At the same time, no one thinks that it is not applicable to the practice. The average usage of Scope Statement is 3.20.

• Change Request

Adapted from Wideman, M (2003), Change Request is a form to log, assess and agree on, before a change to the project could be made. The changes could have effects on the quality, scope, time, cost and/or other planned aspects of the project. 2% of the respondents don't use this tool in the practice, 2% of the respondents use it quite rarely, 8% of the respondents have limited use to it, 19% of the respondents use it extensively and 69% of the respondents have very extensive use to it. And none of the respondents thinks that it is not applicable to the practice. The average usage of Change Request is 3.49.

• Requirement Analysis

An analysis of customer wants and needs, 6% of the respondents don't use this tool in the practice, 2% of the respondents use it quite rarely, 8% of the respondents have limited use to it, 22% of the respondents use it extensively and 60% of the respondents have very extensive use to it. And 2% of the respondents think that it is not applicable to the practice. The average usage of Requirement Analysis is 3.24.

• Work Breakdown Structure

According to PMBOK Guide (2008), Work Breakdown Structure is a deliverable-oriented grouping of project elements which organizes and defines the total work scope of the project and each descending level of decomposition provides a more detailed definition of the project work. 10% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 22% of the respondents use it extensively and 30% of the respondents have very extensive use to it. Whereas 7% of the respondents think that this tool is not applicable. The average usage of Work Breakdown Structure is 2.37.

• Statement of Work

Statement of Work is a description of the work to be done. 8% of the respondents don't use this tool in the practice, 10% of the respondents use it quite rarely, 17% of the respondents have limited use to it, 25% of the respondents use it extensively and 36% of the respondents have very extensive use to it. Meanwhile, 4% of the respondents think that this tool is not applicable. The average usage of Statement of Work is 2.62.

• Activity List

Activity List includes all activities that will be performed on the project and it serves as an extension to the WBS in order to help guarantee its completeness. 6% of the respondents don't use this tool in the practice, 8% of the respondents use it quite rarely, 16% of the respondents have limited use to it, 26% of the respondents use it extensively and 45% of the respondents have very extensive use to it. Besides, none of the respondents thinks that this tool is not applicable. The average usage of Activity List is 2.97.

• Baseline Plan

The Baseline Plan is the plan approved initially and following discrepancies will be compared to it as the project goes on. 30% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 17% of the respondents have limited use to it, 12% of the respondents use it extensively and 11% of the respondents have very extensive use to it. Besides, 6% of the respondents think that this tool is not applicable. The average usage of Baseline Plan is 1.39.

- Re-baselining

Re-baselining is a revised baseline plan which is required when changes like contract requirements changes, funding changes, etc., happen. Justification and proper approvals should be needed when undertaking Re-baselining. 38% of the respondents don't use this tool in the practice, 21% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 11% of the respondents use it extensively and 11% of the respondents have very extensive use to it. Besides, 4% of the respondents think that this tool is not applicable. The average usage of Re-baselining is 1.27.

- Product Breakdown Structure

Product Breakdown Structure is the decomposition of the deliverable into the components of the final product. 63% of the respondents don't use this tool in the practice, 20% of the respondents use it quite rarely, 8% of the respondents have limited use to it, 4% of the respondents use it extensively and 4% of the respondents have very extensive use to it. Besides, none of the respondents thinks that this tool is not applicable. The average usage of Product Breakdown Structure is 0.67.

- Value Analysis

According to Wideman, M (2003), Value Analysis is an activity which devotes to optimize cost performance. It enables the identification of the required functions of an item, the establishment of values for those functions and helps to provide the functions at the lowest overall cost without bringing down the level of performance. 65% of the respondents don't use this tool in the practice, 17% of the respondents use it quite rarely, 4% of the respondents have limited use to it, 7% of the respondents use it extensively and 7% of the respondents have very extensive use to it. Besides, none of the respondents thinks that this tool is not applicable. The average usage of Value Analysis is 0.73.

• PM Software for Task Scheduling

PM Software for Task Scheduling is the use of project management software for task scheduling. 12% of the respondents don't use this tool in the practice, 7% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 2% of the respondents use it extensively and 73% of the respondents have very extensive use to it. Besides, nobody thinks that this tool is not applicable. The average usage is 3.17.

• Gantt Chart

Gantt chart is a graphic display of schedule-related information. Activities or other project elements are enumerated, dates are shown across the top and activity durations are presented as date-placed horizontal bars (PMBOK Guide, 2008). 3% of the respondents don't use this tool in the practice, 9% of the respondents use it quite rarely, 9% of the respondents have limited use to it, 2% of the respondents use it extensively and 76% of the respondents have very extensive use to it. Similarly, nobody thinks that this tool is not applicable. The average usage is 3.39.

• Milestone Planning

According to PMBOK Guide (2008), Milestone Planning is a summary-level schedule which is usually used for the completion of a major deliverable. It identifies the major milestones which are the significant events in the project. 10% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 22% of the respondents use it extensively and 30% of the respondents have very extensive use to it. At the same time, 7% of the respondents think that this tool is not applicable. The average usage is 2.37.

• PM Software for Monitoring of Schedule

PM Software for Monitoring of Schedule is the use of project management software to monitor schedule. 4% of the respondents don't use this tool in the practice, 7% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 26% of the respondents use it extensively and 49% of the respondents have very extensive use to it. None of the respondents thinks that this tool is not applicable. The average usage is 3.09.

• Critical Path Method & Analysis

Critical Path Method & Analysis is a network analysis technique which is used to predict project duration by studying which sequence of activities (which path) has the least level of scheduling flexibility (PMBOK Guide, 2008). 19% of the respondents don't use this tool in the practice, 19% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 18% of the respondents use it extensively and 18% of the respondents have very extensive use to it. 7% of the respondents think that this tool is not applicable. The average usage is 1.83.

• Network Diagram

Network Diagram includes any schematic display of the logical relationships of project activities. It is often referred to as a PERT or PDM or CPM chart (PMBOK Guide, 2008). 30% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 17% of the respondents have limited use to it, 12% of the respondents use it extensively and 11% of the respondents have very extensive use to it. 6% of the respondents think that this tool is not applicable. The average usage is 1.39.

• PM Software for Multi-project Scheduling/Leveling

PM Software for Multi-project Scheduling/Leveling is the use of project management software for scheduling and leveling on multiple projects. 36% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 11% of the respondents use it extensively and 11% of the respondents have very extensive use to it. 6% of the respondents think that this tool is not applicable. The average usage is 1.28.

• Learning Curve

According to PMBOK Guide (2008), Learning Curve is a concept that recognizes the fact that productivity of workers gets improved when they become familiar with the sequence of activities involved in the production process. 61% of the respondents don't use this tool in the practice, 11% of the respondents use it quite rarely, 7% of the respondents have limited use to it, 10% of the respondents use it extensively and 10% of the respondents have very extensive use to it. 1% of the respondents think that this tool is not applicable. The average usage is 0.96.

• Critical Chain Method & Analysis

Critical Chain Method & Analysis is the analysis of the task network in order to determine the longest path and the management of that path under the constraints of tasks and resources. 67% of the respondents don't use this tool in the practice, 15% of the respondents use it quite rarely, 3% of the respondents have limited use to it, 8% of the respondents use it extensively and 7% of the respondents have very extensive use to it. However, none of the respondents thinks that this tool is not applicable. The average usage is 0.72.

- Progress Report

Adapted from Wideman, M (2003), Progress Report is the report on the partial completion of a project and the act of inputting progress information for a project as well. 4% of the respondents don't use this tool in the practice, 4% of the respondents use it quite rarely, 4% of the respondents have limited use to it, 7% of the respondents use it extensively and 80% of the respondents have very extensive use to it. Similarly, none of the respondents thinks that this tool is not applicable. The average usage is 3.53.

- Kick-off Meeting

According to Wideman M. (2003), Kick-off Meeting is a workshop type meeting which enables the principle stakeholders and participants in the project to understand the goals and objectives of the project and how the project will be organized, etc. briefly. 20% of the respondents don't use this tool in the practice, 20% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 17% of the respondents use it extensively and 17% of the respondents have very extensive use to it. However, 7% of the respondents think that this tool is not applicable. The average usage is 1.76.

- Communication Plan

Communication Plan is a project stakeholders' communication and information needs statement (Wideman, M, 2003). 51% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 7% of the respondents use it extensively and 7% of the respondents have very extensive use to it. However, 2% of the respondents think that this tool is not applicable. The average usage is 0.92.

• Work Authorization

Work Authorization is a form to authorize work, which is made before the work is performed on the project. 15% of the respondents don't use this tool in the practice, 17% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 20% of the respondents use it extensively and 22% of the respondents have very extensive use to it. However, 7% of the respondents think that this tool is not applicable. The average usage is 2.06.

• Project Communication Room (war room)

According to Wideman, M (2003), Project Communication Room (war room) is a central location where vital project information is available for all. 30% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 17% of the respondents have limited use to it, 12% of the respondents use it extensively and 11% of the respondents have very extensive use to it. Whereas, 6% of the respondents think that this tool is not applicable. The average usage is 1.39.

• Project Website

Project Website is to make the information concerning the project available on a website. 46% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 8% of the respondents use it extensively and 8% of the respondents have very extensive use to it. Whereas, 3% of the respondents think that this tool is not applicable. The average usage is 1.01.

- Earned Value

Earned Value is a measure of the value of work performed by using original estimates and progress-to-date to reflect whether the actual costs incurred are within budget and whether the tasks are on track compared with the baseline plan. 54% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 9% of the respondents have limited use to it, 7% of the respondents use it extensively and 7% of the respondents have very extensive use to it. And 1% of the respondents think that this tool is not applicable. The average usage is 0.88.

- Trend Chart or S-curve

Trend Chart or S-curve is a graphic display which plots cumulative costs, labor hours, percentage of work or other quantities against time (PMBOK Guide, 2008). 65% of the respondents don't use this tool in the practice, 17% of the respondents use it quite rarely, 4% of the respondents have limited use to it, 7% of the respondents use it extensively and 7% of the respondents have very extensive use to it. Whereas, none of the respondents thinks that this tool is not applicable. The average usage is 0.73.

- Lesson Learned/Post-mortem

Lesson Learned/Post-mortem is a tool to learn from the process of performing the project, which is also considered as a project record (PMBOK Guide, 2008). 22% of the respondents don't use this tool in the practice, 21% of the respondents use it quite rarely, 20% of the respondents have limited use to it, 16% of the respondents use it extensively and 15% of the respondents have very extensive use to it. Whereas, 6% of the respondents think that this tool is not applicable. The average usage is 1.67.

• Customer Satisfaction Surveys

Customer Satisfaction Surveys are used to measure customer satisfaction. 20% of the respondents don't use this tool in the practice, 20% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 17% of the respondents use it extensively and 17% of the respondents have very extensive use to it. Whereas, 7% of the respondents think that this tool is not applicable. The average usage is 1.76.

• Database of Historical Data

Database of Historical Data is an organized collection of historical data. 51% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 7% of the respondents use it extensively and 7% of the respondents have very extensive use to it. And 2% of the respondents think that this tool is not applicable. The average usage is 0.92.

• Database of Lessons Learned

Database of Lessons Learned is an organized body of information on lessons learned, which aims to improve future performance. 53% of the respondents don't use this tool in the practice, 21% of the respondents use it quite rarely, 7% of the respondents have limited use to it, 10% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 1.01.

• Client Acceptance Form

Client Acceptance Form is a form which the signature of the person or organization for whom a project is implemented is need. 22% of the respondents don't use this tool in the practice, 21% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 17% of the respondents use it extensively and 15% of the respondents have very extensive use to it. And 6% of the respondents think that this tool is not applicable. The average usage is 1.69.

• Quality Inspection

Quality Inspection is to inspect and determine whether a deliverable or product meets the specified quality criteria (Wideman, M, 2003). 13% of the respondents don't use this tool in the practice, 17% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 20% of the respondents use it extensively and 22% of the respondents have very extensive use to it. And 8% of the respondents think that this tool is not applicable. The average usage is 2.06.

• Quality Plan

Quality Plan is a document which stipulates the specific quality practices, resources and sequence of activities pertinent to a particular product, service, contract or project. 16% of the respondents don't use this tool in the practice, 19% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 19% of the respondents use it extensively and 19% of the respondents have very extensive use to it. And 8% of the respondents think that this tool is not applicable. The average usage is 1.91.

• Control Charts

According to PMBOK Guide (2008), Control Charts are graphic displays of the results, process and over time against existed control limits in order to decide whether the process is "in control" or not. 61% of the respondents don't use this tool in the practice, 13% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 18% of the respondents use it extensively and 6% of the respondents have very extensive use to it. However, none of the respondents thinks that this tool is not applicable. The average usage is 0.94.

• Cause and Effect Diagram

Cause and Effect Diagram shows how diversified factors might be connected to potential problems or effects, which is also called Ishikawa diagrams or fishbone diagrams (PMBOK Guide, 2008). 74% of the respondents don't use this tool in the practice, 11% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 7% of the respondents use it extensively and 2% of the respondents have very extensive use to it. Similarly, none of the respondents think that this tool is not applicable. The average usage is 0.52.

• Pareto Diagram

According to PMBOK Guide (2008), Pareto Diagram is a histogram, ordered by frequency of occurrence, which aims to display how many results are generated by each identified cause. 79% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 4% of the respondents use it extensively and 2% of the respondents have very extensive use to it. None of the respondents thinks that this tool is not applicable. The average usage is 0.39.

• Project Charter

Project Charter is a document consisting of a mission statement, with the inclusion of background, purpose, benefits, goal, objectives, scope, assumptions and constraints. 4% of the respondents don't use this tool in the practice, 7% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 26% of the respondents use it extensively and 49% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 3.09.

• Responsibility Assignment Matrix

Responsibility Assignment Matrix is a structure which links the project organization structure to the work breakdown structure, thus helping guarantee that each element of the project's scope of work is designated to a responsible person (PMBOK Guide, 2008). 9% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 25% of the respondents use it extensively and 31% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 2.48.

• Financial Measurement Tools

Financial Measurement Tools are the tools helping to evaluate the financial performance of project, such as ROI, NPV, etc. 10% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 22% of the respondents use it extensively and 30% of the respondents have very extensive use to it. And 7% of the respondents think that this tool is not applicable. The average usage is 2.37.

• Feasibility Study

Adapted from PMBOK Guide (2008), Feasibility Study refers to the application of technical and cost data examining methods and techniques to determine the economic potential and the practicality of project applications. 16% of the respondents don't use this tool in the practice, 17% of the respondents use it quite rarely, 19% of the respondents have limited use to it, 20% of the respondents use it extensively and 21% of the respondents have very extensive use to it. And 7% of the respondents think that this tool is not applicable. The average usage is 2.01.

• Configuration Review

Configuration Review is a check to guarantee that all deliverable items on a project are consistent with one another and satisfy the current specifications. 46% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 8% of the respondents use it extensively and 8% of the respondents have very extensive use to it. And 3% of the respondents think that this tool is not applicable. The average usage is 1.01.

