A Framework for Assessing and Analyzing Project Management Software Success

'The Power of Methods and Well-chosen Software'

J. van de Waal

Master Thesis
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"The Power of Methods and Well-chosen Software"

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Management Summary

Executive Summary

The wide deployment of projects in organizations today has not been accompanied by a parallel development of successful project management software. Frequently failing project management applications are being reported.

Since almost every project management software package includes an overwhelming amount of functions and features, this study will not address these characteristics of project management software. It will be the surrounding factors, such as the project organization and the supporting project management methods that are at the center of attention.

Consequently the goal of this study became to uncover important contingency factors that determine the success of project management. But before these factors could be exposed, first the project management and the information systems fields had to be explored.

Therefore this study starts giving an extensive review of the project management literature. Based on this information a preliminary framework was built, which incorporates some promising contingency factors of project management software success.

But in order to study the associations these factors may have with the success of project management software, one must be able to measure this success first. With the help of the widely recognized DeLone and McLean's Information System Success Model and two additional technology adoption models a construct was developed. With this construct the variable 'Project Management Software Success' could be assessed in a comprehensive and reliable way. The next stage in the research was the transformation of the contingency factors and constructed variable into measurable items.

Based on these items a Web survey was developed which was available in two languages. By using different promoting techniques in total 228 valid surveys were returned. This number of responses resulted in an impressing amount of very useful data. This data was analyzed very extensively and with help of the framework various patterns and associations were discovered. Merely the most surprising and practical discoveries will be highlighted here.

Indeed the findings demonstrate that many project management applications are still being considered unsuccessful. Just 53 percent of all 228 respondents indicated that the most often used software within their organizations is successful.

As had been anticipated, Microsoft Project is still by far the most used project management software, as it was reported by 36 percent of the respondents. Unfortunately, the majority of MS Project users (51 percent) rated this software as being unsuccessful.

Less surprising but still very important is top management commitment. Project management software that has the support of top management is successful in 73 percent of the cases.

When it comes to project management methods, these seem well accepted by now, with 82 percent of the respondents indicating formal methods are being used in their organization. Within the standard methods, PRINCE2 is still leading, followed on a relative distance by PMBOK. The use of these formal methods is as well positively associated with the success of project management software. Of the respondents that indicated these methods were used within their organization 59 percent reported successful project management software. But even more fascinating is, when these respondents indicated they were using so-called method-specific software, instead of generic or custom-built, the success rate will increase to 74 percent.

Is your project team reluctant to work with this kind of software that has specially been developed to support a particular method? No problem at all, just make the software mandatory, since mandated use environments are associated with a higher success rate of 62 percent as well. The main findings can be summarized as follows, project management applications should be method specific, should have the support of top management and should be used under mandated conditions in organizations that are using standard project management methods as well (e.g. PRINCE2 or PMBOK). Applications in these ideal situations turn out to be successful in 90 percent of the cases!

"Success is not final, failure is not fatal:
it is the courage to continue that counts."

Sir Winston Churchill
British politician (1874 - 1965)

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Abbreviations and Explanations

Abbreviations

BPR	Business Processes Re-engineering
CPM	Critical Path Method
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
DSDM	Dynamic Systems Development Method
ERP	Enterprise Resource Planning
IS	Information System
IT	Information Technology
KMS	Knowledge Management Systems
OGC	Office of Government Commerce
OSS	Open Source Software
P3M3	Portfolio, Programme & Project Management Maturity Model
PB	Project Board
PERT	Program Evaluation and Review Technique
PM	Project Management
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMM	Project Management Methodology
PPM	Project Portfolio Management
PRINCE2	PRojects IN Controlled Environment version 2
RUP	Rational Unified Process
SaaS	Software as a Service
SSADM	Structured Systems Analysis and Design Method
TAM	Technology Acceptance Model (Paragraph 5.2)
TTF	Task Technology Fit Model (Paragraph 5.3)
XP	eXtreme Programming

Explanations

Programme	*"A programme is a framework for grouping existing projects or defining new projects, and for focusing all the activities required to achieve a set of major benefits. These projects are managed in a coordinated way, either to achieve a common goal, or to extract benefits which would otherwise not be realized if they were managed independently. Programmes differ from projects in that they do not necessarily have a single, clearly defined deliverable, or a finite time horizon (Pellegrinelli, 1997:142)."*
Programme management	*"Programme management is the integration and management of a group of related projects with the intent of achieving benefits that would not be realized if they were managed independently (Lycett et al., 2004:289)."*
Project portfolio management	*"Project portfolio management is a dynamic decision process, whereby a business' list of active new products (and R&D) projects is constantly up-dated and revised. In this process, new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and reallocated to the active projects (Cooper et al., 2001:362)."*

Acknowledgement

On a Saturday afternoon, purely coincidental, I met Sander Nijenhuis at IKEA Hengelo, where I then was working part time. We knew each other ever since he started dating my former girl next door. As we didn't meet recently, he proudly gave me an update about the successful business, called Fortes Solutions, he had founded. I asked him lighthearted if he, by any chance, needed graduates. Surprisingly he did. Thus a couple of weeks afterwards I called him and we made a settlement.

The assignment was to investigate why most project management applications so often are reported as being unsuccessful. This would be very interesting to Fortes Solutions since they developed the Principal Toolbox, an innovative project management application, which more often than not is reported as being very successful. This assignment did fit nicely in the context of Innovation Management, the specialization track of the Master Business Administration I had enrolled. In the spring of 2007 I started my research at Fortes from behind an IKEA desk. Yes, I am quite an excellent salesman.

Over a year later, I can look back with good memories about my time at Fortes Solutions. During my stay I witnessed the success of Fortes myself as the office was moved to a more impressive building, additional offices were opened and the number of employees still kept growing. In the meanwhile something else kept also growing, but more about this later. The time at Fortes flew by with tremendous speed. Just before Christmas 2007 I said goodbye to Fortes and the last part of this thesis work was finished from behind my desk at home.

Now my thesis work is almost finished, it is time for me to thank the persons who have made important contributions to this report. Of all the people that deserve a confirmation of my gratitude I shall mention few.

At first I want to express my sincere gratitude to Sander Nijenhuis. I feel very much thankful for the chance he has offered me at Fortes Solutions. I have learned much more than writing a thesis during my stay at Fortes Solutions. I want to thank him for his continuous inspiration, critical reflections and showing me different facets of running a business. I want also to express my gratitude to all Fortes' employees as they made me feel very welcome and always were prepared to answer my questions. But above all I really enjoyed the peculiar discussions during the lunchtimes. A special expression of my gratitude goes to Berend Tel and Ruud Peltzer as I appreciate their continuous support, their contribution of expertise and their personal network I needed for this study. Their efforts and guidance during my study have always been very helpful.

Then I would like to thank both my supervisors from the University, Ton Spil and Tanya Bondarouk, for all their critical comments, suggestions and patience with me. Their enthusiasm and knowledge helped me a lot in finishing this thesis.

To finalize my respects I should refer to my girlfriend Marieke and my parents, who have been waiting for this occasion far too long but always kept supporting me. As Winston Churchill already mentioned long ago: *"Success is not final, failure is not fatal: it is the courage to continue that counts."* Hopefully my courage to continue studying for almost 14 years now will pay off at last, and will my dear son Sietse, who was born on December 23, have a graduated father.

I hope after reading this thesis one will understand more about the factors that can be associated with the success of project management software. But above all I aspire that you find it interesting to read.

Joost van de Waal

Hengelo, June 3, 2008

Figure 1 My son Sietse (just 4 weeks old) on his photo[illegible] reviewing [illegible]

Note from the Author

The paper that is in front of you is the original volume, named 'Volume 1'. This paper is an extensive document that serves the purpose of a master's thesis.

There has also been constructed a compressed report, named 'Volume 2'. This volume was derived form the original thesis. Modifications, especially in argumentation, abbreviations and omissions of many scientific writings have been made to make it more appropriate for publishing purposes.

Most participants will receive this compressed volume, which is a more informative and reference report. This 'Volume 2' has been constructed for the Project Management Institute Netherlands and other publishing agencies as well. In addition this compressed report can serve as a brief summary of 'Volume 1'.

1 Introduction

This chapter can roughly be divided in two parts. The first part 'background' will illustrate the drive that led to this thesis and tells the story about the company from where this assignment was carried out. In the second part 'research approach' the framework of this thesis will become clear. Furthermore this paragraph explains the structure of this research project.

1.1 Background

This paragraph will describe why (Motive), what (Preliminary Research Assignment) and where (Fortes Solutions) this research was started.

1.1.1 Motive

The motive for conducting an investigation to the implementation of project management software tools was based on several grounds. These were the increasing role of project management in society and science, the frequently reported failure of information systems, my own interests in project management and an issue in a report of Ernst & Young[1]. The two grounds will be given more detail later on (Paragraph 1.2). My own grounds were explained in the 'acknowledgements' of this report. The fourth ground, which formed the immediate part of the motive, will be explained here.

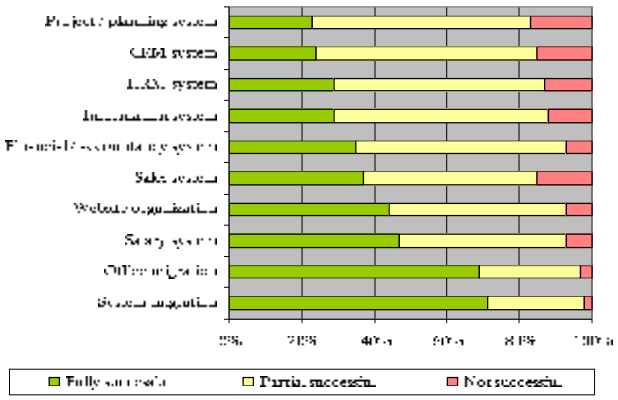

Figure 2 Success-level of different systems (Ernst & Young, 2006)

In a report of Ernst & Young (2006) was stated that system and office migrations are most frequently full successful. The implementations of project and planning software were most often reported not successful (Figure 2). These findings were based on the results of a survey, which was filled in by 600 respondents (CEO's, managers and professionals). This report came under the attention of Mr. Nijenhuis, founder and managing director of a company called Fortes Solutions (Section 1.1.3). His interests were immediately aroused as Fortes Solutions core business is providing project portfolio management software.

1.1.2 Preliminary Assignment

In 2006 the managing director of Fortes Solutions started a cooperation bond with the University of Twente. This bond had as goal to exchange knowledge. As part of this knowledge exchange deal the director of Fortes formulated a preliminary research assignment. "*Why are implementations of project management systems in comparison with other IT implementations relative unsuccessful and how can these be improved in functional and methodical ways?*" These questions heralded the beginning of this research assignment. Before the assignment will be explained further, first a quick look will be given to Fortes Solutions.

1.1.3 Fortes Solutions

Fortes Solutions was founded in 1997. It started as Fortes Engineering with the detachment of higher educated professionals. After a while the core business shifted more to inter- and intranet solutions and the company name turned into Fortes Solutions. For the ease of reading, Fortes Solutions BV will be directed as Fortes in this thesis.

The present Fortes develops and commercializes an open software platform based on an intranet application. This Web-based project portfolio management software is named Principal Toolbox (Figure 3). This application can be used for streamlining and accelerating

[1] Ernst & Young is a leading Dutch organization that provides four core services: accountancy, tax advice, transaction advisory services and legal advice.

work processes in large project organizations. The Principal Toolbox focuses on the following areas: program, portfolio, project and knowledge management. In the Principal Toolbox the project management method PRINCE2 (will be described in Section 2.3.8) is embedded. Customer organizations of Fortes vary from public organizations (e.g., police forces and the Dutch Ministry of Defence) to large private companies (e.g., energy, construction and banking companies). Fortes has clients all over Europe, Asia and Africa.

In 2007 Fortes positioned itself on the eleventh position of the Deloitte[2] Technology Fast 50. This is a list of the 50 fastest growing technology based firms in the Netherlands. The selection of the winners is based on the percentage increase of the turnover in the last five years. At this moment fourteen highly educated employees are working at Fortes; this number increases rapidly.

1.2 Research Relevance

In the preceding paragraph the motivation behind this research project was given. In this paragraph the preliminary research assignment will be translated into a more unambiguous problem statement. The paragraph kicks off with unfolding the potential contributions of this thesis for practitioners and scientists. After explaining the relevance, the scope of this research thesis will be determined. Feasibility and time limitations will be considered to increase the attainability. With having the scope clear in mind, the research problem, objectives and questions will be described. In the subsequent section the argumentation behind the choice of the research method is given. The closing section gives an overview of the thesis structure. This overview makes clear what steps need to be taken to solve the research problem of this research.

1.2.1 Practical Relevance

The practical relevance is split up in two parts. The community part explains, from a broad view, the significance of this research for the society as a hole. The second part is more specific about the importance of this thesis in behalf of Fortes.

Community

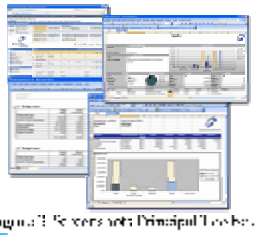

Figure 1: Screenshot Principal Toolbox

In what ways can the outcomes of this research benefit society? Winter et al. (2006) note that one of the most important organizational developments in recent years has been the considerable growth in project work across different sectors and industries. Also the PMI (2000:3) refers to the project management field as an *"emerging profession"*. Which according to Söderland (2004a:655) has been witnessed *"increasing interest"* by many researchers. With the growing importance of this field the significance of successful implemented project management software is as well increasing. Hopefully this study will reveal the cause or at least gives some directions in why so many implementations of this software fail. By unfolding these causes, the companies that deliver, as well as companies that use the software, can setup the implementations in such ways that the success rates increase. More success will lead to better business results and eventually presumable higher welfare.

Fortes Solutions BV

Explicit for Fortes the relevance of this study is that the outcomes may elucidate the perceived success of their project management software and accompanying services. Having a clarified view of their strengths (or perhaps weaknesses) can help Fortes to develop further. A clear vision of their strong points can help during the acquisitions of new customers.

1.2.2 Scientific Relevance

Scientific relevance refers to *"the usefulness of the research results for science"* (Geurts, 1999:133). This research is covering two fields of science. In both fields interaction between

[2] Deloitte Netherlands is the largest Dutch firm in accountancy, tax, consultancy and financial advice. They have about 6,000 people working in the Netherlands.

humans and technique is important. The first field is the project management field. The second field is the software success field. This thesis will summarize several theories, models and best practices of both fields. Based on this knowledge a conceptual framework will be constructed, which covers both fields. This model will be used to explore the presumed influence of several variables on the variable 'Project Management Software Success'.

The first contribution for science may be the synopsis of several scientific writings in both fields. Second, the conceptual framework, which was based on these scientific writings, could be an impulse to investigate in more depth the presumed relations between several factors and their influence on the software success. Last but not least, with anticipation science might benefit from the data that was collected by this research. Hence this data could be used to discuss the dependent variable 'Project Management Software Success'.

1.3 Problem Formulation

The problem, which is the axis this whole research revolves around, is one of a practical kind. It seems that project management software often is failing. If this is true, how can this be explained and what possibilities are there to increase the success rate? Before the research questions will be stated, this paragraph starts with a detailed description of the objectives.

1.3.1 Research Objectives

This thesis has five objectives. Each objective emphasizes a different phase of the research. These phases are the explorative, the descriptive, the explanatory and the presentation phase.

First Objective – Exploration of the Field

The first aim is to explore the project management field by scanning and reading many books and articles about these subjects. The aim of this exploration should be to uncover topics or even relations that could be responsible for the low success rate of project management software. This exploration will have to be summarized so it also can serve as an introduction for the readers of this thesis that are unknown with these management fields.

Second Objective – Describing Promising Contingency Factors

The next objective is to select – based on arguments – interesting and possible factors that could be responsible for the low success rate of the project management software. These factors should then be described into more depth with help of literature.

Third Objective – Assessing Project Management Software Success

The third goal is to measure the success of project management software. Theories about measuring information system success should be reviewed. Hopefully a measure instrument can be developed with appropriate elements found in these theories.

Fourth Objective – Examination of Likely Associations

The fourth goal is to determine if the hypothetical associative relations between the proposed contingency factors and the success of project management software implementations really exists.

Fifth Objective – Presentation of the Results

The final ambition is to present this study in a master thesis. This thesis will have to encompass sufficient scientific quality. Further the research findings will have to be attractive enough to be published. In this way the findings possibly will reach the practitioners in the project management field.

1.3.2 Research Questions

This section describes the knowledge which is necessary in order to reach the objectives of this research. Therefore the questions will be listed that have to be answered in this research to be able to gain the required knowledge.

First a central question is posed, which will be split up in sub questions. Each of the sub questions is corresponding with an aspect of the central question that needs research. The answers to these sub questions can derive directly from theories in scientific literature or from the analysis of the data that will be gathered with the research tool.

Central Question:

- *"What are important contingency factors of project management software success and how can this success be measured?"*

Contingency factors are those environmental aspects which can be associated with the success of project management software. Project management software success is in this thesis defined as the percentage of the respondents (project managers and project team members) which states the project management software -that is most obvious to be used within their organization- is considered as a success within their organization. This belief of success (or failure) will be a constructed variable that is composed of several dimensions and represents the success as being perceived from various perspectives. This central question is split up into several sub questions. If questions are answered the central question

Sub questions:

- *"What factors, belonging within the context of the project management field, could be responsible for the assumed low success rate of project management software?"*
- *"What dimensions, suggested by previous studies and theories of information system success research, could be used to assess the constructed variable project management software success?"*
- *"How can the supposed associations between these contingency factors and project management software success schematically be presented in a framework?"*
- *"What instrument is the most appropriate, within the scope of this research, for measuring the items within the framework and how should this instrument be developed?"*
- *"What patterns and associations can be found by analyzing the data which was obtained by the instrument?"*
- *"What could be concluded based on these findings about the presumed contingency factors and the measured project management software success?"*

1.4 Research Approach

In the previous paragraph the research questions of this thesis have been mentioned. This chapter will discuss and motivate how the research will be conducted.