• Stakeholders Analysis

According to PMBOK Guide (2008), Stakeholders Analysis is a tool to help identify stakeholders and analyze stakeholders' needs. 53% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 9% of the respondents have limited use to it, 12% of the respondents use it extensively and 11% of the respondents have very extensive use to it. And 2% of the respondents think that this tool is not applicable. The average usage is 1.12.

• Quality Function Deployment

As adapted from Wideman, M (2003), Quality Function Deployment is a method to transfer customer needs into product/service technical requirements for product design, development, implementation and delivery. 60% of the respondents don't use this tool in the practice, 18% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 13% of the respondents use it extensively and 3% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.83.

• PM Software for Resource Scheduling

PM Software for Resource Scheduling is the use of project management software for resources scheduling. 10% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 22% of the respondents use it extensively and 30% of the respondents have very extensive use to it. And 7% of the respondents think that this tool is not applicable. The average usage is 2.37.

• Team Member Performance Appraisal

As adapted from Wideman, M (2003), Team Member Performance Appraisal is a technique to evaluate project team members' performance. The tool can help with the process by which the project team members receive recognition for their accomplishments. 2% of the respondents don't use this tool in the practice, 7% of the respondents use it quite rarely, 12% of the respondents have limited use to it, 27% of the respondents use it extensively and 52% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 3.19.

• Team Building Event

As adapted from PMBOK Guide (2008), Team Building Event is an event organized to motivate a group of people with diverse goals, needs and perspectives to work together more effectively. 10% of the respondents don't use this tool in the practice, 13% of the respondents use it quite rarely, 17% of the respondents have limited use to it, 24% of the respondents use it extensively and 29% of the respondents have very extensive use to it. And 7% of the respondents think that this tool is not applicable. The average usage is 2.35.

• Self-directed Work Teams

According to Wideman, M (2003), Self-directed Work Teams refer to teams which are made up of highly motivated and capable members. The members are not only knowledgeable of the project objectives, but also able to work with minimal management supervision. 64% of the respondents don't use this tool in the practice, 2% of the respondents use it quite rarely, 12% of the respondents have limited use to it, 9% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And 3% of the respondents think that this tool is not applicable. The average usage is 0.9.

• PM Software for Resources Leveling

PM Software for Resources Leveling is the use of project management software for resources leveling. 46% of the respondents don't use this tool in the practice, 24% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 8% of the respondents use it extensively and 8% of the respondents have very extensive use to it. And 3% of the respondents think that this tool is not applicable. The average usage is 1.01.

• Top-down Estimating

Top-down Estimating is a way of cost estimate by giving an overall total amount of cost based on one's judgment and experience (Wideman, M, 2003). 57% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 11% of the respondents have limited use to it, 8% of the respondents use it extensively and 8% of the respondents have very extensive use to it. And 3% of the respondents think that this tool is not applicable. The average usage is 0.90.

• Cost/Benefit Analysis

According to Wideman, M (2003), Cost/Benefit Analysis is the analysis of the potential costs and benefits of a project, thus making it possible to compare the returns from alternative forms of investment. 11% of the respondents don't use this tool in the practice, 13% of the respondents use it quite rarely, 18% of the respondents have limited use to it, 24% of the respondents use it extensively and 28% of the respondents have very extensive use to it. And 6% of the respondents think that this tool is not applicable. The average usage is 2.33.

• Bottom-up Estimating

Bottom-up Estimating is a technique of cost estimate which starts from estimating the cost of individual activities or work packages, then rolls up the individual estimates to get the total cost (PMBOK Guide, 2008). 45% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 12% of the respondents have limited use to it, 9% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And 2% of the respondents think that this tool is not applicable. The average usage is 1.10.

- PM Software for Monitoring of Cost

PM Software for Monitoring of Cost is the application of project management software for monitoring of cost. 35% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 16% of the respondents have limited use to it, 9% of the respondents use it extensively and 12% of the respondents have very extensive use to it. And 6% of the respondents think that this tool is not applicable. The average usage is 1.30.

- PM Software for Cost Estimating

PM Software for Cost Estimating is the use of project management software for cost estimating. 49% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 10% of the respondents have limited use to it, 9% of the respondents use it extensively and 16% of the respondents have very extensive use to it. And 3% of the respondents think that this tool is not applicable. The average usage is 1.22.

- Database for Cost Estimating

Database for Cost Estimating is an organized collection of cost estimating related information. 70% of the respondents don't use this tool in the practice, 9% of the respondents use it quite rarely, 3% of the respondents have limited use to it, 12% of the respondents use it extensively and 6% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.75.

• Parametric Estimating

According to PMBOK Guide (2008), Parametric Estimating is an estimating technique which helps to calculate an estimate by using a statistical relationship between historical data and other variables. 79% of the respondents don't use this tool in the practice, 6% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 10% of the respondents use it extensively and 3% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.54.

• Life Cycle Cost ("LCC")

According to Wideman, M (2003), Life Cycle Cost ("LCC") is the total cost of a system or a facility over its whole life, with the inclusion of development cost, acquisition cost, operation cost, etc. 63% of the respondents don't use this tool in the practice, 15% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 13% of the respondents use it extensively and 3% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.80.

• Risk Management Documents

Risk Management Documents are documents in which diversified information concerning risk identification or risk mitigation measure, etc. is recorded. 36% of the respondents don't use this tool in the practice, 21% of the respondents use it quite rarely, 15% of the respondents have limited use to it, 11% of the respondents use it extensively and 11% of the respondents have very extensive use to it. And 6% of the respondents think that this tool is not applicable. The average usage is 1.29.

• Contingency Plans

Contingency Plans is a plan that provides alternative strategies to be used to guarantee project success in case that specified risk events occur (PMBOK Guide, 2008). 43% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 12% of the respondents have limited use to it, 9% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 1.10.

• Ranking of Risks

Ranking of Risks, which can be used to assign resources to projects, make cost-benefit analysis, etc., provides the overall risk position via comparing the risk scores (PMBOK Guide, 2008). 15% of the respondents don't use this tool in the practice, 18% of the respondents use it quite rarely, 20% of the respondents have limited use to it, 20% of the respondents use it extensively and 20% of the respondents have very extensive use to it. And 7% of the respondents think that this tool is not applicable. The average usage is 2.00.

• Graphic Presentation of Risk Information

Graphic Presentation of Risk Information indicates the graphical methods that help to present risk information. 39% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 10% of the respondents use it extensively and 10% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 1.20.

• Probabilistic Duration Estimate (PERT Analysis)

Probabilistic Duration Estimate (PERT Analysis) is a method that makes use of durations calculated by a weighted average of optimistic, pessimistic and most possible duration estimates (PMBOK Guide, 2008). 74% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 8% of the respondents have limited use to it, 3% of the respondents use it extensively and 2% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.47.

• Database of Risks

Database of Risks is an organized body of risks information. 69% of the respondents don't use this tool in the practice, 8% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 9% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.82.

• Decision Tree

Decision Tree is a diagram which describes the implications of the alternatives by rolling up probabilities or risks and the costs or returns of each logical path of events and future decisions (PMBOK Guide, 2008). 80% of the respondents don't use this tool in the practice, 6% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 9% of the respondents use it extensively and 3% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.51.

• PM Software for Simulation

PM Software for Simulation is the use of project management software to help develop alternative schedules, stimulate risk events, etc. 73% of the respondents don't use this tool in the practice, 6% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 9% of the respondents use it extensively and 10% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.78.

• Monte-Carlo Analysis

Monte-Carlo Analysis is a technique which calculates a distribution of likely results by performing many times of project simulation (PMBOK Guide, 2008). 81% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 2% of the respondents have limited use to it, 2% of the respondents use it extensively and 2% of the respondents have very extensive use to it. And none of the respondents thinks that this tool is not applicable. The average usage is 0.33.

• Bid Documents

According to PMBOK Guide (2008), Bid Documents, which is used in the process of acquisition, is a set of documents issued to solicit bids. 38% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 13% of the respondents have limited use to it, 3% of the respondents use it extensively and 18% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 1.31.

• Bid/Seller Evaluation

As adapted from Widerman, M (2003), Bid/Seller Evaluation is a formal review and analysis of response, which aims to measure supplier's ability to perform the work as required. 39% of the respondents don't use this tool in the practice, 22% of the respondents use it quite rarely, 12% of the respondents have limited use to it, 16% of the respondents use it extensively and 6% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 1.17.

• Bidders Conferences

According to PMBOK Guide (2008), Bidders Conferences are the meetings with sellers, which are held before preparing a proposal. It helps to ensure all future sellers' clear and common understanding of the procurement. 48% of the respondents don't use this tool in the practice, 12% of the respondents use it quite rarely, 10% of the respondents have limited use to it, 12% of the respondents use it extensively and 12% of the respondents have very extensive use to it. And 4% of the respondents think that this tool is not applicable. The average usage is 1.19.

• Database or Spreadsheet of Contractual Commitment Data

Database or Spreadsheet of Contractual Commitment Data is an organized collection of information on all obligations which specify the requirements for the actions of project participants, payment of goods, etc. 66% of the respondents don't use this tool in the practice, 8% of the respondents use it quite rarely, 6% of the respondents have limited use to it, 9% of the respondents use it extensively and 9% of the respondents have very extensive use to it. And 2% of the respondents think that this tool is not applicable. The average usage is 0.82.

Furthermore, the 70 tools are ranked by decreasing order of average use in order to make further analysis. The results are presented in Table 6, in which the 5-point Likert scale used in the survey has been reduced to three categories (From Limited to Extensive Use, From Very Limited to Limited Use and Less than Limited Use) in order to simplify presentation.

From Limited to Extensive Use		From Very Limited to Limited Use		Less than Very Limited Use	
Tools	**Category**	**Tools**	**Category**	**Tools**	**Category**
Progress Report	Communication	Ranking of Risks	Risk	Learning Curve	Time
Change Request	Scope	Quality Plan	Quality	Control Charts	Quality
Gantt chart	Time	Critical Path Method & Analysis	Time	Database of Historical Data	Learning
Requirements Analysis	Scope	Customer Satisfaction Surveys	Learning	Communication Plan	Communication
Scope Statement	Scope	Kick-off Meeting	Communication	Top-down Estimating	Cost
Team Member Performance Appraisal	HR	Client Acceptance Form	Quality	Self-directed Work Teams	HR
PM Software for Task Scheduling	Time	Lesson Learned/ Post-mortem	Learning	Earned Value	Communication
Project Charter	Integration	Project Communication Room (war room)	Communication	Quality Function Deployment	Integration
PM Software for Monitoring of Schedule	Time	Network Diagram	Time	Database or Spreadsheet of Contractual Commitment Data	Procurement
Activity List	Scope	Baseline Plan	Scope	Database of risks	Risk
Statement of Work	Scope	Bid Documents	Procurement	Life Cycle Cost (LCC)	Cost
Responsibility Assignment Matrix	Integration	PM Software for Monitoring of cost	Cost	PM Software for Simulation	Risk
PM Software for Resource Scheduling	HR	Risk Management Documents	Risk	Database for Cost Estimating	Cost

Financial Measurement Tools	Integration	PM Software for Multi-project Scheduling/ Leveling	Time	Trend Chart or S-curve	Communication
Milestone Planning	Time	Re-Baselining	Scope	Value Analysis	Scope
Work Breakdown Structure	Scope	PM Software for Cost estimating	Cost	Critical Chain Method & Analysis	Time
Team Building Event	HR	Graphic Presentation of Risk Information	Risk	Product Breakdown Structure	Scope
Cost/Benefit Analysis	Cost	Bidders Conferences	Procurement	Parametric Estimating	Cost
Quality Inspection	Quality	Bid/Seller Evaluation	Procurement	Cause and Effect Diagram	Quality
Work Authorization	Communication	Stakeholders Analysis	Integration	Decision Tree	Risk
Feasibility Study	Integration	Contingency Plans	Risk	Probabilistic Duration Estimate (PERT Analysis)	Risk
		Bottom-up Estimating	Cost	Pareto Diagram	Quality
		PM Software for Resources Leveling	HR	Monte-Carlo Analysis	Risk
		Configuration Review	Integration		
		Database of Lessons Learned	Learning		
		Project Website	Communication		

Table 6: The 70 Tools Ranked by Decreasing Order of Average Use

According to Table 6, the tool that has the most extensive use is Progress Report, which is in the knowledge Area of Communication. The Knowledge Area of Scope includes the most tools with extensive use and the knowledge areas of Time and Integration have many tools with extensive use too. The project management toolbox seems to be better adapted to knowledge areas of scope, time and integration. It is not surprising to find

out that the tools which locate in the area of "From Limited to Extensive Use" are all very well-known and widely used tools, like Progress Report, Change Request, Requirement Analysis, etc. This finding speaks in favor of Proposition 1A, that is, the most used project management tools and techniques in China are the best known.

The middle part of Table 6 includes a long list of tools with neither very high use nor very low use. After analysis, we find that these tools don't gather in any certain Knowledge Area and are quite dispersed. Ranked after the Knowledge Area of Risk which has 4 tools included in this part, the Knowledge Area of Time has 3 tools contained, which is the same case for the Knowledge Areas of Communication, Learning, Cost and Procurement. And the Knowledge Areas of Scope, Quality and Integration have one less tool included as well.

In the columns of Table 6 where tools with the least use level are presented, the knowledge areas of Risk and Cost have the most tools included, which have 5 tools and 4 tools respectively. Besides, the knowledge areas of Communication and Quality just fall behind, both of which have 3 tools contained. Furthermore, Monte-Carlo, which belongs to the Knowledge Area of Risk, is found to be the least used tool among the 70 tools investigated.

5.1.1.3. The Usage of Computerized Project Management Tools and Techniques

After gaining a general idea of tools usage in China, we now focus on the usage of computerized tools. Since computerized project management tools and techniques are among the many found in the project management toolbox and play an indispensable role in the practice, we include them in our investigation as can be seen in the tool list of Table 5. Instead of studying specific software products, we use a more generic method by

identifying eight functionalities often served by project management software. The use of computerized project management tools and techniques varies greatly.

Based on the ranking of Table 6, we can find that PM Software for Task Scheduling is the seventh most extensively used tool. Two other computerized tools: PM Software for Monitoring of Schedule and PM Software for Resource Scheduling are also among the most frequently used ones. In fact, two of the most frequent usages are included in the Knowledge Area of Timing. However, the usage of the eight computerized project management tools and techniques are not equal. On contrary with the three ones having the highest use levels, PM Software for Simulation, for example, is among the ones that have least usage.

Previous studies have stated that the early stage of development has impeded the application of project management tools and techniques in China. And although some best known project management tools like Grant chart, PERT and CPM were brought in China in the early 60s, it is the computerized project management tools and techniques (project management software) that dominate the tools used in China. To be more specific, it was confirmed that the application of project management software accounts for 80% of the usage of project management tools. However, it is not the fact in the real world. According to our findings, as is shown in Table 6, computerized project management tools and techniques only accounts for 14.29% of the tools with most frequent use, which is much lower than 80%. Many non-computerized tools like Progress Report, Change Request, Gantt chart, etc. are also used widely in China and have even higher use level. Therefore, we can hardly declare that computerized project management tools and techniques dominate in China. Certainly, the popularity of computerized project management tools and techniques can't be denied, as 7 out of 8 of computerized tools have more than limited use. In short, the findings are clearly not congruent with previous studies on Chinese tools usage

and Proposition 1B, that is, computerized project management tools and techniques dominate the project management tools and techniques used in China. The facts indicate that computerized tools and techniques do receive high popularity in China, but some non-computerized tools are widely accepted and used as well. Furthermore, the usage of computerized tools and techniques are not equal either.

5.1.2. Potentiality of Project Management Tools and Techniques

As we have mentioned before, the respondents are required not only to evaluate their actual use of tools but also to give opinions on tools' potential for additional contribution to performance. The top ten tools with the highest potential and the least potential are provided in Table 7.

Top ten with the highest potential		Top ten with the least potential	
Tools	**Category**	**Tools**	**Category**
PM Software for Task Scheduling	Time	Bid Documents	Procurement
Learning Curve	Time	Bidders Conferences	Procurement
Progress Report	Communication	Database or Spreadsheet of Contractual Commitment Data	Procurement
PM Software for Monitoring of Schedule	Time	Network Diagram	Time
Database for Cost Estimating	Cost	Critical Chain Method & Analysis	Time
PM Software for Cost estimating	Cost	Cause and Effect Diagram	Quality
Database of risks	Risk	Probabilistic Duration Estimate (PERT Analysis)	Risk
Work Breakdown Structure	Scope	Decision Tree	Risk
Database of Historical Data	Learning	Pareto Diagram	Quality
Feasibility Study	Integration	Monte-Carlo Analysis	Risk

Table 7: The Top Ten Tools with the Highest Potential and the Least Potential (Ranked in Decreasing Order of Scores)

Table 7 shows that the Time Knowledge Area contains 3 tools with the highest potential to contribute to improved project performance, which are PM Software for Task Scheduling, Learning Curve and PM Software for Monitoring of Schedule. While, at the same time, 2 tools of Time Knowledge Area are listed in the top 10 of least potential. Besides, the Knowledge Area of Cost has 2 tools included in the tools with highest potential. The facts may indicate that the Knowledge Areas of Time and Cost are considered to be areas where further improvement and development in practice are needed. With respect to the tools of least potential, both Knowledge Areas of Risk and Procurement have 3 tools contained. Furthermore, according to Table 6, more than 50% of the tools in Risk Knowledge Area are listed in the section of "Less than Very Limited Use", which indicates that the risk management tools investigated don't work well in China and more tools development is needed in this area. While, regarding Procurement Knowledge Area, the situation is a bit more complicated. It is clear that the bidding process is not applicable in all project contexts, thus making the bidding tools not applicable all the time. Since the projects we studied are of various characteristics, it is hard to make the same statement as what we have done for the Risk Knowledge Area.

Besides, it is coincident to find that the five tools: Monte-Carlo Analysis, Pareto Diagram Decision Tree, Probabilistic Duration Estimate (PERT Analysis) and Cause and Effect Diagram, which stay at the bottom of the ranking table (Table 6), take also last 5 places in Table 7.

5.2. Relationships among Variables

In the following sections, the influence of different factors on the usage of tools will be examined. A relationship might exist between the variables, thus we checked it by using Chi-square statistics. The result of Chi-square statistics show that the relationships between

maturity level and project size (0.32990) and the relationships between education level and work experience (0.54596) are slightly stronger than the relationships between any other independent variables. However, though the two relationships are statistically significant, they are relatively weak and unimportant, since the relationships are not found in each individual situation. Therefore, it is assumed that the relationships between the variables are not noteworthy and the influences of different variables reported here are independent of each other.

5.3. Usage of Project Management Tools and Techniques in Different Context

Based on the analysis made above, in this section, efforts will be made on the examination of the usage of project management tools and techniques in different context. The two main contextual variables studied here are the organizational maturity and project size.

5.3.1. Organizational Maturity

Organizational Maturity in this study is measured on a scale similar to the Engineering Institutes Capability Maturity Model (CMM), based on which the respondents were required to rate the level of maturity of their organization.

According to our survey result, 11.23% of the respondents rated their organizational maturity in the initial level; 42.7% of the respondents thought their organizational maturity was in the repeatable level; 25.84% of the respondents put it in the defined level; 14.61% of the respondents ranked it in the managed level and the rest 5.62% of the respondents put their organizational maturity in the optimizing level which is the highest level in the scale. The percentage for each level of organizational maturity is presented in Figure 2.

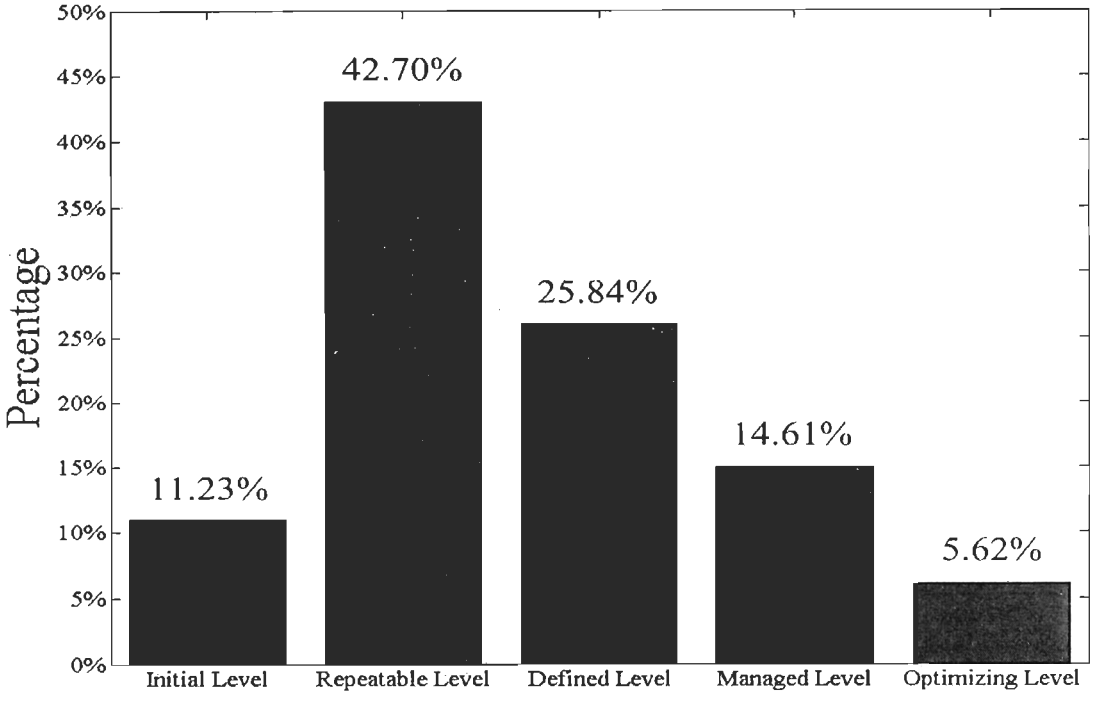
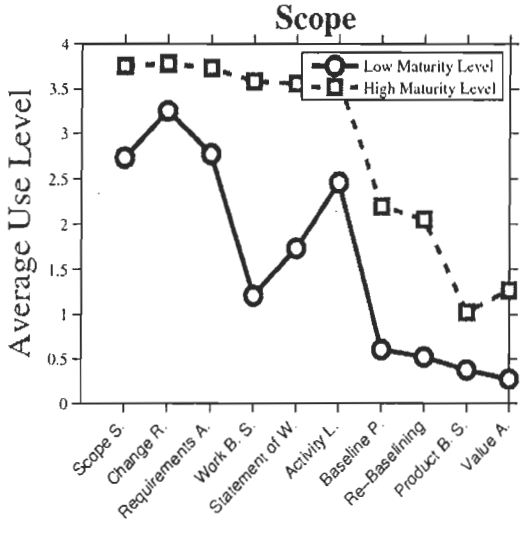


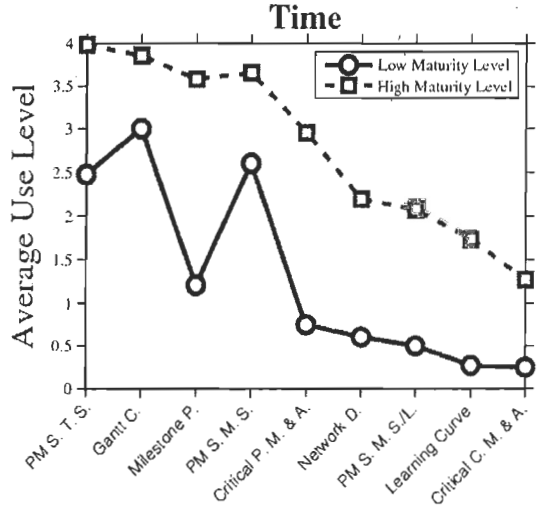
Figure 2: The Level of Organizational Maturity

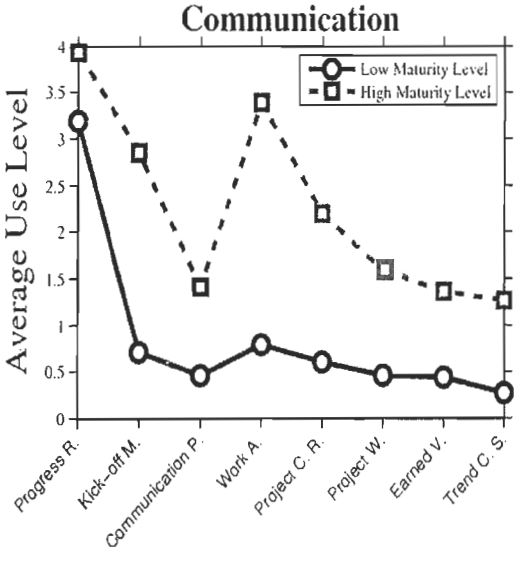
The respondents were classified into two groups with those reporting Initial Level and Repeatable Level combined and those reporting the rest three levels combined. Therefore, the sample was divided into two almost equal groups (53.93% and 46.07%). Then, the method of t-test was applied to these two groups in order to verify the significance of the contextual factor (organizational maturity) and the differences in the average use levels.

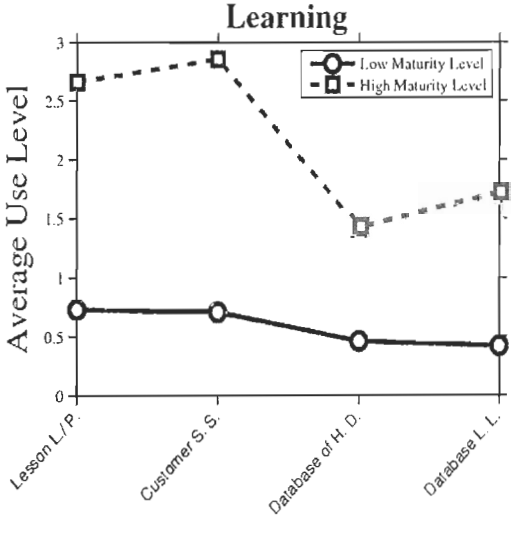
The results of t-test show that, for 64 tools, the level of statistical significance is p <0.0001; for 6 tools, the level is between p=0.00467 and p=0.0500. Since all statistical significance levels are p<0.0500, we can confirm that the contextual factor (organizational maturity) is significant and statistically significant differences exist between the two groups of average use levels and for all the tools. Differences between the two groups of average use levels are further displayed category by category in the following charts of Figure 3

(tools of each category are arranged in the same way as Table 5 and abridged for concision).









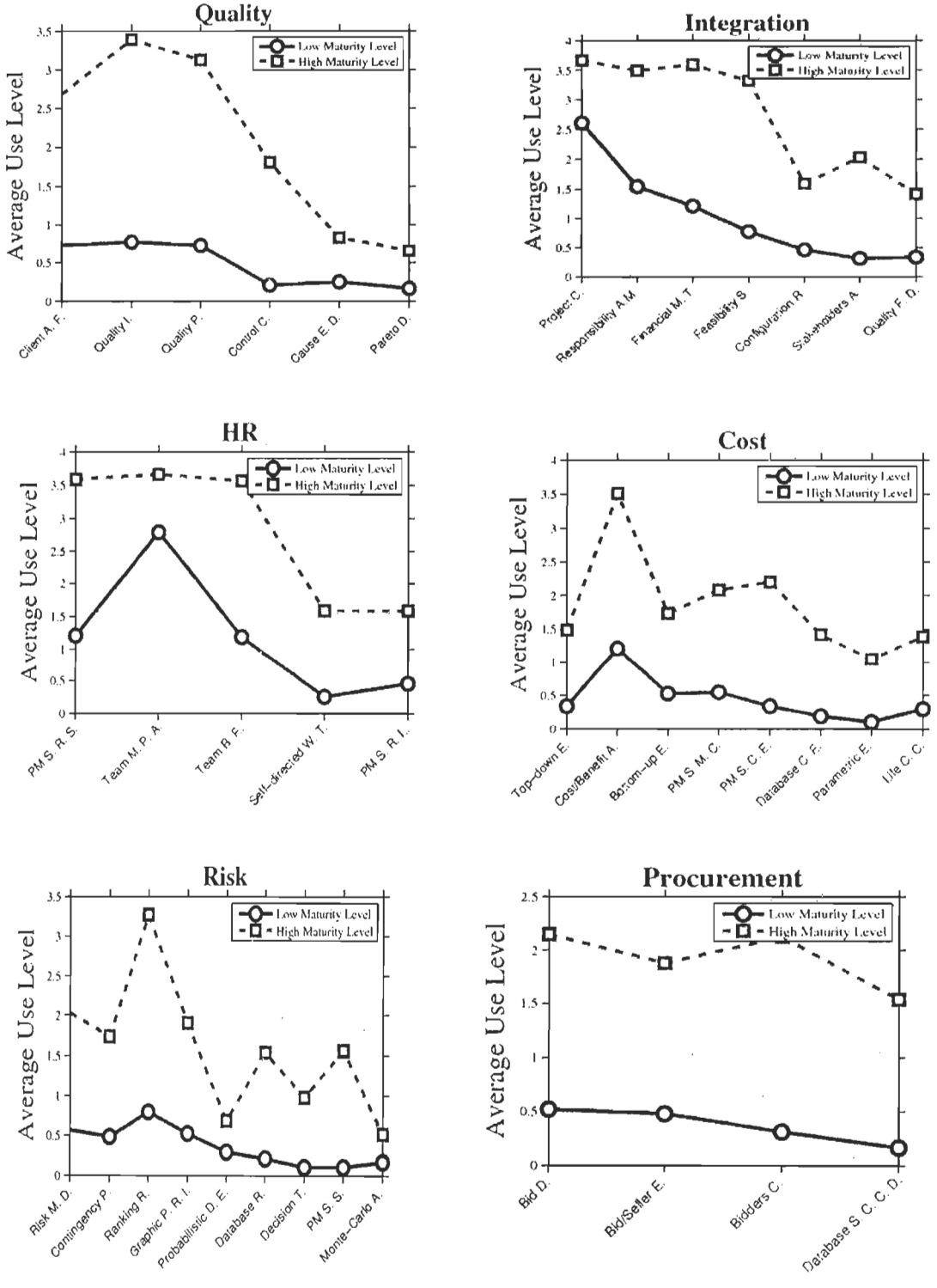


Figure 3: Average Tools and Techniques Use Levels in High and Low Maturity Organizations by Knowledge Area

From the series of charts of Figure 3, we can see that the usage of project management tools and techniques varies in organizations of different maturity levels. Besides, the green dotted line is always above the red solid line, which means that all tools are used more often in organizations with higher maturity level than in organizations with lower maturity level. Our finding as suggested by our Proposition 2A is that the level of maturity of project management systems exerts influence on the usage of project management tools and techniques in China. To be more specific, all tools have higher use levels in organizations with higher maturity level.