1.4.1 Literature Search Strategy

The theoretical exploration was carried out using the available sources of University of Twente and Fortes Solutions. For this exploration, three main sources were used: the library online catalogue, online article databases (e.g. Scopus) and numerous electronic journals.

The first step of the search strategy consisted of defining the main concepts related to the master's thesis topic, these were: project management, project management software and information system success.

The second step was the listing of keywords that described the concepts in order to search the available sources. Examples of keywords that had been used are: project, project management software, management software, planning software, information system, software success, system performance, critical success factors software, software implementation, custom-built software, packaged software, COTS software etc. Of course the Dutch translations of these words were also used in the search queries.

The third step was quick scanning the sources (e.g. Web sites, pdf files, books). Promising sources were saved and catalogued in maps corresponding to one of the main subjects. These subjects were: project management field, project management methods, project management software, general software types, software success measures and scientific methods.

The strategy used was searching broad and general at first. This resulted in general project management books and articles about software implementations. Later on the search became more specific and up to date, resulting in articles, electronic journals, Web sites and dissertations. These handled more specific topics like 'Perceived Usefulness', 'Management Commitment' and reviews about particular theoretical models. Besides these sources, the references in articles, journals and dissertations, as well as the internet forums and hints from practitioner experts were used in finding new sources.

1.4.2 Scope of Thesis

During the first two months of conducting this research the assignment became more and more concrete and feasible. It also grew in practical relevance without loosing in scientific relevance. The initial assignment stated in the previous paragraph is very general and large scaled. It states a general goal that could serve for multiple and different research projects or theses. The scope of this research thesis needs to be narrowed down to have usable and reachable results. Trying to accomplish the whole goal in this one thesis will be very hard mainly due the following two reasons:

Width of the Research

The project management and software field appeared to be large and complex fields. More than 300 scientific articles from well established journals (e.g. Management Science, International Journal of Project Management, Information Systems Research and Journal of Management Information Systems) about these fields were collected from the internet. These articles were scanned during the exploratory literature research. The most relevant and most cited articles then were thoroughly read. By reading this literature it became clear both fields are handling a very wide range of subjects.

Time Constraint

The amount of time that should be spent for accomplishing this thesis is about six months. Considered all the facets, that the initial assignment covered, this probably will not be achievable without making some necessary restrictions (Paragraph 10.3). A summary of how the time was actually spent during this research can be found in the Reflections (Section 10.7.2).

Determination of Domains

Bearing in mind these two reasons, it became clear that the research area had to be reduced. Narrowing down the scope could result in the loss of practical and scientific relevance. In order to make sure that the practical relevance losses remained modest, a table was drawn. This table (Table 1) contains the main domains and their range levels. During a discussion session with the manager director and the chief of the programming department of Fortes the temporary scope boundaries were selected.

Domain	Business Areas	Organizations	Participants	Software Types	Contingency Factors	Software Success
Broad Scope	Compare PM area with other areas	Different sized organizations in different activity sectors	People who work in project organizations	Compare many different PM software applications	Analyzing many possible success factors	Success determined by many measures
	Compare PM area with one other area	Same sized organizations within one specific activity sector	People who use PM software	Compare a few archetypes of PM software	Focus on a few possible success factors	Success determined by a few measures
Narrow Scope	Evaluate situation(s) within PM area	One specific organization within one specific activity sector	One specific group of project team members (e.g. project managers)	Evaluate one particular PM software application	Focus on one possible success factor	Success determined by one measure

Table 1 Research scope boundaries

In this subsection the determining of the scope within several domains is being clarified. In order to compare the success of project management systems with other systems, a variety of systems would have to be studied. And even then it probably would be hard to prove that the differences between the different systems are truly caused by the distinctiveness's of each

system type and not by situational conditions. Also the greater the uniqueness of each system the harder they can be compared. Taking these considerations into account the decision was made to compare merely different project management software.

The units of analysis in this study will different sized organizations operating in different sectors. This choice was based on two reasons. First, by analyzing project management software implementations in many different organizational contexts, comparisons can be made between different situations. This hopefully reveals contingency factors that lead to situations where the software is relative more successful or less successful. Secondly, by setting the unit of analysis as wide ranged the chance of assessing extra respondents increases.

The units of observation will be people who work in project organizations. They can be 'executives', 'project managers' or 'project members'. It's possible they are currently not working with project management software. By keeping the units of observation wide ranged the population of respondents increases and the chance the actual 'Perceived Project Management Software Success' as considered within the whole organization will be measured and not only the 'Perceived Success' from a singular perspective.

The choice of comparing a few different archetypes of project management software was based on three reasons. By classifying all the software into some archetypes, each type probably will have enough cases to be statistical significant. It's hoped for that in this way the intrinsic strengths and weaknesses of each archetype become more understandable. With any luck the analysis of the differences between these types will show some interesting findings that can be associated with other contextual variables.

Because of the limited time and resources the focus will be restricted to a few promising contingency factors. These particular factors will be identified with help of an exploratory literature research and some conversations with practitioners in the project management area.

The success of the project management software will be determined with help of some existing measures of software success. These measures shall belong to only a few theoretical models that cover different perspectives and are complementary to each other. By doing this the likelihood of the measured success representing the actual perceived success by the organization hopefully increases.

Based on these decisions it can be concluded the reasoning of this study will be more nomothetic instead of idiographic. This research tries to examine a class of situations (several types of project management software in different contexts) rather than taking a single case in complete consideration. More over it seeks to associate certain relations 'economically', using only just a few contingency factors.

1.4.3 Research Method

This study will be a quantitative large sample cross-sectional study. The most important rationales for choosing this particular approach were the smaller risk of the findings being biased by the partisanship of Fortes, the ability of comparing the results with other studies, the attractiveness of publishing figures and the mentioned time constraint. The extensive argumentation of these method choices is described in Appendix V.

The experimental units of analysis will most likely be large number of individuals who work with project management software. These units of analysis can't be assigned to certain conditions. Instead the quantified conditions these units will be studied at one point of time. Although possible causal relations will be suggested and discussed with help of literature, the findings will be limited to the revealing of associations between the contingency factors and the constructed variable.

1.4.4 Outline of the Report

The main composition of this thesis will be structured in a linear analytic way. Most journal articles in experimental science and many case studies reflect this type of structure (Yin, 2003). Usually it starts with the problem, then a review of prior literature, proceeding with using methods, collecting and analyzing data, mostly it ends with the conclusions. The main structure of this thesis is displayed on the next page (Figure 4). In Appendix V a more com

prehensive scheme can be found, which also comprises alternative reading routes and levels of theoretical abstraction.

This thesis starts with an introductory chapter, where the motive, the research problem, the objectives and the research method will be brought up. The context, the project management field, will be introduced in Chapter 2. Many different subjects, like the history, definitions and tools will be described in this chapter. Based on the literature, which was explored in Chapter 2, a preliminary framework with the most promising contingency factors will be developed in Chapter 3. This framework will contain several factors and some supposed associations on project management software success.

In the 4th chapter the in contingency factors will be investigated in more depth. Literature about these factors will be reviewed and taxonomies of these variables will be built. Chapter 5 commences with the reviewing of several acknowledged theoretical models that are often being used to measure information system success. In this chapter the strong and weak points of each model will be discussed. In Chapter 6 the framework, which was introduced in Chapter 3, will be refined. Based on the taxonomies built in chapter 4 and the theoretical models reviewed in Chapter 5 all the items and their attributes will be specified.

An instrument will be designed and constructed in Chapter 7. This instrument should measure the attributes of the contingency factors and the constructed variable 'Project Management Software Success'. The plan of how instrument shall be promoted will also be described in this chapter. Chapter 8 is about the coding, editing and cleaning of the data which was obtained by the developed instrument.

In Chapter 9 this data will be analysed. This will be done in two steps. The primarily analysis will focus on single variables while the secondary analysis will focus on associations between variables. The thesis ends with Chapter 10. This chapter will include a presentation of the main findings, a discussion, the limitations of this thesis and the conclusions. The chapter will be closed with recommendations for further research and reflections about working on this thesis.

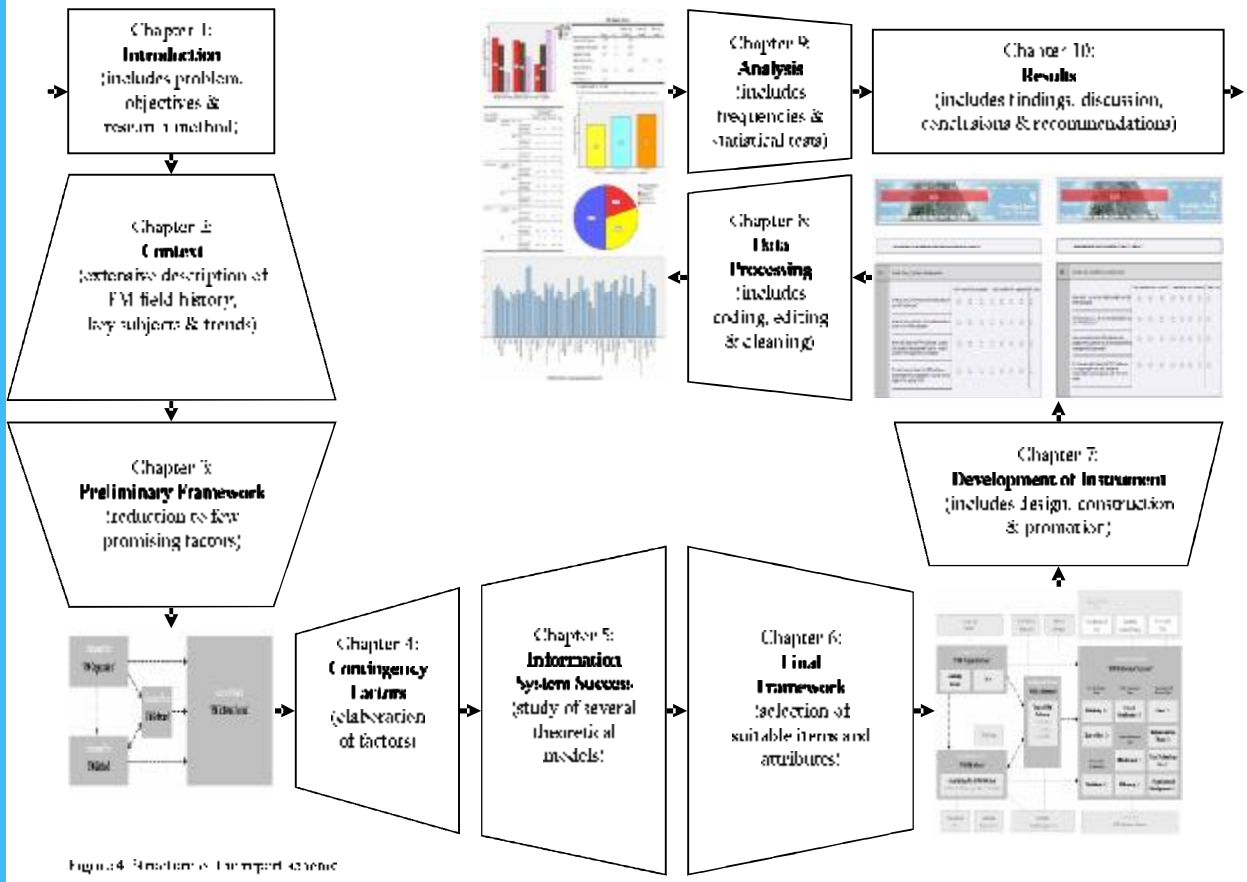

Figure 1.4: Structure of the present research

2 Context

In the previous chapter the research questions and methods were described. However, some important concepts such as 'Project Management', 'Project Management Software' and 'Software Success' remained for the most part unexplained. Therefore the wide ranging field of project management will be explored in this chapter. This chapter summarizes the exploratory literature study about project management. The complex concept 'Information System Success' will be discussed later on in Chapter 5. After reading this chapter the definitions, the developments in history, the main subjects, the findings of earlier studies and the predictions about future developments in the project management field hopefully will be clearer. For the ease of reading 'project management' will further be abbreviated as 'PM'.

2.1 Definitions PM Field

In order to understand the definition of 'project management' first the definitions of 'management' and 'project' will be described.

2.1.1 Definition Management

Figure 5: Henri Fayol (1841-1925)

'Managing' was well defined long ago by Henri Fayol (Figure 5). He asserts management as: *"To manage is to forecast and plan, to organize, to command, to coordinate and to control. To forecast and plan means examining the future and drawing up the plan of action. To organize means to build up the dual structure, material and human, of the undertaking. To command means maintaining activity amongst the personnel. To coordinate means binding together, unifying and harmonizing all activity and effort. To control means seeing that everything occurs in conformity with established rule and expressed command"*(Fayol, 1916).

Based on this definition 'management' can be seen as an activity. It is the activity of planning, organizing, directing and controlling. It is about communicating, deciding and using resources. In the words of a leading management thinker, Peter Drucker: *"It is a practice not a science. It is not knowledge but performance"*(Drucker, 1974).

2.1.2 Definition Project

The word 'project' is derived from Latin, where 'pro' means forward and 'jacere' means 'throw'. As a result the original meaning of a project is something that has been thrown forward in a figurative sense, like a proposal. This original meaning has gradually been extended to include the process of realizing the proposal (Portny, 2001).

At the present time there are many definitions available of what a 'project' is. Many writers (e.g. Mintzberg, 1983; Van Aken, 1996; Suharic, 2001; Newton, 2006) have tried to capture the concept 'project' in a definition. The discussion about the most precise and best definition, or even if a definition is needed in the first place, still goes on these days (e.g. Munk-Madsen, 2006).

Turner (1999) compared many project definitions and based on this knowledge he formulated a definition himself. His definition covers most aspects, thus it's cited here: *"A project is an endeavour in which human, financial and material resources are organized in a novel way to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives"* (Turner, 1999:3).

In this definition the most common conditions of a project are highlighted, these are:

- *Every project as a product or service is different (novel) in some distinguishing way from all other products or services. A project can also be an activity like an organizational change. A project is not a part of the normal operations.*
- *Every project is temporary. It has a definite beginning and a definite ending.*
- *The conditions of a project are predefined (outcomes, time, costs and quality).*

2.1.3 Definition Project Management

Most definitions of PM would agree that, at a minimum, PM involves: *"The integration of the work of others needed to assure project success"*(Morris, 2004:5). This integration can be

achieved by carrying out certain PM functions, practices belonging to different knowledge areas. It is the extent of utilization of these functions, knowledge areas, practices and the nature of the integration that leads to differences in definitions. Many of these topics will be explained soon (Paragraph 2.3).

An example of an often used definition of project management is formulated by the OGC[3]: *"Project management is the planning, monitoring and control of all aspects of the project and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance. (OGC 2005:2)".*

2.2 History PM Field

To understand the field of PM as it currently exists, it can be useful to have some knowledge about how it changed over time.

2.2.1 Early PM

People have been working on projects since the early days of organized labor. The Egyptian pyramids, the Great Chinese Wall and the construction of factories during the Industrial Revolution are examples of major projects of historic importance (Jurison, 1999; Gevers & Zijlstra, 1999; Grit, 2005).

2.2.2 20th Century PM

Figure 6 The Great Chinese Wall

The intellectual roots of the PM discipline are frequently traced to various planning techniques (i.e. tools, see Section 2.3.6) such as PERT- and CPM[4]. Often Henry Gantt is seen as the forefather of modern PM. He invented the Gantt Chart[5] as a PM technique (Söderland, 2004b). Management historians, like Snyder and Fondahl (1987), are pointing to the 1950s as the birth era of modern PM. At that time PM as a special form of management evolved from the work done on several large defense programs (Stretton, 1994a).

In the 1960s, techniques like PERT, CPM and the Gantt Chart continued to be popular in the aerospace and construction industries (Kerzner, 1998). During the 70s 'teamwork' became the center of attention in the PM field (Shenhar, 1996). Another writer (Stretton, 1994b) also notes the emphasis on work breakdown structures (abbreviated as WBS) and systems concepts during the 70s.

According to Stretton (1994c) the 80s were characterized by a focus on project organization, project risk, external influences to projects, and the early work on the development of standard PM methods (Section 2.3.7).

Crawford et al. (2006) examined the trends of PM during the 1990s and early 2000s. During this time period project evaluation and improvement next to strategic alignment were increasing in significance to the field. In addition they found evidence of the reduction of quality management and interpersonal issues in PM.

2.2.3 Present PM

Figure 7 Henry Gantt (1861-1919)

These past developments as described in the preceding section show that the PM field continue evolved itself. Today, PM is concerned with a much wider range of durations and levels of complexity (Maylor, 2001) than it was 50 years ago. In order to understand a recent challenge, the low success rate of PM software implementations, several important themes of the PM field will be explained in the next paragraph.

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[3] The Office of Government Commerce (OGC) is an independent office of Her Majesty's Treasury, a department of state in the government of the United Kingdom. This office developed the project management method PRINCE2.

[4] The Project Evaluation and Review Technique, abbreviated as PERT is a model for project management to analyze and represent the tasks involved in completing a given project.

[5] The Critical Path Method, abbreviated as CPM, or critical path analysis, is a mathematically based algorithm for scheduling a set of project activities.

[6] A Gantt chart is a popular type of bar chart that illustrates a project schedule (see section 2.4.5).

2.3 Key Subjects PM Field

This paragraph is certainly no all-embracing PM portrait. The PM field is immense with many different perceptions, processes and knowledge areas. The objective of this paragraph is to introduce the reader to various important topics in the PM field.

2.3.1 PM Theories

Today's broad deployment of projects in organizations has not been accompanied by a parallel development in PM theories. Many authors have tried to develop PM theories (e.g. Pinto & Covin, 1989; Winch, 1995; Shenhar & Dvir, 1996; Crawford, 2006; Martinsuo & Lehtonen, 2007).