5.3.2. Project Size

Apart from Organizational Maturity, Project Size is the second contextual variable whose influence on tools and techniques usage is interested in. In order to measure size, dollar value was used as a metric. Detailed project size information is provided in Figure 4.

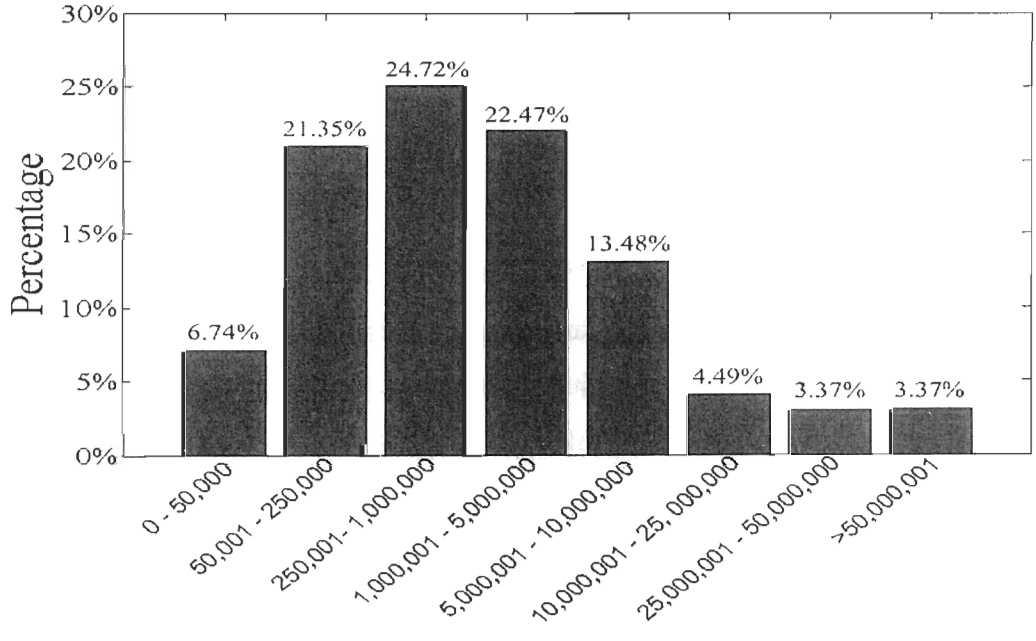


Figure 4: Typical Value (in US $) of the Projects Investigated

According to Figure 4, 6.74% of the respondents work on or manage projects less than $50,000; 21.35% of the respondents participate in projects between $50,001and $250,000; 24.72% involve in projects between $250,001 and $1,000,000; 22.47% work on projects between $1,000,001 and $5,000,000; 13.48% involve in projects between $5,000,001 and $10,000,000; 4.49% participate in projects between $10,000,001and $25,000,000; 3.37% work on projects between $25,000,001 and $50,000,00 and the rest respondents participate in projects more than $50,000,000. Based on the information shown in Figure 4, we split the sample into two groups using $1,000,000 as the criterion. That is to say, the projects less than $1M, which accounts for 52.81%, are put in one group; while the projects more than $1M, which accounts for 47.18%, are put in the other group. The two approximately equal groups enable us to use t-test to verify the significance of the contextual factor (project size) and the differences in the average use levels.

Similarly, the results of t-test prove that the contextual factor (project size) is significant and statistically significant differences exist between the two groups of average use levels and for all the tools. For 67 tools, the statistical significance level is $p<0.001$; for the rest 3 tools, the level is between $p=0.001$ and $p=0.003$ and all statistical significance levels are $p<0.0500$.

Differences between the two groups of average use levels are further displayed in Figure 5 below (tools are arranged in the same sequence as Table 5 from left to right and abridged for concision). Figure 5 reveals that the use levels of project management tools and techniques are not same in projects of different sizes. Moreover, the green dotted line is also above the red solid line, which means that larger projects use project management tools and techniques more often than smaller ones in all cases. Our finding as suggested by our Proposition 2B is that the usage of project management tools and techniques is not

same in projects of various sizes in China. And to be more specific, all tools have higher use levels in larger projects than in smaller projects.

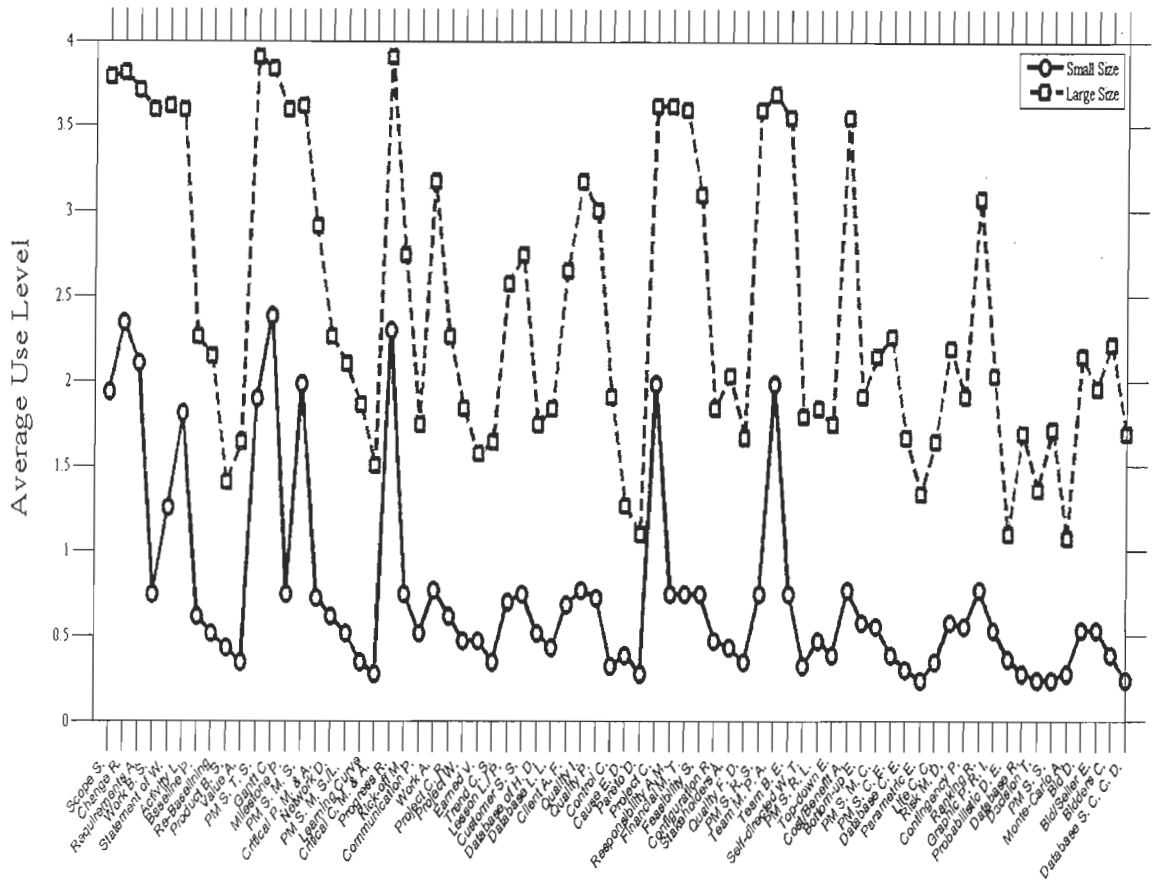


Figure 5: Average Tools and Techniques Use Levels in Projects of Large Size and Small Size

5.4. Usage of Project Management Tools and Techniques in Projects of Different Characteristics

Like project contextual factors, project characteristics may also have influence on the usage of project management tools and techniques. In the following analysis, two

characteristics: project types and project phases will be examined to reveal its relationships with tools usage.

5.4.1. Project Types

Since the financing sources and the purposes of public utility projects are quite distinct from that of projects in private sectors, the projects are basically classified into public ones and private ones. Besides, private ones are further categorized by the type of product they deliver, for example, an IT project in a construction enterprise would be deemed as an IT project rather than a construction one. The percentages below show detailed information concerning project types:

- Engineering & Construction: 41.57%
- Information Technology and Telecommunications: 21.35%
- Public utilities: 14.61%
- Business services: 6.74%
- Industrial Processes: 3.37%
- Others: 12.36%

As can be seen from the percentages above, under this manner of categorization, the sample in this study allows us to compare three types of projects, which are Engineering & Construction, Information Technology and Telecommunications and Public utilities. Table 8 presents the comparisons among the three.

Tools and Techniques	E&C	IT	Pub
Scope			
Change Request		More*	More*
Requirements Analysis	Less*	More*	More*
Baseline Plan		More	
Re-baselining		More	
Value Analysis	More		More

Time			
PM Software for Task Scheduling		More*	
PM Software for Monitoring of Schedule		More*	More*
Critical Path Method & Analysis	More*		More
Communication			
Progress Report		More*	More*
Kick-off Meeting		More*	
Communication Plan	Less	More*	
Work Authorization	More*		More*
Project Communication Room (war room)		More	
Project Website	Less		More*
Earned Value	More	less	More
Trend Chart or S-curve	More	less	More
Learning			
Database of Historical Data			More
Database of Lessons Learned			More
Quality			
Client Acceptance Form		More	
Quality Inspection	More*		More*
Control Charts	More		More*
Integration			
Project Charter	Less		More*
Responsibility Assignment Matrix		More	More
Financial Measurement Tools	More*	Less	
Configuration Review		More	
Stakeholders Analysis			More*
Quality Function Deployment	More	More	
HR			
PM Software for Resource Scheduling		More*	More
PM Software for Resources Leveling		More	More
Cost			
Top-down Estimating	More*		More*
PM Software for Monitoring of cost	More		More*
PM Software for Cost estimating	More		More*
Database for Cost Estimating	More*	Less	More*
Life Cycle Cost ("LCC")			More*
Risk			
Risk Management Documents		More	
Contingency Plans		More*	More
Procurement			
Bid Documents	More*	Less	More
Bid/Seller Evaluation	More*	Less	More
Bidders Conferences	More*	Less	More

Note. E&C= Engineering & Construction, IT= Information Technology and Telecommunications, Pub= Public utilities.

The * indicates tools that are among the most frequently used on each type of project.
Those without * remains at lower use levels.

Table 8: Significant Differences in Tools Usage across Three Types of Projects

Table 8 focuses on the identification of tools for which great differences in use levels have been found. Some tools like Work Breakdown Structure, Activity List are not mentioned in Table 8, since they are nearly equally used in the three types of projects and their uses are almost equal to the uses observed in the whole sample. The small star inserted in the table means that the tool is among the most frequently used tools in that type of project. Therefore, a tool could be used relatively more often yet still at low level as indicated by "More" without a star; while a tools used relatively less often could be among the most often used ones as indicated by "Less*".

Practices of E&C and IT projects contrast in many aspects as indicated by the different usage of project management tools. The knowledge areas of Communication and Procurement show the most tools with contrast use. Since competitive bidding is essential in the project management of E&C projects while less important in IT projects, the three tools related to bidding are found to be used significantly more frequently in E&C projects. The significant greater use of Financial Measurement Tools and Database for Cost Estimating in E&C projects shows that cost and profit issues are placed more emphasis on in E&C projects. Besides, all tools in cost knowledge area show higher use levels in E&C projects. IT projects seem to rely more on tools for communication. Contrast use is shown in the use of Communication Plan, with more use in IT projects and less use in E&C projects. Other communication tools like Progress Report, Kick-off Meeting and Project Communication Room (war room) are also used more in IT projects. The development of requirements is more complicated in IT projects, which can be seen from the higher use of Requirement Analysis in IT projects than in E&C projects. The more use of Change Request, Baseline Plan and Re-baselining also proves the complication. The more use of

Quality Inspection and Control Charts in E&C projects show that E&C projects focus more on project quality in the process. IT projects lay more emphasis on scheduling and monitoring time and resources, which can be seen from the higher use of related PM Software. Earned Value and Trend Chart have contrast use in the two types of projects, both of which are used more in E&C projects and less in IT projects. Moreover, two risk tools are used more in IT projects, which may indicate higher risk levels in IT projects.

For IT projects and Public utility projects (Pub), difference also exists. Tools with contrast use appear in the knowledge areas of Communication, Cost and Procurement. Since many Public utility projects are relevant to construction, thus making bidding related tools used more in Public utility projects. Cost performance controls and quality controls are given more weight in Public utility projects as shown by the greater use of all cost knowledge area tools and two quality tools. It seems that both of the two types of projects lay more emphasis on scheduling and monitoring time and resources, which can be seen from the higher use of related PM Software. The tools in the knowledge area of learning are used more in Public utility projects. The fact indicates that practitioners of Public utility projects tend to learn from the past. Since not only financial benefits but also social and environmental factors should be taken into consideration for Public utility projects, Stakeholders Analysis is undoubtedly used more in this type of project. The more use of Project Website in Public utility projects indicates that the transparency of project information to the public is important for Public utility projects. In the knowledge area of communication, Kick-off Meeting and Communication Plan are used more in IT projects than in Public utility ones. Tools like Change Request, Requirement Analysis, Progress Report, Responsibility Assignment Matrix and Contingency Plans are all used quite often in the IT projects and Public utility projects.

When comparing E&C projects and Public utility projects (Pub), less difference is found. Change Request, Requirement Analysis, Progress Report are used more in Public utility projects. E&C projects focus more on the financial return of the projects as indicated by the greater use of Financial Measurement Tools. Stakeholders Analysis and Project Website are also used more in Public utility projects due to its requirements on information transparency and interest balance. Besides, information on projects' whole life cost is more useful to Public utility projects, which is shown by the greater use of Life Cycle Cost ("LCC"). Compared with E&C projects, practitioners of Public utility projects tend to learn more from the past as indicated by the greater use of Database of Historical Data and Database of Lessons Learned. Moreover, PM Software tools like PM Software for Resource Scheduling are also more used in Public utility projects than in E&C projects.

Overall, through the analysis above we can find that the use of project management tools and techniques varies across the three types of project, which speaks in favor of Proposition 3, that is, in China, the usage of project management tools and techniques differs in projects of different types. Generally speaking, greater differences exist between E&C projects and IT projects and also between IT projects and Public utility projects; while less difference was found between E&C projects and Public utility projects.

5.4.2. Project Phases

According to the result of survey, more than half of the respondents (55%) were involved in the Initiation/Concept phase; 14.6% worked in the Planning/Development phase and 23.6% and 6.74% participated in the phases of Execution/Implementation and Finalization/Commissioning/Handover respectively. Significant differences in the use of project management tools in each phase were found in the analysis.

	Initiation /Concept	Planning /Development	Execution /Implementation	Finalization /Handover
Scope				
Scope Statement	+	+		
Change Request			+	
Requirements Analysis	+			+
Work Breakdown Structure	+			
Statement of Work	+			
Activity List	+			
Baseline Plan	+			
Re-Baselining		+		
Time				
PM Software for Task Scheduling		+		
Gantt chart		+		
Milestone Planning	+			
PM Software for Monitoring of Schedule			+	
Communication				
Progress Report			+	
Kick-off Meeting	+			
Communication Plan	+			
Learning				
Lesson Learned/ Post-mortem				+
Customer Satisfaction Surveys				+
Integration				
Project Charter	+			
Feasibility Study	+			
Stakeholders Analysis	+			
HR				
PM Software for Resource Scheduling		+		

Table 9: Differences in Tools Usage across Project Phases

Since project management activities are quite different in each phase of a project, it is not surprising to find that the application of project management tools and techniques differs across project phases. Table 9 above shows that large numbers of significant differences in use were found the first two project phases, especially the Initiation/ Concept phase.

The tools in knowledge areas of Scope, Communication and Integration are more used in the first project phase. At the very beginning of the project, the main tasks include the establishment of general objectives, the determination of project feasibility, the provision of high-level project description, etc. The scope of project is defined in this phase, which is shown by the greater use of Requirement Analysis, Scope Statement and Statement of Work. And the scope elaborated is further decomposed by the tools of Work Breakdown Structure and Activity Analysis. Stakeholders Analysis is more used in this phase, which helps to identify stakeholders' expectations and balance interests. The project concept is validated as proved by the greater use of Feasibility Analysis. The greater use of Kick-off Meeting and Communication Plan in this phase is to help stakeholders informed. Baseline Plan and Milestone Planning are more used in this phase as well, which indicates that in China, some initial plan issues are also discussed and decided at the front-end of project. The Project Charter, which is the final deliverable of this phase, is undoubtedly used more.

As is expected, the greater use of tools in Time Knowledge Area makes the Planning phase distinct. Scope Statement extends its usage till this phase. The baseline decided in the Initiation phase is often adjusted as shown by the greater use of Re-Baselining. In the Execution phase, tools related to monitor and change are used more. Progress Report is primarily used in this phase, which helps to track the progress of project. In the final phase, Lesson Learned and Customer Satisfaction Survey are used more to evaluate project result and learn from the process. The result provided in Table 9 doesn't mean that the tools listed are not widely used in other phases. It just indicates that some tools are used more in specific phases.

According to previous studies, each project phase has its own characteristics, objectives and project activities, for example, the initial phase focuses on the determination

of the project feasibility, the project authorization and the project descriptions; while the schedules establishment and other project plans are the major tasks of the planning phase. Therefore, there is no doubt that the selection of project management tools and techniques is different across the phases. Overall, our analysis shows that the use of project management tools and techniques varies from phase to phase, which is congruent with our Proposition 4. It is actually quite normal that some tools are used more in certain phases of a project since these tools have been developed specifically for these phases. Furthermore, we have also found that the Initiation phase is the most specific one and the Planning phase is distinct as well. Researchers like Zhao, Yu Jun (2008), Lu, Zhe Yu (1999), Yu Jie (2011) in China have recognized the significance of the Initial phase and studied relevant management tools like Kick-off Meeting, Project Charts, Scope Statement, etc. However, regarding the Planning phase, few emphases were laid on and little studies were made on the selection of management tools in this phase.

5.5. Usage of Project Management Tools and Techniques for Project Managers of Different Experience

After analyzing the influence of factors relating to projects and organizations, in this section, human factors will be added. The relationship between the experience of project managers and the usage of project management tools and techniques will be studied here. As we have mentioned before, the respondents of the survey were all Chinese project managers and program managers/directors, therefore their education level and their work experience were set to be the two main experience factors examined.

5.5.1. Education Level

As in our survey, four education levels were provided to the respondents, which are technical qualification, undergraduate degree, master's certificate or equivalent and graduate degree. Figure 6 below generalizes the answers to the question of education level.

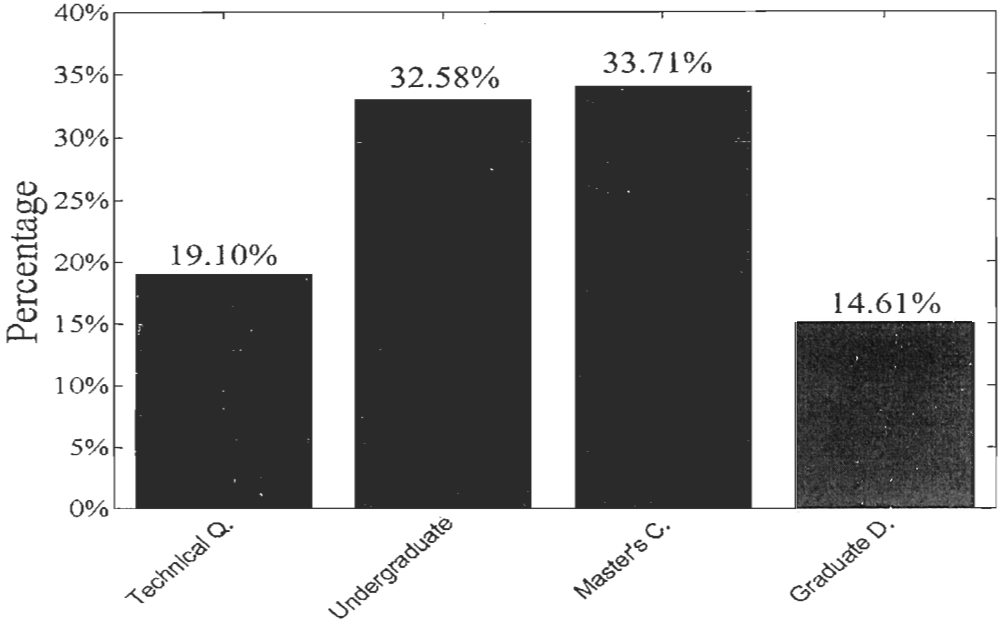
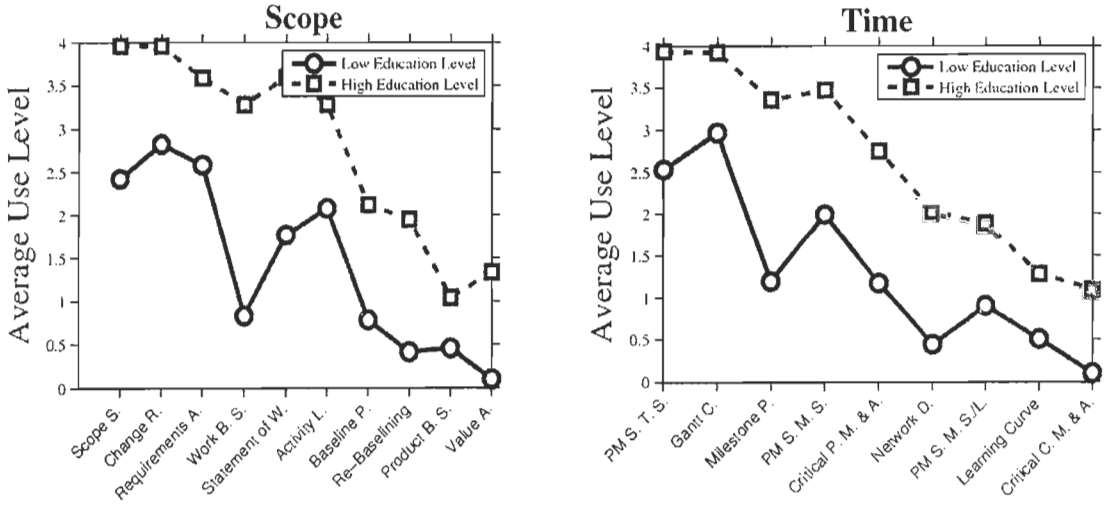
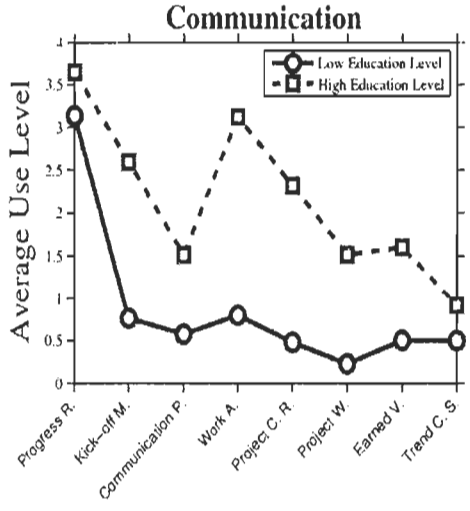


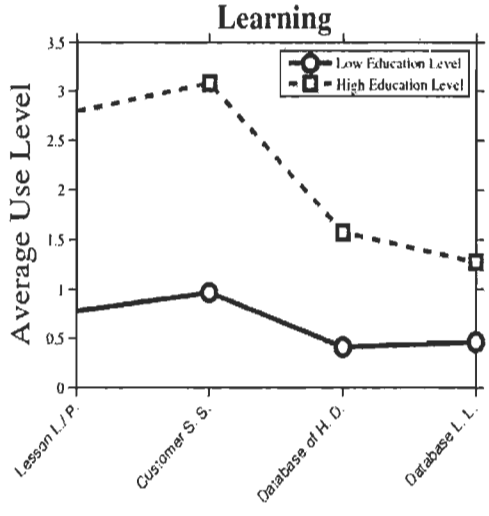
Figure 6: The Level of Education

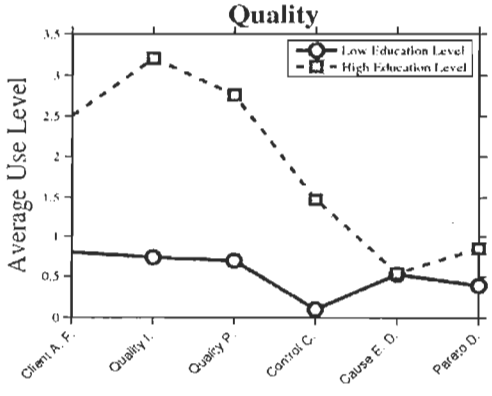
According to Figure 6, 19.10% of the respondents have technical qualification; 32.58% of the respondents hold undergraduate degree; 33.71% have master's certificate or equivalent and 14.61% hold graduate degree. Therefore, the responses were recoded into two groups - those having technical qualification and undergraduate degree and those having master's certificate or equivalent and graduate degree. The sample was accordingly divided into two nearly equal groups, with one group accounting for 51.68% and the other group accounting for 48.32%. Then the method of t-test is used to verify the significance of the experience factor (education level) and the differences in the average use levels

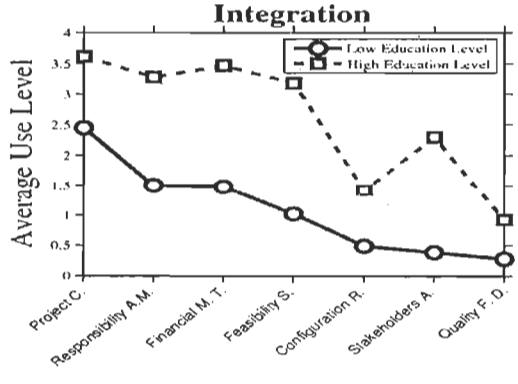
The results of t-test revealed that statistically significant differences in average use were found for 68 of the 70 tools investigated. For 63 tools, the statistical significance level is $p<0.001$; for 5 tools, the level is between $p=0.021$ and $p=0.039$. Therefore, we can conclude that the experience factor (education level) is significant and statistically significant differences exist between the two groups of average use levels for 68 of the 70 tools. Differences between the two groups of average use levels are further displayed category by category in the following charts of Figure 7 (tools of each category are arranged in the same way as Table 5 and abridged for concision).

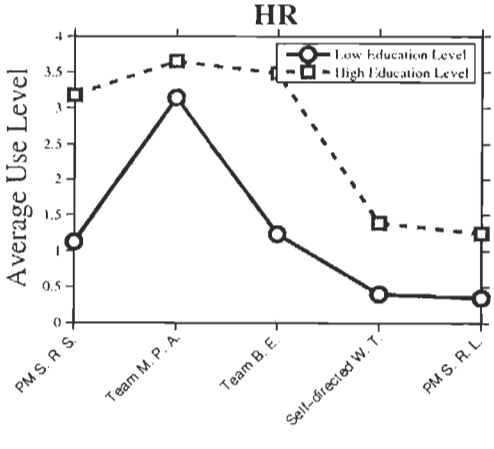


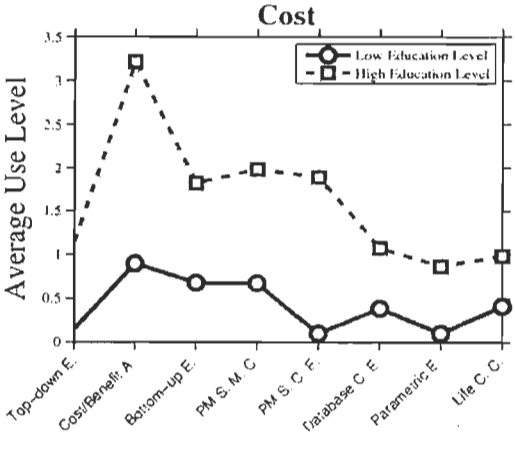

Communication
Average Use Level
Low Education Level
High Education Level
Progress R.
Kick-off M.
Communication P.
Work A.
Project C. R.
Project W.
Earned V.
Trend C. S.


Learning
Average Use Level
Low Education Level
High Education Level
Lesson L./ P.
Customer S. S.
Database of H. D.
Database L. L.


Quality
Average Use Level
Low Education Level
High Education Level
Client A. F.
Quality I.
Quality P.
Control C.
Cause E. D.
Pareto D.


Integration
Average Use Level
Low Education Level
High Education Level
Project C.
Responsibility A.M.
Financial M. T.
Feasibility S.
Configuration R.
Stakeholders A.
Quality F. D.


HR
Average Use Level
Low Education Level
High Education Level
PM S. R. S.
Team M. P. A.
Team B. E.
Self-directed W. T.
PM S. R. L.