Besides these attempts various PM maturity models have been introduced to assess and to improve organizations PM effectiveness (e.g. McCauley, 1993; Remy, 1997; Kwak & Ibbs, 2002, Grant & Pennypacker, 2006). The Capability Maturity Model (Humphrey, 1989) laid the foundation of most these PM maturity models. The Capability Maturity Model (CMM) is a process model based on software best-practices effective in large-scale multi-person projects. The Project Management Institute's PM Body of Knowledge (PMI, 1985) and the more recent OGC's (2006) Portfolio, Programme & Project Management Maturity Model (P3M3) are prominent examples of PM maturity models (Appendix VII, Figures 130 & 131).

Many writers (e.g. Betts & Lansley, 1995; Söderland, 2004b; Tanaka, 2005; Kolltveit et al., 2007) have stressed the importance of working on PM theory or perspectives building, while others (e.g. Koskela & Howell, 2002, Morris, 2004) argue about the added value of such theories. Although there still aren't any generally acknowledged PM theories or models, there are quite a few generally accepted terms that form the PM vocabulary. In the next sections a selection of these terms will be reviewed.

2.3.2 PM Constraints

Figure 8 Classic Triple Management Triangle

Like any human undertaking, projects need to be performed and delivered under certain conditions. Traditionally, these limiters have been listed as scope (features, functionality) i.e. what must be build, resources (cost, budget) i.e. how it must be build and schedule (time) i.e. when it must be build. These are also referred to as the 'Iron Triangle', where each side represents a constraint. One side of the triangle cannot be changed without influencing the others. A further refinement of this triangle into the 'Classic Project Management Triangle' (Figure 8) separates 'quality' or 'performance' from scope, and turns 'quality' into a third constraint which replaces scope (Barnes, 1969) or turns 'quality' into a novel fourth perimeter. A common misconception about this model is that the triangle implies the project manager's job is to 'deliver within the constraints'. This isn't correct. The project manager has to make a plan that can deliver the project scope, to the required quality, within the necessary timeframe and using the available resources.

The Classic Project Management Triangle, which over the last 40 years has become unavoidably linked with measuring the success of PM, has been criticized by numerous writers. Morris and Hough (1987), McCoy (1987), De Wit (1988), Pinto and Slevin (1988), Saarinen Stewart (2000) all agree cost, time and quality should be used as success criteria, but these constraints are not exclusively. For instance, Atkinson (1999) proposes to shift the focus of measurement for PM from the exclusive process driven criteria, the 'Iron Triangle', to the 'Square Route' (figure 9). This Square Route adds several criteria from other models that measure success, like the DeLone and McLean Model (Chapter 4), in a sequence to the 'Iron Triangle'. Atkinson notes the 'Square Route' was not meant to be an exhaustive model, however it was intended to indicate there are more criteria possible.

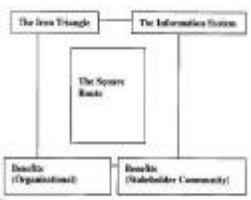

Figure 9 The Square Route Model, by Atkinson (1999)

The most serious critics on the PM constraints come from the process management field. According to this field the majority of the project approaches assume that problems and solutions are reasonable stable within certain limits. This relative stable condition allows the use of PM techniques like time schedules, clear static goals and targets. These techniques will only work in a static world. When the activity is dynamic, which is more realistic, a project approach is impossible and a process approach is more desirable. Dynamics can be caused

internally or externally. An example of an internal dynamic is that an activity starts as a project (only removing a painting) but develops into a process (redecorating wall and refurnishing complete house) by the project owner. An example of an external dynamic is that an activity starts as a project (e.g. stretch of railway line) but turns into a process as external parties (e.g. environmental groups demanding tunnels etc.) interfere with the project (De Bruijn et al., 2002).

2.3.3 PM Stages

There are four distinct project phases or stages which make up the typical project life cycle, namely: definition, planning, execute and termination (Pinto & Prescott, 1988). Even though sometimes the stages bear different names or extra stages are added (e.g. Wideman, 1987; Kor & Wijnen, 1997) the main idea is generally the same. One of the most accepted project life cycle frameworks was suggested by Adams and Barndt (1978). The four stages of their model will be described here (Figure 10).

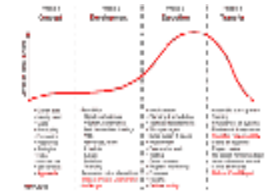

Figure 10: Project Life Cycle Stages

The first stage is the definition (or initiation/conceptualization) phase, here ideas are evaluated and the preferred approach is defined. The project team decides what they intend to produce (deliverables) and how they will know they have completed the project. The final activity in the definition stage is launching the project.

During the planning stage of the project the concept is verified and developed into a workable plan for implementation. The objectives are defined along with the required deliverables. At this stage the core project team is formed.

The executing or development phase of the project is the phase where the project plan is carried out. Projects continue in different ways depending on the required project outcomes as well as the schedule, cost and staffing constraints.

The project is completed and documented in the termination stage. The finished product is transferred to the care and control of the owner. A long-term objective can be to build a PM repository to document best practices and lessons learned.

2.3.4 PM Knowledge Areas

The management functions which are involved in a project typically include various management process areas. Each area presents a special discipline. The requirement for each function depends on the size and nature of the project in question. The most common nine knowledge areas are integration, scope, time, cost, quality, human resource, communication, risk and procurement management (e.g. Wideman, 1987; PMI, 2004; Turner, 2006). These nine areas will be in a few words explained here.

Integration management is the process that strives to guarantee all the various elements of a project are well coordinated. Topics such as integration of different projects, applications, processes, organizations and project life cycle phases are included in this area.

Scope management is the process that ensures all the factors and variables for defining and controlling the project are included. This incorporates project planning and cost control, tradeoff analysis, project charter preparation, kickoff meeting, a scope-of-work statement, validation of the project scope and initiation of change control processes.

Time management ensures completing a project on time. It includes activity definition and sequencing, duration estimation, schedule development and schedule control.

Cost management tries to realize that the project is completed within the approved budget. It includes resource planning, cost estimating, cost budgeting and control, earned value analysis, depreciation and capital budgeting.

Quality management makes certain that the project will meet or exceed all activities of the overall management function. It includes an overview of quality concepts, the cost of quality, statistical process control, variation and measurement and quality improvement.

Human resource management has as goal that the people involved with the project are used in the best possible manner. It is to manage, motivate and organize people effectively. It includes assigning project roles and responsibilities, reporting organizational relationship, staffing, motivation, leadership, team development and conflict resolution.

Communication management should guarantee timely and appropriate generation, collection, dissemination, storage and disposition of project information. It includes having a communication plan, information distribution path, progress reporting and information sharing system for management and customers.

Risk management identifies, analyzes and responds to project risk. It includes defining, identifying and quantifying risk, formulating risk mitigation strategies, developing appropriate risk response and control processes.

Procurement management makes sure that goods and services from outside the performing organizations are acquired. It includes contract administration, contract risk, contract negotiations, configuration management and contract termination.

2.3.5 Project and PM Success

In this section the difference between project and PM success and the question of whether success can be measured will be discussed.

In any discussion on success, it's essential to distinct project success from the success of the PM effort. Good PM can contribute toward project success but is unlikely to be able to prevent project failure (De Wit, 1988).

The most appropriate criteria for project success are the project objectives. The degree to which these objectives have been met determines the success or failure of a project. When measuring project success, one must consider the objectives of all stakeholders throughout the project life cycle and at all levels in the management hierarchy (e.g. Shenhar et al., 2001; Westerveld, 2003; Bryde & Robinson, 2005). Since so many criteria can be used, an objective best way of measuring the success of a project clearly has become an illusion.

The criteria for PM success tended to be restricted to cost, time and quality performance. The better these constraints (Section 2.3.2) are met, the usually higher the PM success is evaluated. Several scholars (e.g. Wateridge, 1998; Atkinson, 1999) are advocating that instead of measuring PM success with these limited success criteria, the measure criteria should be much wider.

2.3.6 Project Organizations

The Classical Contingency Theory, which was introduced by Burns and Stalker (1961), claims that different external conditions call for different organizational characteristics. According to this theory the effectiveness of an organization depends upon the amount of fit between the organizational structure and environmental variables (Lawrence & Lorsch, 1967; Drazin & Van de Ven, 1985). Burns and Stalker were the first that suggested the distinction between incremental and radical innovation, and between organic and mechanistic organizations.

Mechanistic organizations were described as formal, centralized, specialized and bureaucratic. In addition they would have many authority levels and maintain only a minimal level of communication. In contrast organic organizations were described as being informal, decentralized, having just a few authority levels, having a broad view (instead of a specialized one) and typically using comprehensive levels of communication.

According to several classical theorists (e.g. Perrow, 1967; Galbraith, 1982) organic organizations would better handle uncertain and complex environments, while mechanistic organizations predominate in simple, stable and more certain environments.

In literature (e.g. Galbraith, 1971; Hobday, 2000; Wideman, 2000) the range from the classic entirely functional organization to the opposite end of the scale, the purely project organization is quite similar to the difference between respectively mechanistic and organic organizations. In functional organizations people are grouped into departments, each of which addresses an activity (i.e. 'function'). Traditionally, functional management has not been concerned with projects but with on-going enterprises. Change is minimal and slow, with sufficient time to adjust.

In project organizations (or project teams) many of the organizational resources are involved in project based activities. In a project based organization people are assigned to projects,

concerning a unique problem or chance within predefined time and resources (Hedeman, 2000).

Most modern organizations include both structures at various levels (Shenhar, 2001; Hyväri, 2006). Even a fundamentally functional organization may create a special project team to handle a critical project. Although most organizations nowadays include both structures, the concentration of more project orientated organizations varies between sectors. For instance, the results of a study by Grant and Pennypacker (2006) found evidence of most professional, scientific and technical services organizations being more matured project organizations. In addition manufacturing organizations often had lower maturity levels.

2.3.7 PM Tools

Until the 1980s, PM tools and techniques, such as work breakdown structures, critical path methods and Gantt charts, were used primarily to provide schedule and resource data to upper management (Schwalbe, 2004). However with improvements in PM software (Section 2.3.9), countless organizations have found these PM tools to be effective in managing projects. Studies (e.g. Baldry, 1998; White & Fortune, 2002) show that within most project organizations PM tools and techniques still often are being used for better control of financial and human resources, improved customer service, shorter development times, lower costs, higher quality and increased reliability, higher profit margins, improved productivity, better internal control and higher worker morale. Kerzner (2000) even claims that these PM techniques and tools impact PM methods (Section 2.3.8), which then influence project success.

Based on survey the survey of White and Fortune (2002) and the book of Taylor (2004) it can be suggested that the four most used and well known tools (in sequence of importance) for project managers are the Gantt bar chart, work breakdown structure (WBS), critical path method (CPM) and project evaluation and review technique (PERT). Each tool will be briefly described.

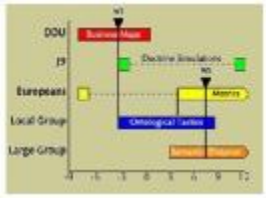

Figure 11: Example of a Gantt Chart

The Gantt chart was developed by Henry Gantt in 1917. A Gantt chart is a bar chart that displays planned and actual progress of a project against projected time lines (Figure 11). A Gantt chart often can be easily created in most PM software and for that reason it provides a sophisticated view of how a project is progressing. A Gantt chart is not a solution technique, but more a tool that facilitates communications between analysts and users (Wilson, 2003). The Gantt chart is often in PM software represented by a projected baseline against which the activity completion is being judged at.

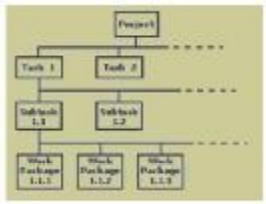

Figure 12: Example of a WBS

A WBS is a fundamental PM technique for defining and organizing the total scope of a project, using a hierarchical tree structure (Figure 12). Each descending level represents an increasingly detailed definition of the project work (PMI, 2000). At each lower level, the parent node (Haugan, 2002). A well-designed WBS shows the planned outcomes instead of planned actions. Outcomes (i.e. work packages) are the desired ends of the project, such as a product, result, or service, and can be predicted accurately. Actions, or the other hand, may be difficult to predict accurately. A well-designed WBS makes it easy to assign any project activity to one and only one terminal element of the WBS. The WBS can be used as the basis for project planning. It can be developed before dependencies are identified and activity durations are estimated. Further it often is used to identify the tasks in the CPM and PERT planning models. Although the Gantt chart and the WBS tools are great presentation techniques, they are less suitable to represent dependencies between activities.

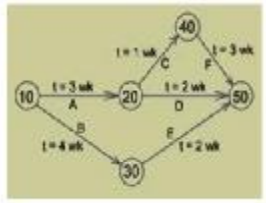

Figure 13: Example of a PERT

Network analysis has been used since the 1950s. It was then that Lockheed and Booz Allen Hamilton developed the PERT for the Navy (Lootsma, 1989). The PERT involves developing an estimated duration and labor requirements for each task. Interdependencies in tasks are identified so that tasks that can be completed at the same time are identified. Numbered nodes (either circles or rectangles) and arrows are used to visualize the order in which the tasks must be carried out (Figure 13). The tasks of a project are represented by arrows and the events or milestones by the nodes. In a PERT chart two time estimates are added for each task, an optimistic and a pessimistic estimate. In the PERT network, the emphasis is put on the project events or milestones instead of the project tasks. This is being accomplished by

defining certain key progress points to be used for overall management control. The PERT network is typically a directed, acyclic network with exactly one initial box, the start and one terminal box, the completion of the project.

The CPM diagram was developed by E.I. du Pont de Nemours in 1957. At almost exactly the same time as the PERT was developed. The CPM was designed to address the challenge of shutting down chemical plants for maintenance and then restarting the plants once the maintenance had been completed (Kelly & Walker, 1989). A CPM diagram looks very similar to a PERT chart. But while the PERT lays emphasis on the milestones, the CPM network focuses on activities, which are represented by arrows (Figure 14). This way of configuration was a direct consequence of the initial development of a parametric linear programming model to tackle normal (most likely) time to complete tasks. In addition the CPM calculates the longest path start and finish without making the project longer. This process determines which activities on the longest path are 'critical'. The CPM is one of the most utilized scheduling tools in the construction industry. However, for more complex types of projects the usefulness of CPM decreases, because then it becomes too problematical to use.

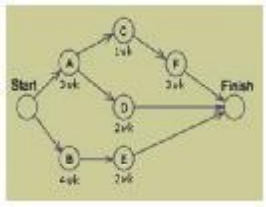

Figure 14 Example of a CPM diagram

These classical PM tools and techniques are predominantly quantitative. They are starting to be seen as appropriate only in simple project contexts (e.g. Jaafari, 2001; Pollack, 2007) and are being recognized as insufficient for more complex projects (e.g. Rodrigues & Williams, 1998; White & Fortune, 2002). This variety of researchers identifying the inadequate working of these tools could indicate the moving away from the traditional approach of how these tools and techniques are being applied.

2.3.8 PM Methods

Project organizations with mature PM processes often define their activities in a formal manner. They apply formal PM methods with strictness and monitor the processes and results carefully (Alleman, 2002). PM methods can be characterized as systematic, well-thought-out way of working in order to accomplish the predefined project objectives (Baardman et al., 2006).

Riemenschneider et al. (2002) assumed that method adoption intentions can be driven by three key factors. These can be the presence of an organizational mandate to use the method, the compatibility of the method with how the project members perform their work and the opinions of the project team members toward using the method. Once methods have been adapted how do they affect the deployment of PM processes in an organization?

On the positive side, good PM methods, can reduce the time to deploy new practices because they provide common reference points for those developing the infrastructures to support the method. In addition methods tend to reduce arguments about which processes to focus on. According to Baardman et al. (2006) the deliberate use of the right PM method by a project manager can be seen as a craftsman that uses the right equipment. The use of a good PM method will most certainly have a positive influence on the project outcome, if it's used in by professionals in the correct context.

On the other hand, if the PM method doesn't appear to fit well with the organization's context, then there will be serious difficulties in getting the method accepted. In this case the chance the method contributes to a positive project outcome is limited.

PM methods many times are either own methods, built up over time through direct experiences, generally accepted PM methods (like PRINCE2 or PMBOK) or a mixture of own and generally accepted methods. The usage of these PM methods has been investigated in several studies. The findings of four earlier studies each show different figures.

A survey held under 236 project managers by White and Fortune (2002) showed that 87 percent of the managers were using PM methods. 56 percent of the project managers were using in house developed PM methods and 31 percent were using generally accepted PM methods, like PRINCE2 and SSADM.

The findings of a Dutch survey in 90 project organizations (PSO Partners, 2005) showed that 16 percent of the organizations didn't use a formal PM method. 48 percent of the organizations used an own PM method and 28 percent used a generally accepted PM method. 8

Figure 2 - PRINCE2 overview model

percent gave other answers.

A globally held survey in 600 organizations by KPMG (2005) revealed that 15 percent of the organizations didn't use a formal PM method. 25 percent of the organizations used a home grown PM method. 36 percent used a hybrid PM method (mixture between own and generally accepted PM methods), 22 percent used a generally accepted PM method and 2 percent was unknown. These results showed that organizations still preferred having their own methodology, with 61 percent indicating they used a hybrid or home grown method. But many comments profiled the increased influence of generally accepted methods, although few accepted them as core.

The most recent survey found, was performed by a partnership of organizations (Vrije Universiteit Amsterdam et al., 2007). The survey was completed by 220 Dutch respondents. According to the findings of this survey 35 percent of the respondents didn't use any PM method. 13 percent used an own method and 52 percent used a generally accepted method. Within the generally accepted PM methods, PRINCE2 was by far the most used (72 percent).

Although the figures of these four surveys show variances, they evidently indicate a trend toward the increased use of generally accepted PM methods.

Some recent studies (e.g. Milosevic & Patanakul, 2005; Zhou, 2006) pointed out that the use of PM tools and methods may have a positive impact on project success. But even supporters of the positive impact of PM methods can only give vague estimations about the strength of this assumed relation (Baardman et al., 2006).

2.3.9 PM Software

The development of the personal computer (PC) in the mid 1980s accelerated the use of PM by making tools and techniques (Section 2.3.6) easily available as part of integrated PM software (Liberatore & Pollack-Johnson, 2003). Previous surveys, by Pollack-Johnson and Liberatore (1998) and later by Ilyvári (2006), showed that almost all PM professionals (92% in 1998 and 96% in 2006) used PM software to some extent.

Most literature available concerning this software is descriptive in nature. This literature lists the available PM software and their features (e.g. PM Network, 1996; Project Manager Today, 2006), or it describes surveys about desired software features (e.g. Allnoch, 1997; Fox & Spence, 2005), or it reviews and compares specific packages (e.g. De Wit & Herroelen, 1990; Farid & Manoharan, 1996; Kolisch, 1999; Gartner, 2007). However, these studies give no indication of the extent to which this PM software is used in practice, by which organizations it's used and how successful the software is.

Potential adopters and current users of PM software are faced with the problem of deciding which type of software will best suit their needs. Several authors wrote textbooks or articles concentrating on PM applications for specific industry sectors, e.g.: construction (Churcher, et al. 1996), mining (Edmundson, 2002) and defense (Deaves, 2003). Others (Fox & Spence, 1998; Liberatore & Pollack-Johnson, 2003) did limited analysis of the relationships between industry, project duration and PM software usage. Yet, there are no reported studies that empirically analyze a broader set of influencing factors. A purpose of this paper could be to assess and analyze those factors that influence the extent of usage, the selection of certain types of PM software and the successfulness of each type.

2.4 PPM Field

Besides PM software repeatedly is spoken about PPM software. PPM is the abbreviation of Project Portfolio Management. Like modern PM, portfolio management was also founded in the 1950s. Portfolio means the grouping of specific activities. Originally it was developed for financial investments (Markovitz, 1952). It was not until the 1980s that portfolio management was explored in the context of other fields, like PM.

An example of a clear definition of project portfolio management is: *"project portfolio management considers the entire collection of projects a company is engaged in, in order to make decisions in terms of which projects are to be given priority, and which projects are to be added to or removed from the portfolio"* (De Reyck et al., 2005:524).

While 'PM' concentrates primarily on doing projects right and 'programme management' concentrates on doing a related set of projects right, 'project portfolio management' is focused on doing the right projects (Linenberg, 2003). This places PPM hierarchical above PM and programme management (see list 'Explanations', in the beginning of this thesis, for definitions).

Although pure 'PM Software' and pure 'PPM software' are fundamental different, in practice they often are mixed up. This confusion simply can be explained as PM software regularly can be used for PPM as well and vice versa. For these reasons, it was decided to consistently use the term 'PM' instead of 'PPM' in this thesis. Hereby the readability was decisive over the accuracy of words.

2.5 Future PM Field

According to Wijnen et al. (1999) project based working started to become more important because organizations tried to compensate the loss of collectivism. Project based working asks less loyalty toward an organization than the traditional way of working, because it's more aiming at results. Furthermore it stands better up to the rapid changes of consumer demand and the speed of innovation.

Present projects are often characterized by increased complexity and interdependencies. A global investigation by KPMG (2005), based on 600 organizations, revealed an increased volume of cross divisional initiatives requiring multi disciplinary teams, aimed at integration of consumer centric objectives. This was foretold by Söderland (2004b), he noted that the PM field rapidly was expanding and would receive wider interest from other disciplines.

The current globalization, in contrast to individualism, will lead to more standardization. International competition is becoming more important than national competition. Cooperation bonds between organizations from different countries are getting more essential. These bonds have a bigger chance to succeed if the participating organizations work according similar standards (Wijnen et al., 1999). This could be an explanation why the use of standard PM methods seems to increase.

3 Preliminary Framework

In the former chapter the distinctive characteristics of and the future developments within PM were explored. In this chapter, based upon these findings, some promising causes of why PM software is so often considered as unsuccessful will be discussed. These causes, their underlying relations and their potential influence on the success rate of the software will schematically be recapitulated in a conceptual framework.

3.1 Interesting Factors

Why are system implementations in other business areas doing better? What factors could be responsible for this low success rate of PM software? In this paragraph the some interesting factors will be summarized. In the next paragraph the most promising ones and their assumed associations will be displayed in a conceptual scheme.

3.1.1 Absence of PM Theories

As was stated previously (Section 2.3.1), the wide deployment of projects in organizations today, hasn't been accompanied by a corresponding development in PM theory (e.g. Morris, 1994; Shenhar, 1996; Mayler, 2001; Söderlund, 2004a). In many other business fields (e.g. marketing, finance and human resource management) the occurrence of theories is much more common.

This lack of theoretical basis could be responsible for PM software being less successful than other software. How can PM be adequately supported by software if PM itself is not understood yet? On the other hand professional organizations, such as the Project Management Institute (PMI) and the International Project Management Association (IPMA) and scientific journals such as, the Journal of Project Management and the International Journal of Project Management have promoted standardization of PM, best practices and certification programs for project managers. For these reasons will an association between presence of theory and PM software not further be investigated.

3.1.2 Support of PM Functions

A second interesting factor being responsible for the low success rate of PM software could be that common aspects (i.e. constraints, stages, knowledge areas, objectives, tools and techniques) aren't adequately supported by the software.

Recent reviews of PM software (e.g. Project Manager Today, 2006; Gartner, 2007) confirm that the majority of the software includes most common aspects (as were described in Sections 2.3.2-2.3.5). As a result an additional review in which an evaluation of the functions and features of PM software applications as main subject almost certainly would be less appealing. For this reason it was decided not the focus on the functionality of PM software.

3.1.3 Leading PM Organizations

The report of Ernst and Young (2006), which was one of the motives that led to this study, was conducted in the context of IT organizations. Studies of PM software in other organizations, for example construction organizations (Liberatore et al., 2001), may reveal contradictory figures. Therefore it's quite possible that the success rate of PM applications varies by organizational factors.

Professionalism of a sector, average organization size, cultural differences, project complexity, etc. could influence the need, use and success of PM applications in an organization. For this reason it's decided to measure limited but promising organizational variables in this study. They will be summarized in the first contingency factor 'PM organizations'.

3.1.4 Uniformity by PM Methods

A lot of projects organizations fail because they lack cooperation. Conflicts can decrease the amount of teamwork in an organization. Verhaar (2001) noticed three different types of PM conflicts in his book. These are social emotional, interest and instrumental conflicts.

Social emotional conflicts are primary about values and identities of the group members.

Feelings have the upper hand in this kind of conflicts. Since project teams are often composed of people with different backgrounds and disciplines (e.g. product developers, production engineers and marketers) the chance that social emotional conflicts occur is probably relative greater, if compared to more functional environments.

Interest conflicts are about dividing resources and opportunities. In many organizations projects are run besides the operational processes. Therefore it's very well imaginable that the dividing of for instance limited man hours between projects and operational processes often results in interest conflicts.

The last type of conflict, the instrumental type, is about the attitude and ideas people have about the choice of goals, preconditions, instruments and procedures. These conflicts are more likely to evolve in project organizations, where processes are often unique. In functional organizations, where operations are for the most part repetitive (like batch, line or continuous processes), the instruments are relative homogeneous (Reid & Sanders, 2002).

The use of formal PM methods, which as has been mentioned earlier (Section 2.3.8), can be characterized as systematic and well thought out way of working. These methods can give organizations direction in developing new agreements, unambiguous role descriptions, harmonized processes and procedures. The chance of PM methods decreasing the conflicts as mentioned by Verhaar seems fair. Implementations of PM software within project organizations, which have less conflicts and more uniform ways of working will most certainly lead to higher success rates.

Another positive effect of standardization of the PM processes by the use of PM methods is the creation and maintaining of a market for PM software (Garcia, 2005). Without PM methods to reference, vendors of PM applications usually have a more difficult time convincing customers that their product will be compatible with the customer's PM processes. If the vendor's PM software explicitly supports a PM method, then customers following using those methods are more confident that the application will fit their practice context.

As a result of this fit, it's very likely that less business process re-engineering (BPR) will be needed. Earlier studies (e.g. Bancroft 1996; Parr & Shank, 1999) showed that not all companies wish to make massive changes (re-engineering) to their business processes in order to implement new ERP systems. Thus less need for PM processes changes might very well lead to an increase of PM Software Success.

These possible effects of PM methods make the idea that the availability of PM methods will be associated with the 'success of PM software' promising. Thus the possibility of an association between these variables will be researched. As a consequence 'PM Methods' will be the second contingency factor.

3.1.5 Variety of PM Software

As described previously (Section 2.3.9) PM applications have become very advanced in time. A quick exploration of recent literature (e.g. Project Managers Today, 2006; Gartner, 2007) and the internet made apparent the PM software market is strongly diverged. PM applications seem to vary from relative simplistic open source software[7] (OSS) to expensive comprehensive custom-built systems. A comprehensive list of 54 Web sites of PM software providers can be found in the References (3rd section).

Figure 16: Screenshot MS Project 2007

Although the currently by far most often used PM software seems to be Microsoft Project (Figure 16), this software has been criticized by many. In addition other illustrious PM applications such as Primavera and Clarity have been praised and damned. Could it be that these comprehensive applications, with all their bells and whistles, have become too complex to implement successfully?

It appears not too far fetched that the variable 'type of PM software' could associate with 'PM Software Success'. As a consequence it's decided that this variable will be the third contingency factor which will be investigated into more depth.

[7] Software that anyone interested can download and have free access to the program source code (Lakhani & Von Hippel, 2003). OSS are built by potentially large numbers of volunteers (Bezroukov, 2002). Further Mockus et al. (2002) note that open source developments typically have a central person or body that selects a subset of the developed code for the 'official' releases and makes it widely available for distribution.

3.1.6 PM Software Commitment

An important factor that could be (partly) responsible for the low success rate of PM software may be the lack of commitment toward the software. At least two promising scenarios are imaginable that could cause the lack of commitment.

A first possible scenario is that within many organizations the importance of PM still is perceived as being modest. Operational processes, which mostly are accompanied with functional management structures (Section 2.3.6), often have priority over PM. For this reason top management may show minimal interest toward PM software and as a consequence will not promote the utilization of the software. This lack of top management will probably have a negative influence on the success of PM software. Given that top management commitment is a very important critical success factor for IT adoption according to numerous scientific authors (e.g. Sumner, 1999; Helland et al., 1999; Fröhlich & Platje, 2000; Estevez & Pastor, 2000, 2001; Parr & Shanks, 2001; Somers & Nelson, 2001; Schmidt et al., 2001; Sarker & Lee, 2003; Umble et al., 2003; Jayaraj et al., 2006).

Nevertheless an opposite opinion of top management is also imaginable. It's not uncommon there appears to be an information asymmetry between top management and the project managers about the status of projects. It's to be expected that most project managers will keep as much 'negative' information about the project and as long as possible to themselves. While top management wants to be able to see the complete actual picture at any time. In order to solve this asymmetry top management could see the implementation of PM software as a solution for their information problem. The project managers may feel threatened by the idea of being monitored constantly and therefore could try to impede the use of the PM software.

The probability of project managers hindering the utilization of PM software is even more likely to increase if using the software will only cost them more efforts (supplying input) but gives them no personal benefits back in return. Maintaining the information asymmetry could also be causing CRM systems being second most unsuccessful (Figure 2). Since the knowledge about projects and sales by respectively project managers and sales representatives are quite similar.

Both these reasons, the modest position of PM in respect to operational management and maintaining the information asymmetry, make it interesting to launch an in depth investigation into top management commitment toward PM software.

3.2 Conceptual Scheme

The promising contingency factors of the previous paragraph and their underlying relations are schematically represented in a scheme (Figure 17). This scheme reveals the possible contingency factors, their intervening relations, their places in time and their association with the variable 'PM Software Success'.

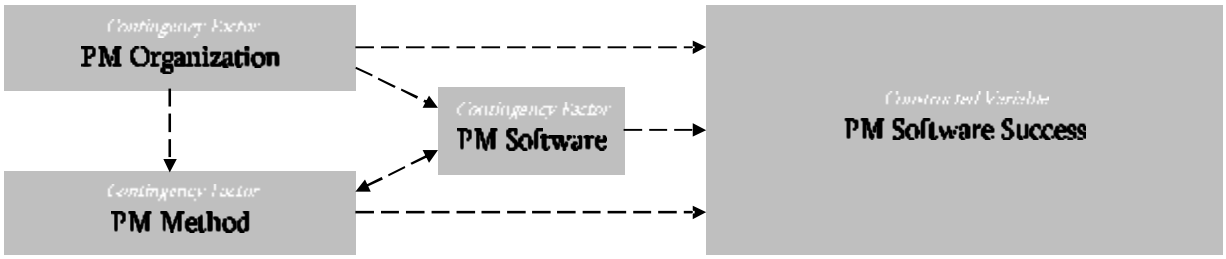

Figure 17 Preliminary Project Management Software Success Framework

3.2.1 Presumed Associations

On the left side of the scheme are those contingency factors positioned, which most likely existed before the implementation of PM software. The directions of the arrows between the elements in the scheme propose likely routes of influences. 'PM Organization' characteristics probably could influence the availability of 'PM Methods'. For instance, in large IT companies

the use of methods could be more usual than in for instance small agriculture firms. Both 'PM Organization' characteristics and the availability of a 'PM method' possibly can be associated with 'PM Software Success', either directly or indirectly through the mediating factor type of 'PM Software'. PM software may more often be successful in larger organizations or when PM methods are used.

In the middle of the scheme is the contingency factor type of 'PM Software' displayed. This factor could straightforwardly relate to 'PM Software Success'. It's imaginable that certain kinds of PM applications are more frequently successful than others. In addition the utilization of a PM application could stimulate the use PM methods. Besides this link one could also think of an indirect association between 'PM Organization', 'PM Methods' and 'PM Software Success' through 'PM Software'. Perhaps particular types of PM software are relative more often successful if they are used within specific organizational contexts and/or in combination with the availability of certain PM methods.

3.2.2 Top Management Commitment

A very interesting factor to investigate into more depth is the commitment of top management toward PM software (Section 3.1.6). Therefore it may be surprising that it was left out of this initial conceptual framework. The main argument for excluding this variable is that top management commitment is an important criterion for almost all kinds of information systems. It's expected that the average amount of top management commitment toward PM software will not differ immensely between different (types of) PM applications and from those of other information systems. As a result it's not very likely this factor will be the discriminating factor as well that explains the differences in success between the overall mean of 'PM Software Success' and the 'PM Software Success' of a particular type (or class of) PM application

Nevertheless the commitment of top management probably will as well predict the success of PM software as it does for numerous other types of systems. For this reason at a later stage in this research the predicting power of commitment toward PM software will be investigated.

3.2.3 PM Software Success

On the right side of the scheme the constructed variable 'PM Software Success' is positioned. Based on the exploratory literature research as described in Chapter 2 and the assumptions in the previous paragraph several associations between the three contingency factors and this variable were suggested.

Nevertheless this variable itself and its potential attributes are still relative unknown. In which ways can the variable 'PM Software Success' be assessed? What measures are adequate in this specific context? And what values will this variable have?

In Chapter 5 this variable will be explored with help of several theoretical models. Later on, in Paragraph 6.2 the way in which this variable will be assessed will be explained. But first the attention will be concentrated on the contingency factors in the left side of the Conceptual Scheme (Figure 17). In Chapter 4 each of the three promising contingency factors will explored in more depth. What organizational characteristics are interesting in this context? Which PM methods can be distinguished? And what types of PM software are available on the market?

4 Contingency Factors

After the exploratory literature research, as illustrated in the prior Chapter 2, it became clear that the rise of standard methods can be seen as an important development in the PM field during the last decennia. The influence of PM methods on project outcome has been studied by several researchers (e.g. MacCormack et al., 2003; Milosevic & Patanakul, 2005; Morris et al., 2006). Some authors believe that the use of standard PM methods has a positive effect on the project outcome (e.g. Baardman et al., 2006), others believe that these methods are critical success factors of project success (Toney & Powers, 1997). Finally, Kerzner (2000) claims that standard PM tools (Section 2.3.7) impact standard PM methods (i.e. process), which in their turn have a positive effect on project outcome.

Surprisingly until now there hasn't been conducted any research about a possible relation between the use of PM methods and the implementation of PM software. Could it be that the use of these methods influences the success rate of PM software? By counseling the director of Fortes and several other practitioners in the PM field this idea proofed not to be too far fetched. They believed there might be a relation. Often organizations that work according to standard methods control their PM processes better than those that don't work according these methods. Supporting controlled uniform processes with PM software is expected to be more successful than supporting more varying processes.

Besides working according formal PM methods the kind of PM software could have enormous impact on the implementation success rate. The current tendency is shifting from custom built software to more generic and even off the shelf software packages. But does this lead to more successful implementations?

In this chapter both contingency factors, 'PM Methods' and 'PM Software', will be explored in more depth. Before these two factors will be investigated a paragraph will be devoted to the first contingency factor 'PM Organization'. Every time a contingency factor will be introduced, a picture will highlight the position of this factor in the Preliminary Framework, which has been introduced in the previous chapter (Figure 17).

4.1 PM Organization

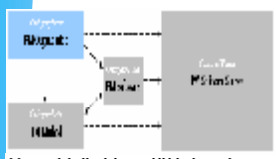

Figure 18 Position of PM Organization in Preliminary framework

In this thesis the term 'PM Organization' will refer to a whole organization where PM occurs. It isn't restricted to the project organization (e.g. project team) within an organization.

While studies of PM software are plentiful, few studies have investigated how 'Software Success' of PM software differs for varying organizational variables.

For the purpose of this study it was decided to explore the items 'Activity Sector' and 'Size' of the organization. Besides these two items, other organizational context variables such as 'Project Complexity' and the 'Maturity Level of PM' also could be interesting to investigate. But due to the scope of this thesis (time and resource constraints) and the striving for attractiveness toward the respondents, it was decided to limit the organizational variables to a maximum of two. Both of these variables can relative easily be obtained by asking the respondents. In this paragraph these two organizational variables will be explained and motivated.

4.1.1 Activity Sector

Figure 19 Position of Activity Sector in PM Organization

Despite the numerous studies related to factors which influence IS success, only a few have addressed the impact of organization type on IS success.