Cost
Average Use Level
Low Education Level
High Education Level
Top-down E.
Cost/Benefit A
Bottom-up E.
PM S. M. C.
PM S. C. F.
Database C. E.
Parametric E.
Life C. C.

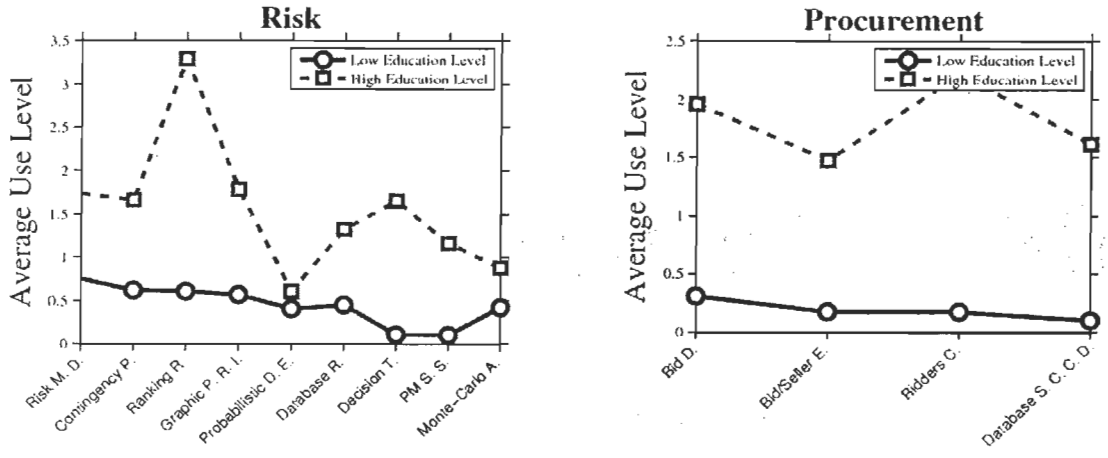


Figure 7: Average Tools and Techniques Use Levels for Respondents with High and Low Education Levels by Knowledge Area

From the series of charts of Figure 7, we can see that the use of project management tools and techniques varies for project managers with different education levels. Besides, the green dotted line is always above the red solid line, which means that project managers with higher education levels use the tools more frequently than project managers with lower education level. Two tiny exceptions were found in the analysis. The use levels of Cause and Effect Diagram and Probabilistic Duration Estimate (PERT Analysis) haven't shown great difference between the two groups and are almost the same, which conforms to the results of t-test. However, the minor exceptions can't impede us to get our finding, which speaks in favor of Proposition 5A, that is, project managers with higher education level use project management tools and techniques more frequently in China.

5.5.2. Work Experience

Apart from education level, the relationship between work experience and use levels of project management tools and techniques is also what we are interested in. Figure 8 below summarizes respondents' work experience information.

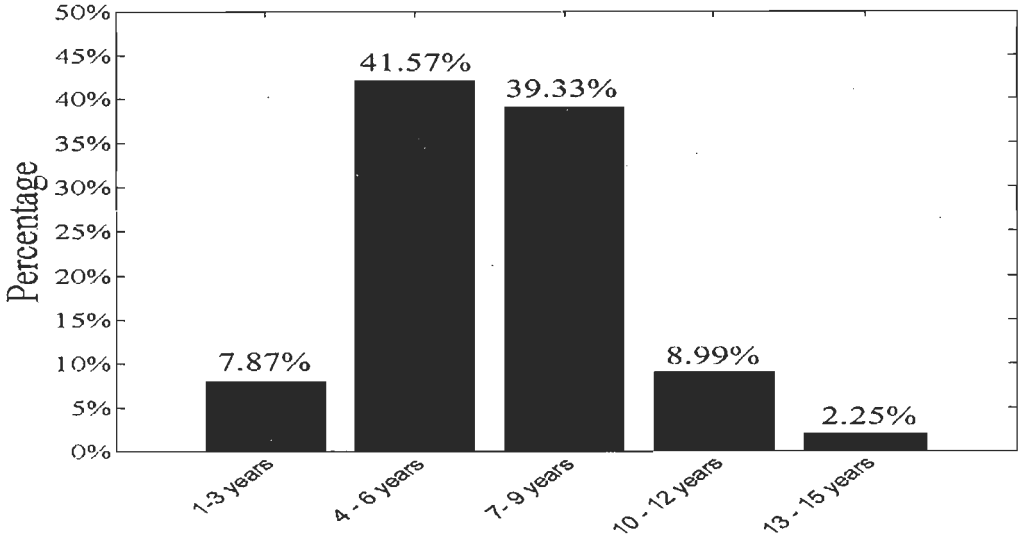


Figure 8: Work Experience Level

According to Figure 8, 7.87% of the respondents have 1 to 3 years' work experience as project or program managers; 41.57% of the respondents have 4 to 6 years' work experience as project or program managers; 39.33% have 7 to 9 years of work experience as project or program managers and 8.99% and 2.25% of the respondents have 10 to 12 years of work experience and 13 to 15 years of work experience as project or program managers respectively. In the following analysis, the responses were again classified into two almost equal groups. The responses with less than 6 years of work experience were put in one group, which accounts for 49.44% of the total; while the rest with more than 6 years of work experience were put in the other group, which accounts for 50.57% of the total. Then the method of t-test can be applied to the two groups so that the significance of the experience factor (work experience) and the differences in the average use levels can be verified.

The results of t-test show that the experience factor (work experience) is significant and statistically significant differences exist between the two groups of average use levels and for all the tools. For 68 tools, the statistical significance level is $p<0.009$; for the rest 2

tools, the level is between p=0.001 and p=0.017 and all statistical significance levels are p<0.0500.

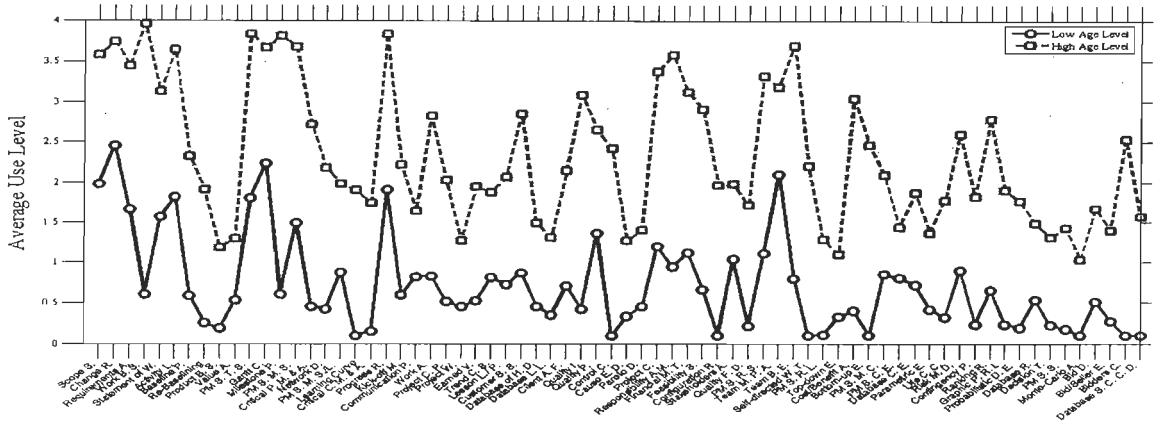


Figure 9: Average Tools and Techniques Use Levels for Respondents with Longer and Shorter Work Experience

Figure 9 (tools are arranged in the same sequence as Table 5 from left to right and abridged for concision) above further shows the differences between the two groups of average use levels. It can be easily seen from Figure 9 that the use levels of tools are different between project managers with longer work experience and shorter experience. Moreover, the green dotted line is also above the red solid line, which means that project managers with longer work experience have higher use levels of tools than project managers with shorter work experience. Our finding speaks in favor of Proposition 5B, that is, project managers with longer work experience have more frequent use of project management tools and techniques in China.

5.6. Comparison

As we have mentioned before, the tools investigated in this research were identical to the ones investigated by Prof. Besner and Prof. Hobbs (2008), which facilitates the comparison between the two research results. With the analysis of the usage of project

management tools and techniques in China in mind, we can now make a simple comparison between the use of tools in China and in North America.

From Limited to Extensive Use		From Very Limited to Limited Use		Less than Very Limited Use	
China	**North America**	**China**	**North America**	**China**	**North America**
Progress Report	Progress Report	Ranking of Risks	Contingency Plans	Learning Curve	Life Cycle Cost ("LCC")
Change Request	Kick-off Meeting	Quality Plan	Re-Baselining	Control Charts	Database or Spreadsheet of Contractual Commitment Data
Gantt chart	PM Software for Task Scheduling	Critical Path Method & Analysis	Cost/Benefit Analysis	Database of Historical Data	Probabilistic Duration Estimate (PERT Analysis)
Requirements Analysis	Gantt chart	Customer Satisfaction Surveys	Critical Path Method & Analysis	Communication Plan	Quality Function Deployment
Scope Statement	Scope Statement	Kick-off Meeting	Bottom-up Estimating	Top-down Estimating	Value Analysis
Team Member Performance Appraisal	Milestone Planning	Client Acceptance Form	Team Member Performance Appraisal	Self-directed Work Teams	Database of risks
PM Software for Task Scheduling	Change Request	Lesson Learned/ Post-mortem	Team Building Event	Earned Value	Trend Chart or S-curve
Project Charter	Requirements Analysis	Project Communication Room (war room)	Work Authorization	Quality Function Deployment	Control Charts
PM Software for Monitoring of Schedule	Work Breakdown Structure	Network Diagram	Self-directed Work Teams	Database or Spreadsheet of Contractual Commitment Data	Decision Tree
Activity List	Statement of Work	Baseline Plan	Ranking of Risks	Database of risks	Cause and Effect Diagram
Statement of Work	Activity List	Bid Documents	Financial Measurement Tools	Life Cycle Cost (LCC)	Critical Chain Method & Analysis
Responsibility Assignment Matrix	PM Software for Monitoring of Schedule	PM Software for Monitoring of cost	Quality Plan	PM Software for Simulation	Pareto Diagram
PM Software for	Lesson	Risk	Bid Documents	Database for	PM

Resource Scheduling	Learned/ Post-mortem	Management Documents		Cost Estimating	Software for Simulation
Financial Measurement Tools	Baseline Plan	PM Software for Multi-project Scheduling/ Leveling	Feasibility Study	Trend Chart or S-curve	Monte-Carlo Analysis
Milestone Planning	Client Acceptance Form	Re-Baselining	Configuration Review	Value Analysis	
Work Breakdown Structure	Quality Inspection	PM Software for Cost estimating	Stakeholders Analysis	Critical Chain Method & Analysis	
Team Building Event	PM Software for Resource Scheduling	Graphic Presentation of Risk Information	PM Software for Resources Leveling	Product Breakdown Structure	
Cost/Benefit Analysis	Project Charter	Bidders Conferences	PM Software for Monitoring of cost	Parametric Estimating	
Quality Inspection	Responsibility Assignment Matrix	Bid/Seller Evaluation	Network Diagram	Cause and Effect Diagram	
Work Authorizatio	Customer Satisfaction Surveys	Stakeholders Analysis	Project Communication Room (war room)	Decision Tree	
Feasibility Study	Communication Plan	Contingency Plans	Project website	Probabilistic Duration Estimate (PERT Analysis)	
	Top-down Estimating	Bottom-up Estimating	Bid/Seller Evaluation	Pareto Diagram	
	Risk Management Documents	PM Software for Resources Leveling	Database of Historical Data	Monte-Carlo Analysis	
		Configuration Review	PM Software for Multi-project Scheduling/ Leveling		
		Database of Lessons Learned	Earned Value		
		Project Website	PM Software for Cost estimating		
			Database for Cost Estimating		
			Database of Lessons Learned		
			Product Breakdown Structure		
			Bidders Conferences		
			Learning Curve		
			Parametric Estimating		
			Graphic Presentation of		

			Risk Information		

Table 10: Comparison between Tools Usage in China and in North America

From Table 10, we can see that the usage of tools in China and in North America is different. Generally speaking, the use levels of tools are higher in North America than in China as shown by more tools located in the areas of "From Limited to Extensive Use" and "From Very Limited to Limited Use" of Table 10. This is consistent to our previous conclusions, which deem that the development of project management in China still stays in the early stage and compared with western countries, it has a long way to go. Most of the most extensively used tools, which are in the left part of Table 10, are same for China and North America. Tools like Progress Report, Gantt chart, Scope Statement, etc. are all used extensively both in China and in North America, though their exact positions in the ranking are different. With respect to the tools with least use, the similarity also appears. Life Cycle Cost ("LCC"), Probabilistic Duration Estimate (PERT Analysis), Database of risks, Trend Chart or S-curve, Control Charts, Decision Tree, Pareto Diagram, PM Software for Simulation and Monte-Carlo Analysis are among the least used tools both in China and in North America. The fact of similarity indicates that some project management tools adapt well to the practice of project management and its usages are irrelevant to the various conditions of different countries, however, some project management tools work well nowhere.

According to Prof. Besner and Prof. Hobbs (2008), on the whole, the project management toolbox seems to be better adapted to scope, time and communication knowledge areas in North America, while in China, project management toolbox works well in knowledge areas of scope, time and integration. The knowledge area of risk is in need of further development both in North America and in China. Besides, the Knowledge

Areas of Time and Cost are also considered to be areas where further improvement and development in practice are needed in China.

Prof. Besner and Prof. Hobbs (2008) have found that the use of project management tools and techniques varies in organizations of different maturity levels and in projects of different sizes. Based on our analysis, we get the same findings in China. Besides, though the types of projects investigated in China are not same to the ones studied in North America, we both found that the use of project management tools across different types of projects varies considerably. With respect to project phase, the Initiation phase was shown to be quite specific as indicated by the large number of significant differences in use in North America. While in China, apart from the Initiation phase, large numbers of significant differences in use were also found in the Planning phase. Researchers like Zhao, Yu Jun (2008), Lu, Zhe Yu (1999), Yu Jie (2011) in China have recognized the significance of the Initial phase and studied relevant management tools like Kick-off Meeting, Project Charts, Scope Statement, etc. However, regarding the Planning phase, few emphases were laid on and little studies were made on the selection of management tools in this phase.

CHAPITER 6
DISCUSSIONS

6.1. Research Result

In this study, we have used the quantitative research method to help find out the actual usage of project management tools and techniques in China. 283 questionnaires were sent and a total of 89 responses were received and used in the study. All the respondents were project managers and program managers/directors who engaged in projects of various sizes, maturity levels and types. Due to the nature of the study, we are confident that the samples selected are highly representative and meaningful.

The purpose of this research was to find out the actual practice of project management in China, especially the general usage of project management tools and techniques and the influence of different factors on it. The questions of the research were as follows:

1. What's the situation of the usage of project management tools and techniques in China?

2. In China, is the usage of project management tools and techniques similar in projects of different contexts and of different types?

3. In China, is the usage of project management tools and techniques comparable in different phases of projects?

4. Is there any relation between the usage of project management tools and techniques and the experience of project managers?