During the 1990s, researchers began to distinguish between management information systems (MIS) designed for public (government) and private sector organizations (Bretschneider, 1990; Newcomer & Caudle, 1991; Cats-Baril & Thompson, 1995). They all identified several differences between MIS for public and MIS for private sectors.

In the context of the PM a recent study (Grant & Pennypacker, 2006) evaluated the PM maturity levels of four different industries. This study reported significant lower levels of maturity in the manufacturing sector. This study didn't identify the reasons for this phenomenon, but the researchers guessed that perhaps in the manufacturing arena, the need for PM infrastructure often competes with a robust and substantial manufacturing operations

infrastructure. This competition of infrastructures share resemblances with the previously mentioned (Section 2.3.6) differences between project and functional organizational structures.

These examples of differences between public and private organizations and the variances in maturity levels between industry sectors illustrate the possibility that the success of PM software differs in each sector. Thus it was decided to measure the item 'Activity Sector'.

4.1.2 Size of Organization

Research related to how success rates of PM software differ for organizations of varying sizes is as well limited. Some studies have focused on general IS/information technology (IT) adoption (e.g. Knol & Stroeken, 2001; Caldeira & Ward, 2002). Within these studies, many researchers noted the relative difficulty of small and medium sized organizations to adopt new systems. Blili and Raymond (1993) suggested that smaller organizations have fewer financial resources, lower technical expertise and poorer management skills, when comparing them to larger organizations.

Figure 20: Location of Factor in PM Organization

Literature and Pollack Johnson's study (2003) indicated that the kind of PM software selected by PM professionals is significantly influenced by the firm size. Larger firms were associated more often with the use of higher end (more expensive and professional) PM software. This relationship seems logical because larger firms can usually afford more expensive software.

These studies clearly illustrate the possibility of an association between the size of an organization and the success of PM software. Therefore it was decided to measure this variable in this research. There are several ways to measure the size of an organization. Kimberly (1976) identified four substantive aspects of size, which are the personnel available, physical capacity (e.g. number of beds in a hospital), organizational in- or outputs (e.g. turnover), discretionary resources available to an organization (e.g. net assets). For this study the personnel available i.e. number of employees was decided to be the most appropriate measure of organizational size. The two foremost reasons for this choice were that most respondents probably can give a quite accurate estimation of the number of employees their organization counts and that these numbers easy can be obtained by a single question.

4.2 PM Methods

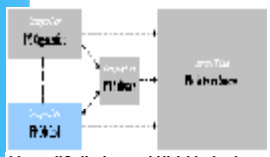
Figure 21: Position of PM Methods in Taxonomy framework

Industry reports, e.g. Global IT Project Management Survey (KPMG, 2002, 2005) and Project Management Survey 2006/2007 of (Vrije Universiteit Amsterdam et al., 2007) highlight the growing adoption of PM methods, standards and practices across large numbers of organizations. In this paragraph the major concepts, the past, the current main types and the predictions of the second contingency factor 'PM Methods' will be described.

Based on this information a classification will be proposed that will be used to cluster the various methods. By clustering the methods in only a few archetypes it will with any luck become possible to discover some general associations between 'PM Methods' and the other variables in the framework.

4.2.1 Definition of Method

In this section the definition of method and other related concepts will be presented and explained, starting with clarifying the difference between method and methodology.

Method versus Methodology

Although method and methodology often synonymous are being used, their denotation is different. The word 'method' is descended from the Greek language, meaning: "*Way of investigation*" (Cronholm & Agerfalk, 1999:231). Jayaratna, a scientist who studied methodologies, defines 'method' as: "*An explicit way of structuring one's thinking and actions*" (Jayaratna, 1994:35).

Methodology is a Greek term meaning 'the study of methods'. The Oxford Dictionary (Simpson & Weiner, 1989) defines methodology as: "*The study of systematic methods of*

scientific research".

Therefore it would be more correctly to speak of 'methods' when referring to specific ways of approaching and solving problems and to reserve 'methodology' for comparative and critical studies of methods in general. Consequently, in this thesis the proper term 'method' will be used (except in case of citations) when referring to specific ways of approaching and solving problems, like the PRINCE2 or SCRUM method.

Perspective

An important concept related with methods is 'perspective'. A perspective is a theory of how a method should be carried out (Gronholm & Agerfalk, 1999). The method constructor's perspective is based on how he or she perceives the world. The perspective is not necessarily made explicit in the method. It's frequently implicit and taken for granted. Nevertheless a method is always based on a perspective which in its turn is based on principles, values, conceptions, experiences, categories and definitions. The main thought behind PRINCE2 method, for instance, is the focus on product delivery.

Elements

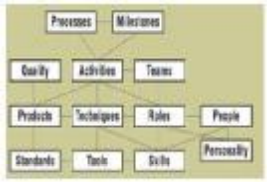

Figure 22 Potential elements of a method

Most methods typically consist of several elements (Figure 22). These elements cover the processes, the means and the people dimensions of a method. For instance, all PM methods use techniques and tools. A technique is a way in which something can be done, like a prescribed way to make a plan, creating reports or control the quality. A tool helps with applying techniques, like a plan board, a form or an IS system. Further most PM methods give job descriptions and hereby distinguish different roles such as project manager, executive, senior user etc.

Another example is that PM methods normally include standards. These describe what is permitted or not permitted in the work. Standards can be formal, like decision standards or more informal, such as project conventions. As final example the element 'activities' is explained. Often PM methods include what meetings, reviews, milestones and other general activities each person must attend, generate or do.

Model

Another concept which repeatedly is related with a method is a 'model'. Almost all methods use a central model or framework which provides structure to help connect the set of concepts that form the major thoughts behind the method. According to Yourdon (1989), a model is used to highlight certain critical features of a system, while simultaneously de-emphasizing other aspects of the system. Examples of models belonging to eminent PM methods can be found in Appendix III.

4.2.2 History of PM Methods

Since the mid 1970s, PM associations around the world have made serious attempts to present themselves as professional associations (Morris et al., 2006). Other traditional professions distinguished themselves by emphasizing standards such as developing quality marks, competence in their field and by ensuring that their members meet these standards. PM associations have spent considerable time and effort in developing Bodies of Knowledge (BOKs) and/or methods. The roots of the PM methods lie in North America (Turner, 1996), all other continents elaborated further on these (Baardman et. al., 2006). Indeed the popularity of these has been notable. PM methods and bodies nowadays are used globally (e.g. KMPG, 2005; Vrije Universiteit Amsterdam et al., 2007).

PM methods were developed for different reasons. Some methods were developed 'in-house' by companies as a response to a need for structured work or ways of controlling the times and budgets of projects. An early example of such method is the PRODOSTA method of Philips in 1969. Other PM methods were developed commercially, mostly by consultancy firms, like SDM by Cap Gemini, or as in the case of the PRINCE2 method by the government of the United Kingdom. The last group of methodologies stems from research into PM and is mostly

Figure 2.6: Dimensions of PM Methods

created by knowledge institutions, like for instance the IDEAL method of the SEI. A short overview of some well known and often used PM methods can be found in the Appendix III.

4.2.3 Taxonomy of PM Methods

There are lots of different PM methods, but in literature there were found no more than two existing classifications of PM methods. These were a taxonomy based on the degree of ceremony and one based on the presence of PM methods and the amount of best practices.

The first taxonomy consists of the 'agile or light group' versus the 'heavy weight frameworks' (e.g. Alleman, 2002; Charvat, 2003). The 'light' group has little or no ceremony; examples are SCRUM, DSDM, Crystal, Adaptive Software Development and Extreme Programming (XP). The 'heavy' group consists of methodologies which have considerable more formal procedures; examples are Rational Unified Process (RUP), PRINCE2, PMBOK and processes based on the Software Engineering Institute's Capability Maturity Model[8]. Both these light and heavy methods are cases of generally accepted PM methods. Additional options like 'absence of PM methods' or 'in-house developed PM methods' were not included in this classification. Further there have been no indications that the degree of ceremony is influences the project success. Therefore the second taxonomy which was found in literature seemed more appropriate for this study.

For the purpose of this study the taxonomy of PM methods will be exploited that was used in similar reports (e.g. KPMG, 2005; PSO Partners, 2005; Vrije Universiteit Amsterdam et al., 2007). The reason for this decision is twofold. First, by choosing a regularly used taxonomy the findings of this research can be compared with earlier studies. Second, although it's being argued (e.g. Turner, 1996, Baardman et al., 2006) whether there's a relation between the types of this taxonomy and the project success, there could be an association between the types and PM Software Success. The taxonomy of PM methods that is used will consist of 'no PM methods', 'in-house developed PM methods' and 'standard PM methods'.

No PM Methods

The first group of organizations is those that do not use any formalized PM methodology. The PM processes in these organizations most likely aren't standardized. Project managers in these organizations run their projects in their own way. The second group and third group of organizations are those organizations where the use of formal PM methods is dominant.

In-house or Home-grown PM Methods

The second group represents those organizations where formal 'in-house developed PM methods' are most dominant. The PM methods these organizations use are developed in-house or home-grown. These methods are not publicly available, but are formally being used within a specific organization. Often these methods are derived from the so called standard PM methods (see third group) and adjusted to match the organizational context. In the report of KPMG (2005) these mixtures between own and standard PM methods are called 'hybrid PM methodologies'. In the taxonomy of this study the 'hybrid' group will not be utilized. In an organization the 'most' used PM method will be or an 'in-house developed PM method' or a 'standard PM method'. Leaving the 'hybrid' option out will force the respondents to choose.

Standard PM Methods

The third type 'standard PM method' corresponds to those organizations where the foremost used PM method is a generally accepted method or body. Many of these standard PM methods are free of costs and publicly available (e.g. DSDM). In other cases the standard methods, although being free to use, are owned by authorities (e.g. PRINCE2) or institutes (e.g. PMBOK). These often sell – straightforward or indirect via consultancy firms or training centers – method supporting books, trainings and certifications.

[8] Capability Maturity Model is a collection of model frameworks for assessing the maturity of a specific practice. Key Practice Areas are used to identify the various levels of maturity. CMM now consists of: Software, People, Software Acquisition, Systems Engineering and Integrated Product Development.

4.2.4 Future of PM Methods

What many practitioners now are looking for, particularly those charged with developing PM methods within companies, is at least some evidence to show that the use of formal PM methods and practices produces better project outcomes. The current data on this is only slight (Pinto & Slevin, 1988, 1989; Morris, 1987, 2001a; Ibbs & Kwak, 1997; Crawford, 2006; Baardman et al., 2006). To illustrate this, Baardman et al. (2006) note that professionals being interviewed estimate the influence of a PM method on the project outcome varies from 10 to 40 percent. Yet there is no evidence that demonstrates a causal relationship between the application of formal PM methods and project outcomes.

As methods are being developed from perspectives, which are based on principles, values, conceptions, experiences, categories and definitions, they will change in time. Baardman et al. (2006) assume that the demand for more international orientated PM methods will keep increasing as the globalization continues. Even the use of internationally used standard methods like PRINCE2 and PMBOK are mostly limited respectively to West European countries and North America. However large multinational organizations (e.g. ING, Philips and IBM) have already started to develop these international orientated PM methods.

4.3 PM Software

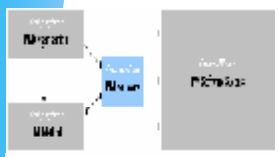

Figure 2: Position of PM Software in Preliminary Framework

In this paragraph the third contingency factor 'PM Software' will be looked into extensively. The paragraph will start with a description of the history and the current market of PM software. Next, different PM software types are being classified. It's expected this taxonomy will help explaining why particular contingency factors can be associated with a higher PM Software Success rate. Hopefully these predefined types of PM software reveal that some sorts of PM applications are more successful than other kinds in certain conditions. The paragraph ends with some future predictions about PM software.

4.3.1 Origin of PM Software

Supposedly, the first PM software was D21, which was developed by Datasaab (Johansson, 1999). Datasaab was the data processing division of Saab Automobile. In the 1970s PM software started to be used on large projects. These first mainframe systems were text based, difficult and expensive to operate. Therefore it's not surprising that at one of the first PM conferences (in 1972) PM software techniques were not mentioned at all. Although during the 1970s and 1980s resource leveling algorithms occupied some of the premium minds in universities and software companies, these back then didn't caught on with practitioner project managers (Barnes, 2002).

In the mid 1980s micro computer PM software started to become more popular. Software was ported from mainframe systems to the micro computers. The first commercial scheduling software for this class of computer was developed by Micro Planning Services in the UK in 1980. An article written by Assad and Wasil (1986) already presented a profile of the capabilities of commercial PM system packages. They underlined the emerging number of PM software packages for the microcomputer besides the traditional mainframe systems.

Early PM software for the PC (e.g. Primavera and Artemis) was concentrated on single large projects and it was limited to the number of tasks and resources that could be handled. Microsoft Project (further abbreviated as MS Project) was one of the first low end products that particular aimed at smaller projects. But soon MS Project experienced strong competition from products such as Super Project, Hornet and Project Scheduler 4 (PS4). While running on DOS, Project Schedule 4 was the first PM software with a real Graphics User Interface (GUI). With the shift to enterprise PM, PM software was developed to support multiple projects and multiple users.

By the second half of the 1990s, microcomputer PM software had all the features or even much more than needed by the average project manager. For instance, Project Scheduler 7 was able to handle an infinite number user defined fields and quite complex customizations. Microsoft Project 98 incorporated many case of use features such as 'predefined project

templates' for beginner project managers (Jaafari & Manivong, 1998).

In the year 2000 the majority of this desktop PM software had become far more powerful. Most software was able to provide client/server environments, cross project resource analysis, cross-project roll-up and reporting (Liberatore & Pollack-Johnson, 2003). Today nearly all the PM software is Web-based (Project Manager Today, 2006). This software can be implemented as a Web application, accessed through an intranet or the internet using a Web browser.

4.3.2 Market of PM Software

By studying the origin of PM software it became clear there were and still are many different types of PM software (e.g. Gido, 1985; Seachriat, 1998; De Zwart, 2001; Gartner, 2007). This large variety of PM software will make it hard to formulate any generalized recommendations. Second, the evaluation of software that only will be observed in one or a few cases can easily become biased.. For these reasons it was decided that the current available PM software had to be categorized in a few distinctive types.

In literature several archetypes of PM software could be distinguished. For instance Assad and Wasil (1986) divided PM software into three categories or levels based on their capabilities. Software in level 1 performed straightforward project analysis, while those of level 2 added project control and progress reporting features. Level 3 PM software was capable of handling multiple projects with shared resources and had advanced reporting features. O'Connor (1997) supposed a categorization of PM software based on intelligence assistance.

A third example of classification was used by Liberatore and Pollack-Johnson (2003). They categorized the PM software packages as either high end or low end, based on price. High end packages did cost $900 or more, while low-end packages did cost $600 or less, with no packages priced between these levels. High-end packages tended to have more features and/or the ability to handle larger-sized projects and perform more multi-project management tasks.

A final example is represented by the Magic Quadrant of Gartner[3] (2006, 2007). Gartner distinguishes four groups (leaders, challengers, visionaries and niche players) of PPM software. The distinction between these groups is based on the ability to execute and the completeness of vision (Appendix VII, Figure 132 & 133).

4.3.3 Taxonomy of PM Software

Many of the classifications, listed in the preceding section (Section 4.3.2), would nowadays be less relevant. Just about all current PM software has the abilities of level 3, includes help assistance and can handle multi-project management tasks (Project Manager Today, 2006). In addition the *"mixture of a half-dozen major factors"* (Gartner, 2007:3) that determined the classification of Gartner couldn't be traced back. For these reasons a new interesting classification of PM software was proposed for this study.

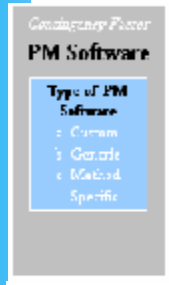

Figure 75: Different architectures of PM Software

Based on the review of general IS research (e.g. Gross, 1984; Jaafari, 1998; Sawyer, 2000; Keil & Tiwana, 2005) essentially two types of systems can be distinguished. Those systems that have been developed 'in-house' as custom systems and are not generally available to outsiders and those which are either commercially developed and marketed or developed by software providers. For this paper, commercial developed software, also known as packaged software, shrink wrapped, commercial off the shelf (COTS), means all software sold as a tradable product (purchased from a vendor, distributor or store) for all computer platforms (Grudin, 1991; Klepper & Hartog, 1992, Andersson & Nilsson, 1996, Carmel & Sawyer, 1998). With commercially developed software, the intellectual property is generally licensed for use rather than sold outright as the vendor retains ownership of the application and negotiates a license with the purchaser (Carmel, 1997; Edward & Kovac, 2001).

When an application is custom-built, all the bells and whistles of the existing processes can be incorporated. The development of custom built software however frequently is not favored, as it is time-consuming and expensive. Small businesses, unlike their large counterparts, often even lack the organizational resources and technical expertise to develop a IS in

[3] Gartner is a leading IT research and advisory company. The goal of their Magic Quadrant for IT Project and Portfolio Management is to provide a global view of Gartner's opinion of the relevant software vendors that should be considered by organizations seeking to PPM software.

house. In other words, for small businesses commercially developed systems are not just an attractive alternative but, in fact, they are the only way to acquire a IS (Janson & Subramanian, 1996).

Implementing this commercially developed software gives rise to a unique set of risks (Jivari 1990; Montazemi et al., 1996. Pollock et al., 2003). Some features may be incompatible with the organization's information needs and business processes. This problem can be solved by adapting the business processes to the software (Davenport, 1998; Phrahalad, 1999; Edward & Kovac, 2001) or by adapting the software to the business processes (Gross, 1984; Light, 2005). Each approach has its drawbacks including increased IS costs, longer implementation time and inability to benefit from the periodic vendor initiated software updates.

At the PM software market, like at other software markets, the in house developed system seems to be on its last legs (Laudon & Laudon, 1996). Only a few large organizations still utilize custom built PM software. There is an increasing body of evidence that suggests organizations are shifting from custom built to commercially developed software for major applications (Deloitte & Touche, 1996; PriceWaterhouse, 1996; Sawyer, 2001; Houghton & Vickery, 2004; Howcraft & Light, 2006). Only a minority of real large organizations still utilize custom-built PM software. Although there are some open source PM applications (e.g. dotProject, Open Workbench, Trac Project) available on the Web, it looks like the commercially developed PM software is the future.

This large group of commercially developed software can be divided in two types. The first type, which probably is the most common, is the 'generic PM software'. Large, configurable, generic packages cover the fullest range of organizational PM activities and processes. This software needs to be configured to support the specific PM activities and processes within an organization.. Well known examples of this type of software are MS Project, Primavera and Clarity. The second type, which is relative new, is the PM software that supports a specific PM method. This further called 'method specific PM software' might sometimes require little tailoring, but the main processes that belong to a particular PM method are already in place. Some examples of this type software are Project in a box, i method and P2.net. Appendix IV includes a list of all method-specific PM software vendors that were reported by this study.

Based on the increasing use of standard PM methods (Paragraph 4.2) and the new type of PM software (i.e. method specific PM software) the taxonomy of PM software in this research will be based on the amount of implementation effort and it will consist of three groups.

Custom built PM Software

The first group 'custom-built PM software' has to be developed from scratch. Therefore the implementation probably will be relative time-consuming and the implementation costs high. A big advantage of 'custom-built PM software' is that it can be molded to suit unique processes, so the eventual fit can be perfect.

Generic PM Software

The second group, which will probably be the largest group, is the 'generic PM software'. This mainly commercially developed software often has loads of standard functions and features but has to be configured to support specific PM processes. The implementation efforts of this generic software will as a result, whilst less than those of custom-built software, be modest. This generic PM software group will, when encountered, also include open source PM software. This because most open source PM software will have to be configured in order to support specific PM processes. If an open source PM application is developed to support a particular PM method it will be classified to the third group.

Method specific PM Software

By the third group, 'method-specific PM software', implementation efforts are expected to be the smallest. The reason for this is twofold. First, the specific standardized PM processes are 'embedded' in the software. Second it will be likely the users recognize these processes right from the start. Therefore there probably will be no need for extensive configurations

and/or trainings. An important precondition of harvesting these low implementation efforts is of course that the customer organization already should work (or at least be familiar) with the specific standard PM method.

4.3.4 Prospects of PM Software

Crawford et al. (2006) reported a slight increase in interest for PM software in the Project Management Journal and the International Project Management Journal. In literature several trends of PM software are predicted.

The vendors of commercially developed PM software will keep inventing new ways to differentiate themselves in the heavy competing market. According to Gartner (2007) examples of recent inventions are the flexible licensing and delivery options, such as Software as a Service (SaaS). Further Gartner predicts an increased integration of project portfolio, IT service and application life cycle management (ALM) functions into comprehensive IT Planning and Control (ITPC) applications toward the year 2009.

Pollack (2007) states the PM tools, techniques and software still will regularly be refined and improved. However, the refinements suggested will be quantitative and will be offered as a way of increasing accuracy of estimation. Pollack predicts no significant innovative perspectives, techniques or tools will occur in the near future.

All these predictions have one aspect in common; they predict the incremental development of PM software, no radical inventions are expected.

5 Information System Success

In order to assess the success of PM software, first the concept 'Success' within the context of information systems will have to be investigated. 'Information System Success' is widely accepted throughout information system (further shortened as IS) research as the principal criterion for evaluating information systems. This chapter gives an examination of three well established theoretical models that try to represent or explain 'IS Success'. After introducing each model's main idea, every model will be reviewed. When the strengths and weaknesses of each particular model have been discussed, the purpose for using the model in this research will be explained. Each paragraph will end with a figure in which the exactly duplicated or deducted items are revealed

The first model that will be introduced is the DeLone and McLean Model (1992). The reason this model was chosen is that it categorizes the numerous measures of 'IS Success' into six main dimensions. Hence the chance of an important measure of 'IS Success' being overlooked will in this way be diminished.

The second model that will be described is the Technology Acceptance Model of Davis (1986). This model explains, from a behavior perspective, why individuals do or do not adopt a technology. The ground for selecting this model is twofold. First, this model explains individual motives that lead to the use of an IS. Because the units of analysis in this research probably also will be individual project managers this model could explain their motivation to use or not to use PM software. The second reason, for describing the model of Davis, is that the use of PM software can be obligatory or voluntary. This makes the dimension 'Amount of Use' into an incorrect measure of 'IS Success'. Nevertheless the behaviors that lead to use could be interesting to investigate.

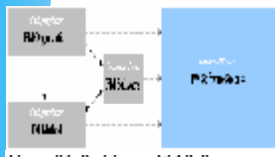

Figure 26 Positioning DeLone & McLean Success in Preliminary Framework

The third model, which will be outlined in this chapter, is the Task-Technology Fit model of Goodhue and Thompson (1995). This model emphasizes that a better fit between the individual task characteristics and the technology characteristics should lead to an increase of performance. The tasks characteristics are supposed to match the PM processes within an organization. As a result it would be reasonable to conclude that a better fit between PM software and PM processes would lead to higher IS Success.

5.1 DeLone & McLean Model

The DeLone & McLean model (1992) is an important contribution to the literature on IS Success measurement, as it was the first study in trying to create some order in IS researchers' choices of success measures (Seddon et al., 1999).

In 1992 DeLone and McLean identified over 100 developed measures in the 180 theoretical and empirical studies they reviewed. To organize these various measures, as well as to present a more integrated view of the concept 'IS Success', they introduced a comprehensive taxonomy. This taxonomy includes six main dimensions.

Later on, in 2003, DeLone and McLean modernized their model, which led to some small changes in the structure of the taxonomy and the addition of a new dimension 'Service Quality'. This updated model will not further be discussed in this paragraph but a figure of this model can be found in Appendix VII (Figure 134).

5.1.1 Main Idea DMM

In the attempt to introduce order in the IS success research DeLone and McLean (1992) assembled a relational model that interrelates six variable categories. This model was based largely on the basis of Mason (1978). Mason adapted the communication theory of Shannon and Weaver (1949). This theory distinguishes three levels of information. These levels are technical, semantic and effectiveness or influence level. Mason used these levels to demonstrate the serial nature of information. According to Mason an IS creates information which is communicated to the recipient who is then influenced or not. The six interrelated main dimensions which shape the DeLone & McLean (D&M) model are 'System Quality', 'Information Quality', 'Information Use', 'User Satisfaction', 'Individual Impact' and 'Organizational Impact'.

The first variable 'System Quality' measures the information processing system itself. Examples of measures of this variable are 'Integration of Systems', 'Response Time', 'Reliability', 'Content of the Database', 'Accessibility' and 'Ease of Use'. The majority of these measures are fairly straightforward and reflecting the more technical performance characteristics of information systems.

The second variable 'Information Quality' measures the quality of the information which is outputted by an IS. Some examples of 'Information Quality' measures are 'Accuracy', 'Completeness', 'Relevance', 'Sufficiency' and 'Report/Information Usefulness'.

The third variable 'Information Use' determines the recipient consumption of the IS output. 'Information Use' is frequently reported as measure of IS success. 'Information Use' can be measured in many different ways, examples are 'Frequency of Use', 'Actual Use', 'Reported/Perceived Use', 'Voluntary/Mandatory Use', 'Specific Use', 'Number of Sessions', 'Number of Minutes' and 'Number of Functions'. When the use is required or mandatory this variable become less useful. Perhaps then the following variable can help out.

The fourth variable 'User Satisfaction' measures the recipient response to the use of the output of an IS. According to DeLone and McLean this variable is probably the most widely used single measure of 'IS Success'. This mainly is because satisfaction has a high degree of face validity. It's hard to deny the success of a system which its users say they like. But also the fact that there are many reliable tools available that can measure satisfaction, like the instrument of Bailey and Pearson (1983), makes this variable popular. Distinctions can be made between for instance 'User Satisfaction', 'Top Management Satisfaction', 'Overall Satisfaction' and 'User Information Satisfaction'.

The fifth variable 'Individual Impact' measures the effect of the information on the behavior of the recipient. DeLone and McLean note this variable probably is the most difficult to define in a non ambiguous manner. Impact is for instance closely related to performance, but also better understanding, which can lead to better decision making. Examples of 'Individual Impact' measures are 'Decision Quality', 'Task Performance', 'User Understanding' and 'Cost Awareness'.

The sixth and final variable 'Organizational Impact' is the effect of information on organizational performance. According to DeLone and McLean organizational performance is considered of substantial importance to IS practitioners. On the other hand, academic researchers have tried to avoid performance measures, apart from laboratory studies. This because of the difficulties of isolating the effect of the IS from other effects which influence organizational performance. Examples of measure of 'Organizational Impact' are 'Operating Cost Reductions', 'Return on Investments', 'Increased Market Share', 'Product Quality' and 'Organizational Effectiveness'.

These six variables and the many specific IS measures within each of these variables clearly indicate that IS success is a multidimensional construct and that it should be measured as such. Based on these concepts and the previously described serial process approach of information by Mason a model was developed by DeLone and McLean. This model is presented below (Figure 27).

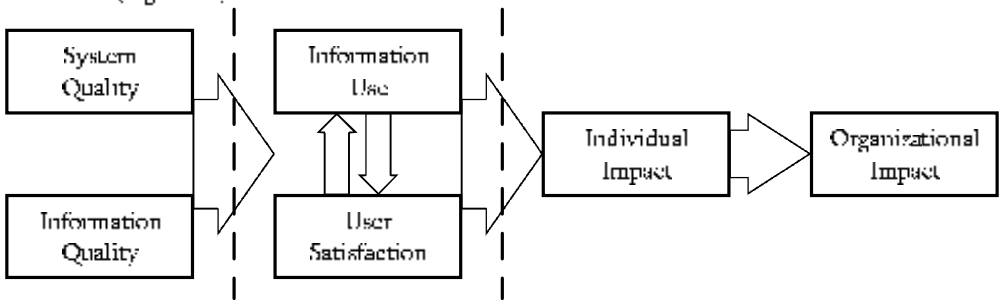

Figure 27 - Information System Success Model (Source: DeLone & McLean, 1992)

In the D&M Model the interrelations between the variables and the serial process are presented. 'System Quality' and 'Information Quality' singularly and jointly affect both 'Informa-

tion Use' and 'User Satisfaction'. In addition, the amount of 'Information Use' can have an effect on the degree of 'User Satisfaction' and vice versa. 'Information Use' and 'User Satisfaction' are direct antecedents of 'Individual Impact'. Finally this impact on individual performance should have some 'Organizational Impact'. DeLone and McLean stressed that particularly this last variable should be assessed more in further research.

5.1.2 Strengths & Weaknesses DMM

Since DeLone and McLean proposed their model in 1992, nearly 700 articles in refereed journals have directed to or even used this IS success model. This wide popularity of the model proves the need for a comprehensive framework in order to integrate IS research findings. Therefore the reputation and the simplicity of the model – the reduction of numerous success dimensions of system success to only six – are certain strong points of this model.

Many researchers (e.g. Goodhue & Thompson, 1995; Igbaria & Tan, 1997; Wixom & Todd, 2005) have tested the assumed relations between the variables in the D&M Model. The majority of these studies validated those relations. For instance Rai et al. (2002) performed a goodness of fit test on the entire D&M Model based on survey responses from 274 users of a university student IS. Their study concluded that some goodness-of-fit indicators were significant but others were not. However, all of the path coefficients among the six success dimensions of the D&M Model were found to be significant.

In addition to the many papers that have tested and validated the D&M Model, several articles have been published that critique the model. Seddon (1997) believes the DeLone and McLean's model is too encompassing and introduces some confusion because it mixes process and causal explanations of IS success. Further Seddon points out that the concept 'Use' in the DeLone and McLean Model should be removed as a success variable in the causal model. A number of researchers (e.g. Whyte et al., 1997; Jiang & Klein, 1999) commented on the difficulty of applying the D&M Model in order to define and make 'IS Success' operational in specific research contexts.

In their *"Ten Year Update of the D&M Model"* DeLone and McLean (2003) presume that many of the suggested improvements to the D&M IS Success Model flow from a confusion between what is an independent variable and what is part of the dependent variable 'IS Success'. 'User Involvement' and 'Top Management Support' are but two examples of suggested additions to the D&M Model. However these are clearly variables that may cause success rather than being a part of success.

5.1.3 Assigned DMM Items

The well-acknowledged and often validated DeLone and McLean Model covers a broad spectrum of IS success aspects. By using their model as the foundation for assessing the success of PM software in this research the chances of important measures being missed will be minimal. The second reason for choosing this model as the center is that it encompasses measures of IS success from different perspectives. As has been explained earlier (Section 1.3.2) this corresponds with the definition of 'PM Success', which was set at the broad perception of a whole organization.

Each of the original six dimensions of D&M Model will be used to order the items in this research. Every dimension of the D&M Model will be part of the Final Framework (Figure 28). All six dimensions will be represented with one or more items. However the dimension 'Information Use' will not be used to assess the constructed variable 'PM Software Success'. The purpose of measuring this dimension will be explained later on (Section 6.2.3). Most items within each dimension will be exactly taken over or deduced from the comprehensive lists of existing measures that were composed by DeLone and McLean (1992; 2003). Additional items from the Technology Acceptance Model (Paragraph 5.2) and the Task Technology Fit model (Paragraph 5.3) will make the framework complete. A detailed explanation of the actual used items will be given at a later stage (Paragraph 6.2).

Figure 26 Assignment of measurement items from D&M Model to PM Software Success

5.2 TAM of Davis

Technology adoption research has flourished in recent years (e.g. Davis, 1989; Taylor & Todd, 1995; Igbaria et al., 1996; Agarwal & Prasad, 1997; Dishaw & Strong, 1999; Venkatesh, 2000, Moon & Kim, 2000; Van der Heijden, 2004). Presently, the most effective tool to describe adoption is the Technology Acceptance Model (TAM) which was developed by Davis (1986). TAM is an IS theory that models how users come to accept and use a technology.

5.2.1 Main Idea TAM

Davis' TAM model (Figure 29) is an influential extension of Ajzen and Fishbein's (1975, 1980) Theory of Reasoned Action (TRA). TRA is a widely studied model from social psychology. This model (Appendix VII, Figure 135) proposes that one's intention to perform or not perform a given behavior is a function of two cognitive variables. The first variable is 'One's Attitude toward the Behavior in Question'. The second variable is 'One's Subjective Norm', which represents one's general perception of how other people, who are considered important, think about the performance or non-performance of the behavior (Ajzen, 1991). The TAM is considerably less general than TRA. The TAM was designed to apply only to computer usage behavior.

Nowadays the TAM is a widely acknowledged Technology Acceptation model. The TAM has been used in many different settings and fields, for instance it has been used to test the acceptance of e-mail (Gefen & Straub, 1997), online retail shopping (Childers et al., 2001), an electronic prescription system (Spil et al., 2004) and E-HRM (Voermans & Van Veldhoven, 2007).

The central idea of the TAM is that the 'Actual System Use' by an individual is determined by the 'Behavioral Intention to Use'. This intention is the effect of the 'Attitude toward Using' and the 'Perceived Usefulness'. In its turn this attitude is the result of two particular believes, which are 'Perceived Usefulness' and 'Perceived Ease of Use' (Figure 29).

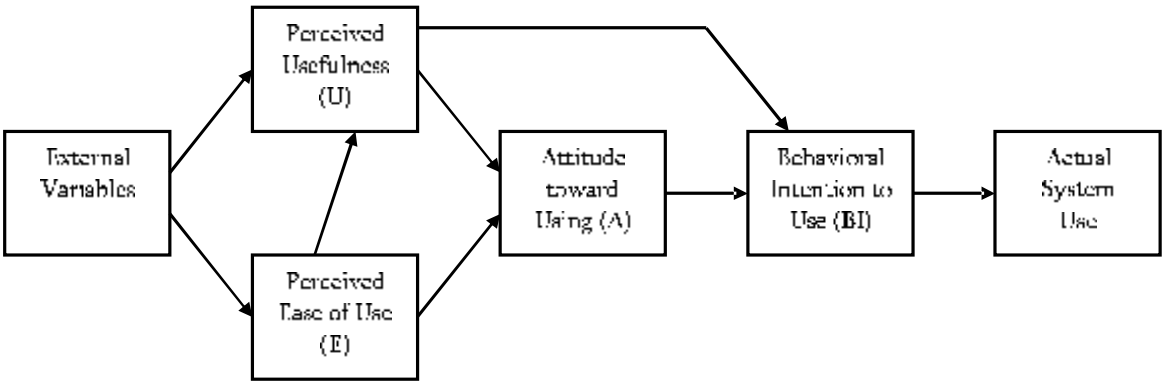

Figure 29 Technology Acceptance Model (Source: Davis et al., 1989)

'Perceived Usefulness' is defined as the degree to which a person believes that using a particular technology will enhance his or her job performance. People tend to use or not to use an application to the extent they believe it will help them perform their job better (Davis et al., 1989). 'Perceived Usefulness' explains the user's perception to the extent that the technology will improve the user's workplace performance. This includes decreasing the time for doing the job, more efficiency and accuracy.

'Perceived Ease of Use' refers to the degree to which a person believes that using a particular technology will be free of effort (Davis et al., 1989). Despite the fact that users believe that a given application is useful, they may at the same time believe that the technology is too hard to use and that the performance benefits of usage are overshadowed by the effort of using the application.

Since the TAM was published many alterations and extensions have been proposed (e.g. Gefen & Keil, 1998; Moon & Kim, 2001; Konradt et al., 2006). The TAM2 (Venkatesh & Davis,

2000) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) are examples of such extensions. They extend the TAM and take into account several new constructs such as 'Performance Expectancy', 'Effort Expectancy' and 'Social Influence') that bear significant influence on 'Behavioral Intention to Use' and 'Actual System Use'. At this moment TAM still seems to evolve with TAM3 in preparation. Two of these extended models can be found in Appendix VII (Figures 137 & 138).

5.2.2 Strengths & Weaknesses TAM

The most important strengths of the TAM are its face validity, its simplicity, its basis in social psychology theory and the reliability of its instruments (Adams et al., 1992). These strengths make it a preferred model for studying and discussing IS acceptance, as can been seen by the many references in the preceding section. But it is this simplicity which leads as well to many discussions.