Based on the subjects and the purpose of my research, we have put forward the following five propositions: Proposition 1: The usage of project management tools and techniques is uneven in China, which has two extended propositions, Proposition 1A: The most used project management tools and techniques in China are the best known and Proposition 1B: Computerized project management tools and techniques dominate the project management tools and techniques used in China; Proposition 2: In China, the usage of project management tools and techniques is different in projects of different contexts, which has two extended propositions, Proposition 2A: The level of maturity of project management systems exerts influence on the usage of project management tools and techniques in China and Proposition 2B: The usage of project management tools and techniques is not same in projects of various sizes in China; Proposition 3: In China, the usage of project management tools and techniques differs in projects of different types; Proposition 4: In China, the usage of project management tools and techniques changes in different project phases; Proposition 5: In China, the usage of project management tools and techniques is connected with the experience of project managers, which has two extended propositions, Proposition 5A: In China, project managers with higher education level use project management tools and techniques more often and Proposition 5B: In China, project managers with longer work experience have more frequent use of project management tools and techniques.

The foregoing analysis has enabled me to validate the propositions and offer some general conclusions. From the use percentages offered by Table 5 and the ranking shown by Table 6, we can easily tell that the usage of project management tools and techniques is uneven in China, which confirms our Proposition 1 and is consistent with the existing

literature. Nowadays, China has enjoyed rapid development in project management (PM Network, 2011). Some best known project management tools like Grant Chart, PERT and CPM were introduced to China in the early 60s. Many researchers have set these tools and techniques as their topics, like Yang, Xiao Di (2004), who studied the application of PERT in estimating project durations; Liu, Shi Xin, Song Jian Hai & Tang Jia Fu (2003), who were interested in the tool of CPM, etc. The fact that the tools in the area of "From Limited to Extensive Use" of Table 6 are all very well-known and widely used tools supports our Proposition 1A and is also consistent with the existing literature. Previous studies have stated that the early stage of development has impeded the application of project management tools and techniques in China. And although some best known project management tools like Grant chart, PERT and CPM were brought in China in the early 60s, it is the computerized project management tools and techniques (project management software) that dominate the tools used in China. To be more specific, it was confirmed that the application of project management software accounts for 80% of the usage of project management tools. However, it is not the fact as what we have found. According to our findings in Table 6, computerized project management tools and techniques only accounts for 14.29% of the tools with most frequent use, which is much lower than 80%. Many non-computerized tools like Progress Report, Change Request, Gantt chart, etc. are also used widely in China and have even higher use level. Therefore, we can hardly declare that computerized project management tools and techniques dominate in China. Whereas, there is no doubt that computerized project management tools and techniques enjoy high popularity in China, as 7 out of 8 of computerized tools have more than limited use. In short, the findings are clearly not congruent with previous studies on Chinese tools usage and Proposition 1B, that is, computerized project management tools and techniques dominate the project management tools and techniques used in China. The facts indicate that computerized tools and techniques do receive high popularity in China, but some non-computerized tools are widely accepted and used as well. Comparatively higher technical requirements of certain computerized tools and techniques may lead to its lower use levels

than we have thought. Greater organizational support and training efforts required are also possible reasons.

Existing literature has found that usage of project management tools and techniques in North America is influenced by the organizational project management maturity. Besides, the size of projects is also a contextual factor that may lead to different usage of project management tools and techniques (Besner & Hobbs, 2008).The situation is the same in China. By way of dividing the sample into two groups according to one specific contextual factor, we can find that all tools are used more often in organizations with higher maturity level than in organizations with lower maturity level and that larger projects use project management tools and techniques more often than smaller ones in all cases in China. Thus, Proposition 2A and Proposition 2B are well confirmed.

Payne and Turner (1999) and Shenhar (1998) found that project management practices do vary greatly from one type of project to the other. Furthermore, the research of Crawford, Hobbs, and Turner (2005, 2006) have found out that organizations divide their projects into categories so that different tools, techniques, and approaches can be applied to different types of projects. Since different types of projects have different practices, it is not surprising to find their uses of project management tools and techniques are different, which makes Proposition 3 reasonable.

According to previous studies, each project phase has its own characteristics, objectives and project activities, for example, the initial phase focuses on the determination of the project feasibility, the project authorization and the project descriptions; while the schedules establishment and other project plans are the major tasks of the planning phase. Therefore, there is no doubt that the selection of project management tools and techniques

is different across the phases. Our analysis in Table 9 shows that the use of project management tools and techniques varies from phase to phase, which is congruent with our Proposition 4 and the existing literature. Furthermore, we also find that the Initiation phase is the most specific one and the Planning phase is distinct as well.

The relations between the experience of project managers and the usage of project management tools and techniques are shown in Figure 7 and Figure 9 which indicate that project managers with higher education level and longer work experience have more often use of project management tools and techniques. Therefore, Proposition 5 and its extended propositions (Proposition 5A and Proposition 5B) are all verified.

In the present research, we did find great differences in the use levels of the project management tools and techniques investigated. On the whole, computerized project management tools and techniques haven't dominated the project management tools and techniques used in China. Some non-computerized tools are widely accepted and used as well such as some very well-known ones (Progress Report, Change Request, Requirement Analysis, etc.). Based on the analysis, the Knowledge Areas of Time and Cost are considered to be areas where further improvement and development in practice are needed. Similarly, the tools of risk management don't work well in China and more tools development is needed in this area. Generally speaking, the use levels of tools are higher in North America than in China. The development of project management in China still stays in the early stage and compared with western countries, it has a long way to go.

It is found that projects of different characteristics and in different contexts have to face different critical issues, therefore project management practice has to adapt to these as

shown by the differentiated use of tools and techniques. Besides, the tools usage is also connected with the practitioners' work experience.

The findings of this study may be instrumental in discovering the true picture of project management practice and the actual usage of project management tools in China. The understandings of the actual situation of the profession and the usage of project management tools can help the practitioners to have deeper comprehension of project management and get some inspiration from their peers. Furthermore, the study also enables professionals to identify the limits of the existing practice and find ways to improve it.

6.2. Forces and Limits of Study

All researches have its forces and limits. In this section, the forces and limits of my study will be presented.

The force of this research is the use of the quantitative research methodology. According to Burns N & Grove S K (1987), the quantitative method offers an unbiased, formal and systematic process to quantify or measure phenomena and produce findings by using numerical data, besides, it also helps to describe, test and examine cause and effect relationships. The method enables me to get a detached and unbiased view on the actual practice of project management, especially the actual usage of project management tools and techniques in China. Besides, the comparatively large sample of this study has provided adequate data for the research, thus making our analysis and conclusions more trustable and comprehensive. Since in China, there is little study of this kind that explores the actual usage of project management tools and techniques in practice and the influences of different factors on it, this study serves as a good try in this aspect.

The limit of the research is related to the analysis of the data. The study has provided abundant data analysis, through which we can get very direct understanding to the actual usage of project management tools and techniques in China; however, with respect to the reasons of the differences in tools usage, it provides few explanations. Questions like why Pareto Diagram, PM Software for Simulation and Monte-Carlo Analysis are among the least used project management tools in China while Progress Report, Change Request and Gantt chart are so popular haven't been resolved. Besides, few arguments were made in the case where there are conflicts between actual findings and previous researches. The causes to the less usage of computerized project management tools and techniques than what was stated before are not found. Therefore, the findings of this study are limited. Continuing efforts are needed to discover the possible reasons of some tools' comparatively higher use levels and some tools' relatively lower use levels in order to provide deeper and more comprehensive conclusions. Furthermore, as we have mentioned, in the process of data collecting, we have got help from the Changeway Project Management Training Center in Shanghai, who provided us a contact list of project managers. The business relationship between the respondents and the Changeway Project Management Training Center may influence their responses to the questionnaire.

6.3. Recommendation

Research on project management in China reveals that many project managers still get trouble from cost over-run, resources lack, quality insufficiency, etc. (Hubert Vaughan, 2008) due to various reasons and that the development of project management in China still stays in the early stage and compared with western countries, it has a long way to go. The result of this study is consistent with previous research. Though many tools other than computerized ones are found to be widely used in China, the use levels of tools are lower in China than in North America. Since project management tools and techniques play an essential role in increasing the efficiency and effectiveness of project management, project

management practitioners in China should lay more emphasis on it. Here we would like to raise some suggestions to project management practitioners in China in order to expand their usage of tools.

6.3.1. Project Management Tools Training Course

Receiving training courses on project management tools is one of the most efficient ways to expand project management practitioners' understanding of different tools. People tend to stick to the tools they know and are unwilling to try the ones unfamiliar. Training courses on project management tools enable project management practitioners to get familiar with more tools, thus making use of more tools that help.

Normally speaking, the project management tools training course involves the following aspects:

(1) Project management tools introduction

(2) How to use project management tools

6.3.2. Organizational Support

Besides training courses on project management tools which help to make project management tools known, organizational support and investment is indispensible in increasing the usage of project management tools. Some tools cannot be used without support. Database-type tools are the good examples. It is impossible for an individual to produce, manage and update a database without the involvement and investment from the organization. Therefore, organizations should provide more support and investment in order to promote the use of project management tools in the organizations, which will bring

higher efficiency and effectiveness in its project management practice in return. In addition, based on previous analysis, project management has longer history and is better developed in western countries, thus, more cooperation between Chinese organizations and western ones will also help. Organizational cooperation will not only facilitate communication between Chinese practitioners and western professionals, but also provide great opportunity for Chinese practitioners to update their knowledge and learn from their foreign peers.

CHAPITER 7
CONCLUSION

In this research, we have made my efforts to discover the actual project management practice in China, particularly the actual usage of project management tools and techniques. 283 questionnaires were sent and 89 responses were received and analyzed by the quantitative method. Abundant data analyses were used to help validate the propositions and get the conclusions. We deem that the results of this study will prove to be useful and there will be a lot of avenues for further researches in project management tools and techniques. We have not only discovered the general usage of project management tools and techniques in China, but also examined the influences of different factors on it. The findings show that the most used project management tools and techniques in China are the best known; besides computerized project management tools and techniques, many other tools are also widely used in China; project management tools are used more often in organizations with higher maturity levels and in projects of larger size; the use of project management tools are different across project types and project phases; project managers with higher education levels and longer work experience use more often the project management tools and techniques. The most surprising finding is that computerized tools and techniques do receive high popularity in China, but some non-computerized tools are widely accepted and used as well. This finding is inconsistent with the existing literature and it indicates that the usage of project management tools and techniques in China is much better than assumed. As far as we are concerned, in China, there is little study of this kind that explores the actual usage of project management tools and techniques in practice and the influences of different factors on it. However, the understanding of the true picture of project management practice and the actual usage of project management tools is necessary and essential for future improvement and development. Therefore, this study serves as a good try in this aspect. Further research should be undertaken to discover the reasons of the

differences in tools usage. This may help us to get a more complete and comprehensive understanding of the actual practice of project management.

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APPENDICES

Questionnaire: Survey on usage and value of project management tools & techniques in China

Part Ⅰ: Identification and Project Environment

1. EDUCATION Please indicate the highest level of education obtained

- ○ Technical qualification,
- ○ Undergraduate Degree,
- ○ Master's certificate or equivalent,
- ○ Graduate degree

2. PROJECT MANAGEMENT EXPERIENCE
Please indicate the level of project management experience you have by recording the total number of years you have been engaged at each level.

	1 to 3 years	4 to 6 years	7 to 9 years	10 to 12 years	13 to 15 years	more than 16 years
Team Member	○	○	○	○	○	○
Project Manager	○	○	○	○	○	○
Programme Manager / Director	○	○	○	○	○	○
Other roles in Project management	○	○	○	○	○	○

3. What is your current primary role? (select one only)

○ Team Member ○ Project Manager ○ Program Manager / Director

○ Other (please specify) _____

4. The deliverable of your current primary project is of which of the following types? (Select one only)

○ Engineering & Construction ○ Business services

○ Information Technology and Telecommunications ○ Computers/Software/DP

○ Industrial Processes ○ Public utilities

○ Other (please specify) _____

5. Which of the categories listed below best describes the level of maturity of the project management systems in your operational area?(select one only)

○ Initial Level - ad hoc and chaotic; relies on the competence of individuals not the organization's.

○ Repeatable Level - there is a project management system and plans are based on previous experience.

○ Defined Level - common, organization wide understanding of project management activities, roles and responsibilities.

○ Managed Level - stable and measured processes against organizational goals; variations are identified and addressed.

○ Optimizing Level - the entire organization is focused on continuous improvement.

6. What is the typical value (in US $) of the projects you work on or manage, in your primary project role?

- ○ 0 < 50,000
- ○ 50,001 - 250,000
- ○ 250.001- 1,000,000
- ○ 1,000,001- 5,000,000
- ○ 5.000,001 - 10,000,000
- ○ 10,000,001 - 25,00,000
- ○ 25,000,001 - 50,000,000
- ○ > 50,000,000

Part II : Project Environment

1. Indicate the phase(s) of a project during which you are most often involved.

- ☐ Initiation/Concept
- ☐ Planning/Development
- ☐ Execution/Implementation
- ☐ Finalization/Commissioning/Handover

Part III: Tools

For each tool presented below, answer the following questions:
A- Use: Extent of use of this tool or technique.
B- Improvement: In your opinion, more extensive or better use of this tool or technique would improve project performance.

A- Extent of Use	B- Improvement from more or better use
0: No use	0: No improvement
1: Very Limited 2: Limited	1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A						B					
	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Scope												
1. Scope Statement:	○	○	○	○	○	○	○	○	○	○	○	○
2. Change Request:	○	○	○	○	○	○	○	○	○	○	○	○
3. Requirements Analysis:	○	○	○	○	○	○	○	○	○	○	○	○
4. Work Breakdown Structure:	○	○	○	○	○	○	○	○	○	○	○	○
5. Statement of Work:	○	○	○	○	○	○	○	○	○	○	○	○
6. Activity List:	○	○	○	○	○	○	○	○	○	○	○	○
7. Baseline Plan:	○	○	○	○	○	○	○	○	○	○	○	○
8. Re-Baselining:	○	○	○	○	○	○	○	○	○	○	○	○
9. Product Breakdown Structure:	○	○	○	○	○	○	○	○	○	○	○	○
10. Value Analysis:	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use B- Improvement from more or better use

0: No use 0: No improvement

1: Very Limited 2: Limited 1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

A B

	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Time												
1. PM Software for Task Scheduling:	○	○	○	○	○	○		○	○	○	○	○	○
2. Gantt chart:	○	○	○	○	○	○		○	○	○	○	○	○
3. Milestone Planning:	○	○	○	○	○	○		○	○	○	○	○	○
4. PM Software for Monitoring of Schedule:	○	○	○	○	○	○		○	○	○	○	○	○
5. Critical Path Method & Analysis:	○	○	○	○	○	○		○	○	○	○	○	○
6. Network Diagram:	○	○	○	○	○	○		○	○	○	○	○	○
7. PM Software for Multi-project Scheduling/Leveling:	○	○	○	○	○	○		○	○	○	○	○	○
8. Learning Curve:	○	○	○	○	○	○		○	○	○	○	○	○
9. Critical Chain Method & Analysis:	○	○	○	○	○	○		○	○	○	○	○	○

A- Extent of Use

0: No use

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A						B					
	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Communication												
1. Progress Report:	○	○	○	○	○	○		○	○	○	○	○	○
2. Kick-off Meeting:	○	○	○	○	○	○		○	○	○	○	○	○

3. Communication Plan:	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○
4. Work Authorization:	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○
5. Project Communication Room (war room):	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○
6. Project website:	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○
7. Earned Value:	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○
8. Trend Chart or S-curve:	○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○

A- Extent of Use

0: No use

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A						B					
	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Learning												
1. Lesson Learned/ Post-mortem:	○	○	○	○	○	○	○	○	○	○	○	○
2. Customer Satisfaction Surveys:	○	○	○	○	○	○	○	○	○	○	○	○
3. Database of Historical Data:	○	○	○	○	○	○	○	○	○	○	○	○
4. Database of Lessons Learned:	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use

0: No use

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited 1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A						B					
	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Cost												
1. Top-down Estimating:	○	○	○	○	○	○	○	○	○	○	○	○
2. Cost/Benefit Analysis:	○	○	○	○	○	○	○	○	○	○	○	○
3. Bottom-up Estimating:	○	○	○	○	○	○	○	○	○	○	○	○
4. PM Software for Monitoring of cost:	○	○	○	○	○	○	○	○	○	○	○	○
5. PM Software for Cost estimating:	○	○	○	○	○	○	○	○	○	○	○	○
6. Database for Cost Estimating:	○	○	○	○	○	○	○	○	○	○	○	○
7. Parametric Estimating:	○	○	○	○	○	○	○	○	○	○	○	○
8. Life Cycle Cost ("LCC"):	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use B- Improvement from more or better use

0: No use 0: No improvement

1: Very Limited 2: Limited 1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

A B

	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Quality												
1. Client Acceptance Form:	○	○	○	○	○	○	○	○	○	○	○	○
2. Quality Inspection:	○	○	○	○	○	○	○	○	○	○	○	○
3. Quality Plan:	○	○	○	○	○	○	○	○	○	○	○	○
4. Control Charts:	○	○	○	○	○	○	○	○	○	○	○	○
5. Cause and Effect Diagram:	○	○	○	○	○	○	○	○	○	○	○	○
6. Pareto Diagram:	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use

0: No use

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A						B					
	Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Risk												
1. Risk Management Documents:	○	○	○	○	○	○	○	○	○	○	○	○
2. Contingency Plans:	○	○	○	○	○	○	○	○	○	○	○	○
3. Ranking of Risks:	○	○	○	○	○	○	○	○	○	○	○	○
4. Graphic Presentation of Risk Information:	○	○	○	○	○	○	○	○	○	○	○	○
5. Probabilistic Duration Estimate (PERT Analysis):	○	○	○	○	○	○	○	○	○	○	○	○
6. Database of risks:	○	○	○	○	○	○	○	○	○	○	○	○

7.	Decision Tree:	○	○	○	○	○	○	○	○	○	○	○	○
8.	PM Software for Simulation:	○	○	○	○	○	○	○	○	○	○	○	○
9.	Monte-Carlo Analysis:	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use

0: No use

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited

3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

		A						B					
		Not Applicable	0	1	2	3	4	Not Applicable	0	1	2	3	4
Integration													
1.	Project Charter:	○	○	○	○	○	○	○	○	○	○	○	○
2.	Responsibility Assignment Matrix:	○	○	○	○	○	○	○	○	○	○	○	○
3.	Financial Measurement Tools:	○	○	○	○	○	○	○	○	○	○	○	○
4.	Feasibility Study:	○	○	○	○	○	○	○	○	○	○	○	○
5.	Configuration Review:	○	○	○	○	○	○	○	○	○	○	○	○
6.	Stakeholders Analysis:	○	○	○	○	○	○	○	○	○	○	○	○
7.	Quality Function Deployment:	○	○	○	○	○	○	○	○	○	○	○	○

A- Extent of Use

0: No use

B- Improvement from more or better use

0: No improvement

1: Very Limited 2: Limited 1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A							B						
	Not Applicable	0	1	2	3	4		Not Applicable	0	1	2	3	4	
HR														
1. PM Software for Resource Scheduling:	○	○	○	○	○	○		○	○	○	○	○	○	
2. Team Member Performance Appraisal:	○	○	○	○	○	○		○	○	○	○	○	○	
3. Team Building Event:	○	○	○	○	○	○		○	○	○	○	○	○	
4. Self-directed Work Teams:	○	○	○	○	○	○		○	○	○	○	○	○	
5. PM Software for Resources Leveling:	○	○	○	○	○	○		○	○	○	○	○	○	

A- Extent of Use B- Improvement from more or better use

0: No use 0: No improvement

1: Very Limited 2: Limited 1: Very Limited 2: Limited

3: Extensive 4: Very Extensive 3: Extensive 4: Very Extensive

Please make sure that you give credits both for the use (A) and the improvement (B)

	A							B						
	Not							Not						

	Applicable	0	1	2	3	4	Applicable	0	1	2	3	4
Procurement												
1. Bid Documents:	○	○	○	○	○	○	○	○	○	○	○	○
2. Bid/Seller Evaluation:	○	○	○	○	○	○	○	○	○	○	○	○
3. Bidders Conferences:	○	○	○	○	○	○	○	○	○	○	○	○
4. Database or Spreadsheet of Contractual Commitment Data:	○	○	○	○	○	○	○	○	○	○	○	○

Questionnaire in Chinese

调查问卷：中国项目管理工具的价值和使用情况调查

第一部分：信息确认和项目环境

1. 教育 请选出您所获得的最高学历

☐ 技术文凭，　　☐ 本科

☐ 硕士文凭或者等效文凭　　☐ 硕士

2. 项目管理经验

请记录在每一个管理水平的工作年限

	1到3年	4到6年	7到9年	10到12年	13到15年	16年以上
团队成员	☐	☐	☐	☐	☐	☐
项目经理	☐	☐	☐	☐	☐	☐
项目总经理/总监	☐	☐	☐	☐	☐	☐
项目管理的其他职位	☐	☐	☐	☐	☐	☐

3. 您现在的主要职责是什么？(只能选一种)

☐ 团队成员　　☐ 项目经理

☐ 项目总经理/总监　　☐ 其他

4. 您现在从事的主要项目是以下哪一种? (只能选一种)

☐ 工程和建造　　☐ 商业服务

☐ 信息技术　　☐ 电脑/软件

☐ 工业过程　　☐ 公共事业

☐ 其他

5. 下面列出的哪种水平能够最好地描述您工作领域项目管理系统的成熟度水平? (只能选一种)

☐ 初始水平 – 经常出问题; 依赖于个人的能力而不是机构的能力

☐ 重复水平 – 有项目管理系统和根据先前经验制定的计划

☐ 确定水平 – 全机构人员对项目管理活动，职位和职责有普遍的了解

☐ 管理水平 – 对机构目标有稳定的可以衡量的过程; 能够确定和解决变动

☐ 最大化水平 – 整个机构都注重不断的改进

6. 就您目前的职位，您从事或管理的项目的大概数额是多少（美金）?

☐ 0 < 50,000　　☐ 50,001 - 250,000

☐ 250.001- 1,000,000　　☐ 1,000,001- 5,000,000

☐ 5.000,001 - 10,000,000　　☐ 10,000,001 - 25,00,000

☐ 25,000,001 - 50,000,000　　☐ > 50,000,000

第二部分: 项目环境

1. 请说明您最经常参与的项目阶段.

□ 初始/概念　　□ 计划/发展

□ 执行/实施　　□ 结尾/交接

第三部分：工具

对以下列出的每个工具, 回答以下问题:
A- 使用: 这个工具的使用程度
B- 改进: 依您的观点，更多更好的使用这个工具可以改进项目表现的程度

A- 使用程度　　B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无　　0: 无

1: 非常有限　2: 有限　　1: 非常有限　2: 有限

3: 广泛 4: 非常广泛　　3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
规模		
1. 规模报告:	□ □ □ □ □ □	□ □ □ □ □ □
2. 变动申请:	□ □ □ □ □ □	□ □ □ □ □ □
3. 要求分析:	□ □ □ □ □ □	□ □ □ □ □ □
4. 工作分解模型:	□ □ □ □ □ □	□ □ □ □ □ □
5. 工作报告:	□ □ □ □ □ □	□ □ □ □ □ □
6.活动表:	□ □ □ □ □ □	□ □ □ □ □ □
7. 基线计划:	□ □ □ □ □ □	□ □ □ □ □ □

8. 基线计划调整:	□ □ □ □ □ □	□ □ □ □ □ □
9. 产品分解模型:	□ □ □ □ □ □	□ □ □ □ □ □
10. 价值分析:	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
时间		
1.帮助日程安排的项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
2.甘特表:	□ □ □ □ □ □	□ □ □ □ □ □
3.里程碑计划:	□ □ □ □ □ □	□ □ □ □ □ □
4.帮助监督日程进度的项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
5.关键路径方法与分析:	□ □ □ □ □ □	□ □ □ □ □ □
6.网络表:	□ □ □ □ □ □	□ □ □ □ □ □
7.帮助多项目日程安排的项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
8.学习曲线:	□ □ □ □ □ □	□ □ □ □ □ □
9.关键链方法与分析：	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度　　B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无　　0: 无

1: 非常有限　2: 有限　　1: 非常有限　2: 有限

3: 广泛 4: 非常广泛　　3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
交流		
1.进度报告:	□ □ □ □ □ □	□ □ □ □ □ □
2.启动会议:	□ □ □ □ □ □	□ □ □ □ □ □
3.交流计划:	□ □ □ □ □ □	□ □ □ □ □ □
4.工作授权:	□ □ □ □ □ □	□ □ □ □ □ □
5.项目交流室:	□ □ □ □ □ □	□ □ □ □ □ □
6.项目网站:	□ □ □ □ □ □	□ □ □ □ □ □
7.挣值管理:	□ □ □ □ □ □	□ □ □ □ □ □
8.趋势表或 S 曲线:	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度　　B- 更多更好的使用这个工具可以改进项目表现的度

0: 无　　0: 无

1: 非常有限　2: 有限　　1: 非常有限　2: 有限

3: 广泛 4: 非常广泛　　3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
学习		
1.经验学习/		
事后剖析:	□ □ □ □ □ □	□ □ □ □ □ □
2.客户满意度调查:	□ □ □ □ □ □	□ □ □ □ □ □
3 历史数据数据库:	□ □ □ □ □ □	□ □ □ □ □ □
4.经验学习数据库:	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
成本		
1.从上至下的估计:	□ □ □ □ □ □	□ □ □ □ □ □
2.成本/效益分析:	□ □ □ □ □ □	□ □ □ □ □ □
3.从下至上的分析:	□ □ □ □ □ □	□ □ □ □ □ □
4.帮助成本监督的		

项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
5.帮助成本估计的项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
6.成本估计的数据库:	□ □ □ □ □ □	□ □ □ □ □ □
7.参数估计:	□ □ □ □ □ □	□ □ □ □ □ □
8.生命周期成本 ("LCC"):	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度　　B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无　　0: 无

1: 非常有限　2: 有限　　1: 非常有限　2: 有限

3: 广泛 4: 非常　　3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A						B					
	不适用	0	1	2	3	4	不适用	0	1	2	3	4
质量												
1.客户接受表:	□	□	□	□	□	□	□	□	□	□	□	□
2 质量检测:	□	□	□	□	□	□	□	□	□	□	□	□
3.质量计划:	□	□	□	□	□	□	□	□	□	□	□	□
4.控制表:	□	□	□	□	□	□	□	□	□	□	□	□
5.因果表:	□	□	□	□	□	□	□	□	□	□	□	□
6.帕累托表:	□	□	□	□	□	□	□	□	□	□	□	□

A- 使用程度　　B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无　　0: 无

1: 非常有限 2: 有限 1: 非常有限 2: 有限

3: 广泛 4: 非常广泛 3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
风险		
1.风险管理文件:	□ □ □ □ □ □	□ □ □ □ □ □
2.突发事件计划:	□ □ □ □ □ □	□ □ □ □ □ □
3.风险排序:	□ □ □ □ □ □	□ □ □ □ □ □
4.风险信息的图表呈现:	□ □ □ □ □ □	□ □ □ □ □ □
5.持续时间概率		
估计 (PERT 分析):	□ □ □ □ □ □	□ □ □ □ □ □
6.风险数据库:	□ □ □ □ □ □	□ □ □ □ □ □
7.决策树:	□ □ □ □ □ □	□ □ □ □ □ □
8.帮助风险模拟的		
项目管理软件:	□ □ □ □ □ □	□ □ □ □ □ □
9.蒙特卡洛分析:	□ □ □ □ □ □	□ □ □ □ □ □

A- 使用程度 B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无 0: 无

1: 非常有限 2: 有限 1: 非常有限 2: 有限

3: 广泛 4: 非常广泛 3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A						B					
	不适用	0	1	2	3	4	不适用	0	1	2	3	4
整合												
1.项目章程:	□	□	□	□	□	□	□	□	□	□	□	□
2.责任分配矩阵:	□	□	□	□	□	□	□	□	□	□	□	□
3.财务衡量工具:	□	□	□	□	□	□	□	□	□	□	□	□
4.可行性分析:	□	□	□	□	□	□	□	□	□	□	□	□
5.配置回顾:	□	□	□	□	□	□	□	□	□	□	□	□
6.利益相关者分析:	□	□	□	□	□	□	□	□	□	□	□	□
7.质量功能部署:	□	□	□	□	□	□	□	□	□	□	□	□

A- 使用程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A						B					
	不适用	0	1	2	3	4	不适用	0	1	2	3	4
人力资源												
1.帮助资源分配安排的 项目管理软件:	□	□	□	□	□	□	□	□	□	□	□	□
2.团队成员表现评估:	□	□	□	□	□	□	□	□	□	□	□	□
3.团队构建活动:	□	□	□	□	□	□	□	□	□	□	□	□
4.自我指导的工作团队:	□	□	□	□	□	□	□	□	□	□	□	□
5.帮助资源均衡的												

项目管理软件: □ □ □ □ □ □ □ □ □ □ □ □

A- 使用程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

B- 更多更好的使用这个工具可以改进项目表现的程度

0: 无

1: 非常有限 2: 有限

3: 广泛 4: 非常广泛

请确定您回答了使用（A）和改进（B）两个问题

	A	B
	不适用 0 1 2 3 4	不适用 0 1 2 3 4
采购		
1.出价文件:	□ □ □ □ □ □	□ □ □ □ □ □
2.供应商评估:	□ □ □ □ □ □	□ □ □ □ □ □
3.供应商会议:	□ □ □ □ □ □	□ □ □ □ □ □
4.合同承诺数据的数据库:	□ □ □ □ □ □	□ □ □ □ □ □