A first possible weakness is that although numerous empirical investigations have established strong empirical support for the TAM, the importance of one of the two determinants still is arguable. The 'Perceived Usefulness' has been identified consistently in the literature as significant in attitude formation (e.g. Davis, 1989; Taylor & Todd, 1995; Szajna, 1996; Gefen & Keil, 1998; Agarwal & Prasad, 1999; Venkatesh & Davis, 2000; Jeyaraj et al., 2006). In contrast with this, the evidence for 'Perceived Ease of Use' has been ambiguous (Chau, 1996). Even Davis et al. in 1989 already noted that 'Perceived Usefulness' seemed more important than 'Perceived Ease of Use'. A longitudinal study of Szajna (1996) suggests that the decreasing effect of 'Perceived Ease of Use' over time indicates an exhausting effect of users' initial self consciousness concerning the 'Perceived Ease of Use' as they gain experience with and become comfortable in using certain systems.

This example of time influence reveals as well the second often discussed shortcoming of the model. The TAM is cross sectional; it measures perceptions and intentions at a single point in time. However, perceptions change over time as individuals gain experience. Therefore there's need for a more dynamic model according to Mathieson et al. (2001).

Finally, as the numerous alterations and extensions in the previous section show, much criticism is about the limited explanatory and predictive power of the TAM. There is a continuous discussion in the user acceptance and adoption research field on whether the TAM is explanatory enough or whether additional factors (e.g. social norms) should be included in the model to obtain a richer explanation of technology adoption.

5.2.3 Assigned TAM Items

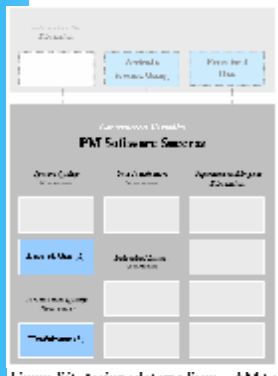

Figure 51: Assigned items from TAM to PM Software Success

The regularly proofed reliable Technology Acceptance Model will be used to extend the framework of this research with one extra item. In this way it hopefully becomes clearer, from a behavior perspective, why individuals do or do not use PM software. Since the items 'Usefulness' and the 'Ease of Use' both already will be part of the constructed variable (Section 5.1.3), it would be interesting to see if these items actually influence, in combination with the mediated variable 'Attitude toward Using', the 'Use' of PM software.

As a consequence the item 'Attitude toward Using' will be added to the framework, besides the already included items 'Usefulness', 'Ease of Use' and 'Use'. Although this supplementary item will not be part of the constructed variable 'PM Software Success', it will be used to investigate why PM software is being used or not, as well as in voluntary as in obligatory conditions. Besides exploring the behavior perspective of PM software users, it will also be fascinating to examine if the TAM in case of PM software appears to be valid.

5.3 TTF Model

In 1988 Goodhue and later on in 1995 Goodhue together with Thompson articulated Task-Technology Fit (TTF) as an additional model of IS success. This relative new model is consistent with the model that was proposed by DeLone and McLean in 1992 (Paragraph 5.1). In both models 'Utilization' and 'User Attitudes' about the technology lead to 'Individual Performance Impacts'.

But the TTF Model goes further than the DeLone and McLean Model in two important ways. First, it emphasizes the importance of the fit between tasks and technology in explaining how technology leads to performance impacts. According to Goodhue (1992) 'TTF' seemed a critical construct that was hidden or even missing in many previous models. Second, it is more precise concerning the relations between the constructs. In this way the model provides a stronger theoretical basis for thinking about a number of issues relating to the impact of IT on performance.

5.3.1 Main Idea TTFM

The concept of fit has received attention in many different research contexts (e.g. Van de Ven & Drazin, 1985; Venkatraman, 1989). It has been used to refer to, for example, the relationship between a person and his or her environment (e.g. Caplan, 1987). But the concept of fit also has been used by researchers to refer to the conformity between an IS and its organizational environment (e.g. Iivari, 1992; Henderson & Venkatraman, 1993; Silver et al., 1995, Kanellis et al, 1999; Hong & Kim, 2002).

The TTF Model, which also uses the concept of fit, is like the TAM a technology adoption model. It extends the TAM (Paragraph 5.2) by considering how tasks affect the performance. The TTF Model suggests that technology acceptation depends in part on how well the new technology fits the requirements of a particular task. A technology will be adopted if it's: *'... a good fit with the task it supports'* (Goodhue & Thompson, 1995:213). The TTF Model consists of five main variables. These are 'Task Characteristics', 'Technology Characteristics', 'Task-Technology Fit', 'Utilization' and 'Performance Impact' (Figure 31).

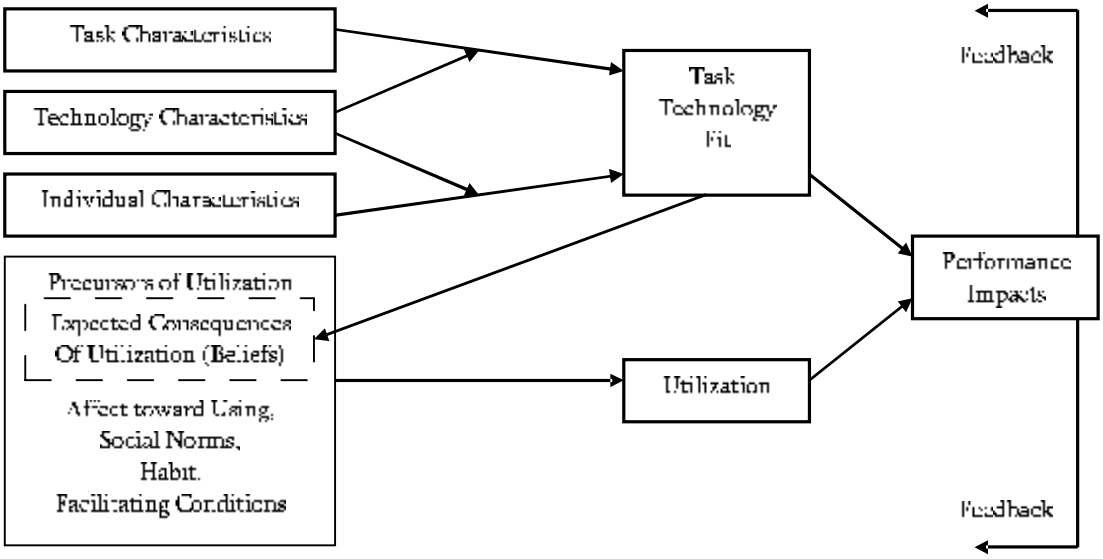

Figure 31: Task - Technology Fit Model. (Source: Goodhue & Thompson, 1995)

The first independent variable 'Technology Characteristics' can be seen as the functionality of tools used by individuals in carrying out their tasks. In the context of IS research, technology refers to computer systems provided to assist users in their tasks. The model is intended to be general enough to focus on either the impacts of a specific system or the more general impacts of the entire set of systems.

Tasks are broadly defined as the actions carried out by individuals in turning inputs into outputs. Tasks include not only 'what' must be accomplished to meet stated goals, but also 'how' those goals should be accomplished. In other words it includes the processes by which the tasks should be carried out (Hackman, 1969). Therefore the second variable 'Task Characteristics' includes those processes that might move a user to rely more heavily on certain aspects of IT.

'Individual Characteristics', the third variable, refers to how individual people may use

technologies to assist them in performing their tasks. The characteristics of an individual (training, computer experience, motivation etc.) could affect how easily and well he or she will utilize the technology.

The fourth and key variable 'Task-Technology Fit' ('TTF') is the degree to which a technology assists an individual in performing his or her portfolio of tasks. More specifically, the 'TTF' is the correspondence between task requirements, individual abilities and the functionality of the technology. Goodhue and Thompson (1995) supposed the 'TTF' would decrease if tasks became more demanding or technologies offered less functionality. The proposed measure of 'TTF' first consisted of eight dimensions, later on of this number increased to twelve (Goodhue, 1998).

The fifth variable 'Utilization' is the behavior of making use of the technology in completing tasks. It should ideally be measured as the proportion of time in which the users choose to utilize the system. Unfortunately, this proportion is extremely difficult to determine in a field study. In addition, there is also the problem of 'mandatory/voluntary use'. A solution to this problem which was proposed by Goodhue and Thompson (1995) is to conceptualize utilization as the extent to which the information systems have been integrated into each individual's work routine, whether by individual choice or by organizational mandate. The antecedents of 'Utilization' can be suggested by theories about attitudes and behavior, like 'one's subjective norms' of TRA (Section 5.2.1) and the impact of 'TTF'. This impact of 'TTF' on 'Utilization' is represented by the link between 'TTF' and beliefs about the consequences of using a system. This is because 'TTF' should be an important determinant of whether systems are believed to be more useful, more important or give more relative advantage. All of these related constructs have been shown to predict 'Utilization' of systems (Davis, 1989; Hartwick & Barki, 1994; Moore & Benbasat, 1992), though they are not the only determinant, as the model (Figure 31) shows.

The sixth variable 'Performance Impact' often will be measured by perceived performance impacts, since objective measures of performance are seldom available in field studies.

Finally, the loops of 'Feedback' are an important aspect of the model. Once a technology has been utilized and performance effects have been experienced, these experiences probably influence the variables 'TTF' and 'Utilization'.

Summarizing the above, the 'TTF' can be conceptualized as the degree that a technology helps individuals perform their portfolio of tasks. The 'TTF' is higher when the gap between the task need and the functionality of the technology is reduced. The 'TTF' is lower as tasks become more demanding or technologies offer less functionality. A higher 'TTF' will lead to an increased behavior to use ('Utilization') and positive 'Performance Impact'. Consequently a lower 'TTF' will have a negative influence on these variables.

Since the initial work, the TTF Model has been applied in the context of a diverse range of IS including decision support systems (Ferratt & Vlahos, 1998), software engineering tools (Dishaw & Strong, 1998) and electronic commerce systems (Garrity et al., 2005). By many scientists (e.g. Dishaw & Strong, 1999, Maruping & Agerwal, 2004; Staples & Seddon, 2004) the TTF Model was tested, combined with or used as an extension of other models related to IS outcomes. An example of a similar fit model was presented by Zigurs & Buckland (1998). Their General Model of Task/Technology Fit is operating at the group level and was examined in the context of group support systems (GSS).

5.3.2 Strengths & Weaknesses TTFM

A major benefit of the TTF Model is that it sees technology as an 'instrument for a goal directed individual to perform a task. It emphasizes that it is not the technology in isolation which affects the performance (Goodhue et al., 2000).

The significant evidence of the predictive power by 'TTF' on 'Performance Impact' is also an important advantage of the TTF Model. Goodhue and Thompson (1995) tested their model with a large sample of 1200 computer users employing in 25 different technologies, working in 26 different departments in two different organizations. A response rate of 33 percent resulted in 400 proper surveys. In addition to Goodhue and Thompson quite a number of

researchers (e.g. Dishaw & Strong 1998, 1999; Ferrat & Vlahos, 1998; Staples & Seddon, 2004; Majchrzak et al., 2005) confirmed the relevance of the 'TTF' concept in explaining and predicting IS success for individual performance. Another big advantage of the TTF perspective is it's applicable for both mandatory and voluntary use situations (Goodhue et al., 2000).

Besides these strong points there are some aspects of the TTF Model that are being argued. First, the link between 'TTF' and 'Utilization' is questionable. Research results (Goodhue & Thompson, 1995) provided little support for the relation between these variables. A second arguable aspect of the TTF Model is the measurement of several constructs. Goodhue & Thompson (1995) admit it can be very complex or even impossible to assess the 'TTF' and 'Performance Impact'. For instance frequently not all the tasks are explicit known and the actual 'Performance Impact' can't be measured.

5.3.3 Assigned TTFM Items

The last expansion of the constructed variable 'PM Software Success' will originate from the Task Technology Fit Model. This model emphasizes that a better fit between task characteristics and the technology characteristics should lead to increased utilization and performance. The tasks characteristics are supposed to match the PM processes within an organization. As a result it would be pragmatic to suggest that a better fit between PM processes and the assistance provided by the PM software probably will lead to higher 'PM Software Success'.

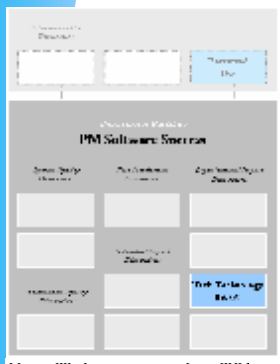

Figure 38 - Assigned items from TTF Model to PM Software Success

Therefore two items of the TTF Model will be added to the framework. The first item 'Task-Technology Fit' will be assigned to the 'Organizational Impact' dimension of the constructed variable. The rationale of why it will be part of this particular dimension will be explained later on (Section 6.2.6). The second item 'Utilization' (i.e. 'Use') already existed in the framework. Incorporating the 'TTF' item in the framework emphasizes that the 'PM Software Success' will positively be influenced if a PM application has the ability to support the PM processes within an organization in a sufficient way.

6 Final Framework

In this chapter the Preliminary Framework, which was presented in Chapter 3, will be extended. This more detailed framework is based on the in depth studies of the Contingency Factors (Chapter 4) and the three IS Success models (Chapter 5).

In the first paragraph the variables of the contingency factors and their attributes will be labeled. In some cases the variables consist of multiple items. The items will be defined with help of additional literature in each section.

The second paragraph will be devoted to the elaboration of the items and attributes that give shape to the variable 'PM Software Success'. These items were carefully selected from the theoretical models and many attributes will be taken over from acknowledged studies. Each section in this paragraph will give a brief description of a particular item.

In the third paragraph the composed Final Framework will shortly be explained and displayed in a scheme. This framework will include all the items of the three contingency factors and the constructed variable 'PM Software Success'. The scheme even includes those items that aren't components of the factors or the constructed variable but will be measured to gain more understanding about PM software use.

In the fourth, fifth and sixth paragraph of this chapter respectively the proposed scale construction of the constructed variable 'PM Software Success', the single item test variable and some exit items will be explained.

6.1 Contingency Factors Variables

Figure 33: Positioning of contingency factors in Final Framework

This paragraph will be devoted to the three contingency factors (Figure 33). All the variables of the contingency factors will be evaluated.

The first factor 'PM Organization' consists of two main variables, which are the organizational 'Activity Sector' and the organizational 'Size'.

The other two factors 'PM Methods' and 'PM Software' have both one main variable and a few supplementary variables. The main variables are respectively 'Availability/Kind of PM Method' and 'Type of PM Software'. Only the main variables will eventually become part of the Final Framework. Though the supplementary variables will be displayed in the final scheme (Figure 44). These supplementary variables will be used to gather additional information about PM methods, PM software and its utilization. With anticipation they lead to the better understanding of these variables. In each section of this paragraph the attributes of a particular variable will be described.

6.1.1 PM Organization

Figure 34: Variables of contingency factor PM Organization

The first contingency factor is the 'PM Organization'. This factor will include two main variables (Figure 34); however it contains, besides the language version the participants will choose, no real supplementary variables. The first main variable that will be measured is the organizational 'Activity Sector'. Assumptions of why the success of PM software could differ in each activity sector were listed in advance (Section 4.1.1). The second main variable will be the organizational 'Size'. A number of postulations of why the success of PM software could be influenced by the size of an organization were listed in a prior section (Section 4.1.2).

1st Main Variable – Activity Sector of PM Organization

In literature and in similar studies as this study many different categorizations of the variable 'Activity Sector' were found (e.g. Clegg et al., 1997; Liberatore & Pollack-Johnson, 2003; Ilyvari, 2006). These categorizations are varying in range of variation from just two attributes (e.g. public versus private or manufacturing versus service) to about twenty attributes.

Because there seems not to be a most agreed on classification, the sectors used in this research were derived from NACE (Rev. 2). NACE stands for *"Nomenclature Generale des Activites Economiques dans l'Union Europeenne"* (European Parliament & the Council, 2006). This is a common statistical classification of economic activities in the European Community. Only the main section classification will be used, hence the total number of classes is very extensive. An additional benefit of using this classification will be that it is

available in many languages, which probably saves time and effort during the operational translation phase of this research.

Based on this main section classification of NACE, the variable 'Activity Sector' will consist of seventeen attributes, sixteen of these are existing activity sectors and one attribute will be the option 'other'. The precise list of sectors can be found in the Appendix I (final versions of the survey, ther the first question).

2nd Main Variable – Organizational Size

The second main variable of the contingency factor 'PM Organization' is the organizational 'Size'. In advance (Section 4.1.2) it already was decided to measure the size in number of employees.

In literature often a dichotomous categorization is being used, small and medium business enterprises (SMEs) versus large organizations. In general organizations with 500 or fewer employees are being considered as small businesses. But there does not seem to be a specific definition for SMEs. However, most authors view them as profit making businesses of limited size, which stand alone and not as a subsidiary of a company. The maximum number of employees varies by country. Smaller, less developed countries set the size limit often at 200 employees or smaller (e.g. Mehrtens et al., 2001). More developed countries set the size limit habitually at 500 or fewer employees (Grandon & Pearson, 2004).

For this study it was decided to use a categorization of 'number of employees' that is more explicit and differentiated. The variable organizational 'Size' will consist of eight attributes, varying from '0-50' to 'more than 10.000' employees. This ordinal measure of organizational size corresponds with several earlier studies (e.g. White & Fortune, 2002; PSO Partners, 2005; Vrije Universiteit Amsterdam, et al., 2007). By using this range of variation it will be less problematic to make any comparisons with other similar studies that have same or lower ranges of variation.

6.1.2 PM Methods

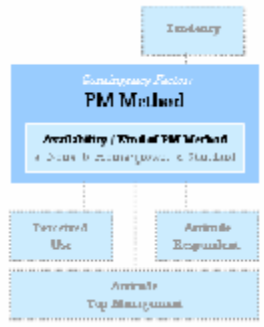

Figure 35: Variables of contingency factor PM Methods

The second contingency factor 'PM Methods' will consist of one main variable, which will be 'Availability/Kind of PM method'. In order to obtain additional information about the factor 'PM Methods' four supplementary variables will be measured. These four extra variables will be the estimated 'Use of PM Methods', the estimated 'Attitude of Top Management toward PM Methods', the estimated 'Importance of PM Methods' and finally the 'Attitude of the Respondent toward PM Methods' (Figure 35).

Main Variable – Availability/Kind of PM Method

The first decision that had to be made about main variable 'availability/kind of PM method' was: "Will all the PM methods that are being used within an organization be measured or only the most used one?" It was decided to measure the latter. Although the first option would lead to a more complete representation of the actual world - many organizations are using more than one method - the amount of data probably would become gigantic and too complex. As in addition to the registration of multiple methods within each organization, these methods should be ranked as well within every particular case. Further it would be almost impossible to ask additional questions about each singular method. The increase of data and the variance of data within each case would make comparisons between cases far more complicated than in case of assessing only the most used method.

This second option 'only measuring the most used PM method' would be, despite its simplistic representation of the real world, adequate enough for serving the goal of this research. As Garcia (2005) notes in the case of adopting PM methods, more isn't necessarily better. One PM method might reduce argument, but applying multiple methods in the same organization could cause confusion and conflict.

Taking these arguments and the taxonomy, as described earlier (Section 4.2.3), in consideration the attributes of the variable 'availability/kind of PM method' became 'no PM method' is used, a 'home-grown PM method' is most used and a 'standard PM method' is most used.

The attribute 'standard PM method' will not be measured explicitly. Instead the assessment of this attribute will be done by asking the respondents if in their organization PM methods are being used. When the answer is 'yes', they can select the name of the (most used) method of a list of frequently used PM methods. This list was based on the outcomes of other PM surveys (White & Fortune, 2002; Vrije Universiteit Amsterdam et al., 2007). The pre-defined answers will, in addition to seven standard PM methods, include the options 'yes, a home-grown method', 'other' and 'I don't know'.

1st Supplementary Variable – Perceived Use of PM Methods

If a (most used) PM method is present, the first additional measure will be the 'Perceived Use' of this method. This use will be measured in percentage ranges that correspond with the estimated proportion of all the projects within an organization that are run according the prescribed procedures, processes and documentations of this (most used) method. The attributes of this variable will vary from 0 to 100 percent in ranges of 25 percent.

2nd Supplementary Variable – Attitude of Top Management toward PM Methods

The second supplementary variable will be the 'Attitude of Top Management'. Often in literature (Kappelman et al., 2006) the importance of management support is highlighted. That's why the estimated attitude of top management toward the method will be assessed. The attributes of this variable will be 'no top management support' and 'top management support'.

3rd Supplementary Variable – Importance of PM Method

The third supplementary variable is about the future of PM methods. How do the respondents estimate the 'Importance of the PM Method', does it increases or decreases? The attributes of this variable will be varying in a seven point scale from 'strongly decreasing' to 'strongly increasing', including a 'neutral' and 'I don't know' attribute.

4th Supplementary Variable - Attitude of respondent toward PM Method

The fourth additional variable is about the 'Attitude of the Respondents toward the most used PM Method'. The attributes of this variable will be varying in a seven point scale from 'very negative' to 'very positive', including a 'neutral' and 'I don't know' attribute.

6.1.3 PM Software

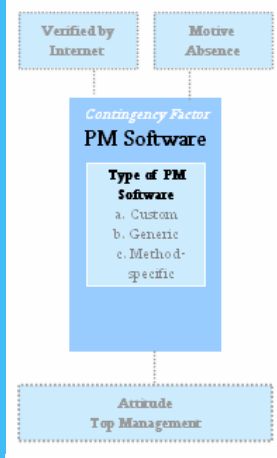

Figure 36: Variables of contingency factor PM Software

The third contingency factor 'PM Software' will consist of one main variable, which will be the 'Type of PM Software'. This variable will be measured in two ways. How this will be done is being explained in the next subsection.

Besides this main variable two supplementary variables will be formulated. These variables will be used to obtain additional information about the factor 'PM Software'. One variable hopefully will expose reasons of why PM software is 'unavailable' within organizations. The other supplementary variable will measure the estimated 'Attitude of Top Management' toward the implementation of PM software (Figure 36).

Main Variable – Type of PM Software

The variable 'Type of PM Software' can have the values 'custom-built PM software', 'generic PM software' and 'method-specific PM software'. These values originate from the taxonomy as was composed earlier (Section 4.3.3). The value of each PM software application will be determined with the help of two items.

The first item will be the 'Name of the PM Application'. Each particular PM application will be assigned to a certain type of PM software. These assignments will be executed by searching and visiting the vendors' Web sites. The information about the applications available on these Web sites will carefully be explored and analyzed. Based on these content analyses each application will be assigned to one of the three PM software types. If for example the vendor highlights the compatibility of the software with a specific standard PM method, then the

software will be assigned to 'method-specific PM software'. If the vendor stresses the ability of the software being adjusted and configured to meet the processes of the customer organization, then the software will be assigned to 'generic PM software'. A complete overview of all method specific PM software providers and the phrases that highlight the specific support of particular standard methods is included in Appendix IV.

The second item will be the 'Type of PM software according to the Respondent'. This item serves two goals. First, it may ratify or invalidate the assignment of a particular PM application to a group type. Second, in case of when the first item 'Name of the PM Application' results in a name that can't be found on the internet, the assignment can proceed on the basis of the information obtained by this item. For instance, it's very imaginable the name of a custom built PM application will not lead to a developer's Web site, because it simply doesn't exist (anymore).

This second item has three predefined attributes, which are 'purpose built software', 'generic software' and 'custom-built software'. Each of these attributes includes a description of what is meant with that particular type of software. A fourth attribute is the option 'other' and includes an open answer field.

If the first and second item of the variable 'Type of PM Software' will lead to dissimilar assignments, then the assignment based on the first item will be decisive. Unless the opposite assignment, that is supported by the second item, is the same in more than 50 percent of the cases.

1st (Optional) Supplementary Variable – Reason of Unavailability of PM Software

The first supplementary variable will be the 'Motive of why PM Software is Unavailable'. This variable will only be assessed by those respondents in whose organization no PM software is being used.

This variable has three predefined attributes, which are 'respondent doesn't know why', 'PM organization is too small' and 'previous bad experience with PM software'. The fourth attribute is the option 'other reasons' and includes an open answer field.

2nd Supplementary Variable – Attitude of Top Management toward implementation of PM Software

The second supplementary variable will once more be the 'Attitude of Top Management', but in this case toward the implementation of PM software. The attributes of this variable are varying in a seven point scale from 'very uncommitted' to 'very committed', including a 'neutral' and 'I don't know' attribute.

6.2 PM Software Success Items

Chapter 5 makes apparent that 'IS Success' and its determinants are considered critical to the field of IS. Despite the many attempts to model success (e.g. Davis, 1986; Delone & McLean, 1992; Goodhue & Thompson, 1995), the definition and measure of 'IS Success' still remains problematic for many factors.

The first problem is the mishmash of the technical and social aspects of an IS. According to Kanellis, Lycett & Paul (1998) IS success is then a perspective that emerges from the social and technical interplay within organizations.

Second, Alter (2000) argues that IT and work practices are now so intertwined that it is difficult to identify their respective contribution to success.

Other researchers (Garrity & Sanders, 1998) link the difficulty of defining 'IS Success' to the methodological aspects involved in measuring 'IS Success'. Specifying a dependent variable is difficult because of the many theoretical and methodological issues involved in measuring the constructed variable 'IS Success'.

And finally, Seddon, Staples, Patnayakuni and Bowtell (1999) consider 'IS Success' as a vague concept, contingent upon different stakeholders and different types of IT. For instance in the practice community, Markus and Tanis (2000) claimed that there is a fundamental gap in both practical and academic thinking about IS. They believe where IS are concerned, there

Figure 37 - Variables of Conceptual Model in Final Framework

is a lack of consensus and clarity concerning the meaning of success.

All these factors and without doubt many more cause the meaning of 'PM Software Success' to be different from different stakeholders perspectives (end users, top management, customer organization as a whole, practitioners, scientists, etc.). For this reason it was decided to use the relative broad-spectrum categorization of DeLone and McLean (1992). Their generally accepted model covers many aspects, which are important to numerous stakeholders. Therefore their model will be used as the foundation to assess the success of PM software in this research. This foundation will be extended with some measures of Davis' TAM (1989) and the TTF Model of Goodhue and Thompson (1995). The reasons for using measures of these additional models were explained earlier (Sections 5.2.3 & 5.3.3).

Each section in this paragraph will briefly introduce a dimension that corresponds with variable belonging to one of the mentioned three models. Together these dimensions will determine the variable 'PM Software Success' (Figure 37). Although most dimensions can be assessed by numerous items, it was decided to limit the number of items to only one, two and four items per dimension. In total ten main items will be used to determine the variable 'PM Software Success'. Otherwise the way of measuring the variable 'PM Software Success' would become too time consuming and complex. Three supplementary items will be used to obtain additional information about the PM software. The items and their attributes were taken over from acknowledged studies, but in some cases simplified.

6.2.1 System Quality

Figure 38 - Variables of System Quality dimension

The first dimension that is being considered to help assessing the variable 'PM Software Success' will be 'System Quality'. As mentioned earlier (Section 5.1.1) 'System Quality' refers to measures of the information processing system itself (DeLone & McLean, 1992). This dimension will in this research be measured with two items; to be precise these will be 'Reliability' and 'Ease of Use' (Figure 38).

1st Main Item - Reliability of PM Software

The reason for using this particular measure instead of other items is threefold. First some measures of 'System Quality' might be vague or even unknown by the respondents, like for instance 'Content of the Data Base' (Hamilton & Chervany, 1981) and 'Stored Record Error rate' (Morey, 1982). Other measures like 'Response Time' (Emery, 1971) and 'Convenience of Access' (Bailey & Pearson, 1983) probably are short of differentiating power, because most modern PM applications attain these characteristics at sufficient levels. The third reason for using the measure 'Reliability' is, that it has been used and validated by many respected IS researchers (e.g. Hamilton & Chervany, 1981; Belardo et al., 1982; Srinivasan, 1985, Wixom & Watson, 2001; Jiang, Klein & Carr, 2002).

The attributes of the item 'Reliability of PM Software' will vary in a seven point scale from 'very bad' to 'very good', including a 'neutral' and 'I don't know' attribute.

2nd Main Item – Ease of Use of PM Software

The second item which will be measured as part of the dimension 'System Quality' will be the 'Ease of Use' of PM applications. Davis and Olson (1985) note that the ease of use of a system is a fundamental aspect of its technical quality. This item has been used and validated by several IS scientists in assessing IS success (e.g. Swanson, 1974, Belardo et al., 1982; Etezadi-Amoli & Farhoomand, 1996). Similar to the item 'Reliability' it reflects the more engineering oriented performance characteristics of the PM systems. Further it is as well a relative unproblematic concept for the respondents to comprehend.

An extra advantage of this item is that it holds an important position in the Technology Acceptance Model (TAM) of Davis. In TAM the 'Perceived Ease of Use' together with the 'Perceived Usefulness' (which will be introduced in the subsequent section) influence the 'Attitude toward Using' which in its turn impacts the 'Actual System Use'.

The attributes of the item 'Ease of Use' will, like the item 'Reliability', vary in a seven point scale from 'very bad' to 'very good', including a 'neutral' and 'I don't know' attribute.

Figure 39: Variables in Information Quality dimension

6.2.2 Information Quality

The second dimension that will be considered in order to assess the variable 'PM Software Success' will be 'Information Quality'. As was mentioned previously (Section 3.1.1), 'Information Quality' addresses to measures of the IS output rather than the measuring the information system performance (DeLone & McLean, 1992). This dimension will in this research be measured with simply one item which will be 'Usefulness' (Figure 39).

3rd Main Item – Usefulness of the Functions and Features of PM Software

Most measures of 'Information Quality' are from the perspective of the user of this information and are therefore relative subjective in character. 'Information Quality' measures such as 'Completeness of Information' (Bailey & Pearson, 1983), 'Relevance to Decisions' (King & Epstein, 1983) and 'Timeliness of Reports' (Mahmood, 1987; Miller & Doyle, 1987). All these measures could, in a rudimentary way, be represented by one item the 'Usefulness of the Functions and Features of PM Software'.

A useful function either duplicates or replaces the way of performing a particular task. Indeed complete and relevance information, for instance a clear overview provided by PM software of how work packages are related to each other and how they fit in the whole project, could alter the way of managing projects. In addition a useful feature can be described as something the software does to enhance a function. For instance automated reporting in PM software definitely can make communication during a project easier and faster.

Mahmood et al. (2000) stated that if 'Perceived Usefulness' is a quality of the IS, the users were more likely to accept the IS and therefore 'Usefulness' could purpose as a measure of 'IS Success'.

The attributes of the item 'Usefulness of Functions and Features of PM Software' will, similar to the items 'Reliability' and 'Ease of Use' of the dimension 'System Quality', vary in a seven point scale from 'very bad' to 'very good', including a 'neutral' and 'I don't know' attribute.

6.2.3 Information Use

The third dimension that will be considered in assessing the variable 'PM Software Success' will be the dimension 'Information Use'. As has been mentioned earlier in the D&M Model (Section 3.1.1), 'Information Use' means the utilization of an IS. Although this definition seems simplistic, this dimension is a very complex variable.

Use can be the 'Actual Use', which could be recorded in hands on hours, hours spent in analyzing reports, frequency of use, number of users or simply as a binary variable, i.e. use/non-use (Seddon, 1997). Nevertheless in many cases the 'Actual Use' may be impossible to determine, in those cases the reported or perceived use could be considered. Although these measures are far more subjective – hence self report usage isn't an appropriate surrogate measure for 'Actual Use' (Szajna, 1996) - they often are much easier to obtain.

Besides the different ways of computing the dimension 'Information Use', it also can have different forms. Is an IS used at its full functional capability level or is it limited to the use of some simple functions/features? As well the amount of use can heavily be impacted whereas the use of a system is voluntary or mandatory. In the review of their model, DeLone and McLean (2003) ascertain that most studies which follow the D&M Model replace the 'Information Use' box with 'usefulness', still they prefer 'Information Use' as in the original work (DeLone & McLean, 1992). In this research it's likely that voluntary and mandatory conditions come across. Therefore employing 'PM software Use' as an item of the constructed variable 'PM Software Success' almost certainly will lead to wrong conclusions.

In addition to the problem of disparities between voluntary and mandatory conditions a study performed by Gelderman (1988) showed a major setback of 'Use' as an item of 'IS Success' as well. He held a questionnaire under 1024 Dutch Managers about IS success. It showed low and insignificant correlations between 'Use' measures and 'IS Success'. However, Gelderman stated that for some systems (e.g. internet sites or other information systems

Figure 40 Supplementary items of Information Use dimension

aimed at a general public) 'Use' may remain the most appropriate and most easily assessed success measure.

As a result it's decided not to employ the 'Information Use' dimension as an item in the construction of the variable 'PM Software Success'. This doesn't mean 'PM Software Use' will not be measured at all in this research. In the contrary, Jiang, Klein and Discenza (2002) stressed that research designs which incorporate system use as an independent (intervening) variable that is based on multi dimensional measures may provide an important step forward for advancing research. For this reason the dimension 'Information Use' will, although kept out of the constructed variable 'PM Software Success', be further investigated with the help of Davis' TAM (1986). As predicted in the TAM (Paragraph 5.2) the 'Perceived Usefulness' and the 'Perceived Ease of Use' eventually impact the 'Use of an IS'. Since the 'Perceived Usefulness' and the 'Perceived Ease of Use' both already will be measured (see previous Sections 6.2.1 & 6.2.2), it would be interesting to observe if these items actual influence, in combination with the mediated variable 'Attitude toward Using', the 'Use of PM Software'.

Thus the 'Conditions of Use', the 'Perceived Use' and the 'Attitude toward Using' will be measured as supplementary items (Figure 40). Although these supplementary items will not be part of the constructed variable 'PM Software Success', they will be used to investigate the validity of the TAM model in case of PM software.

1st Supplementary Item – Conditions of Use of PM Software

As mentioned earlier (previous subsection) the use of PM software within an organization can vary from fully voluntary to fully mandatory. A complete voluntary use environment is one in which users feel the use or adoption of software is an entire free choice. A truly mandatory environment is where users perceive the use of software to be completely compulsory (e.g. Hartwick & Barki, 1994; Agarwal & Prasad, 1997; Venkatesh & Davis, 2000). Between these complete opposing environments numerous situations in which the condition of use could be partial free and partial obligatory. For example, in the case of PM software it's imaginable that project managers aren't obliged to use the software. But without using the software would (almost) impossible to complete ones own job tasks (e.g. checking project progress, scheduling of milestones, writing reports).

Although numerous situations and degrees of compulsory are thinkable, it was determined to limit the attributes of this item to the ends of the continuum, i.e. 'voluntary' and 'mandatory' and add the option 'other' with an open answer field for ambiguous situations.

2nd Supplementary Item – Perceived Use of PM Software

Instead of the objective 'Actual Use' (Section 6.2.3) the more subjective 'Perceived Use' will be measured as the second supplementary item of the dimension 'Information Use'. The reason for choosing this measure is that the 'Actual Use' of PM systems can only be measured with help from the inside of organizations (e.g. Robey, 1979; Yuthas & Young, 1998). And even then it would probably be very difficult due to privacy reasons. Luckily it is relative easy to ascertain the 'Perceived Use' by a survey (e.g. DeLone, 1988; Teng & Calhoun, 1996; Weill & Vitale, 1999).

The item 'Perceived Use' of PM software will be measured in the estimated percentage of all the projects within an organization in which the PM software actually is being used. The attributes of this variable will vary from 0 to 100 percent in ranges of 10 percent and the option 'no idea'.

3rd Supplementary Item – Attitude toward Using PM Software

In many ways, IS research to date has assessed the 'Attitude toward the Outputs' of an IS (see next section 'User Satisfaction'), rather than the 'Attitude toward Using' an IS. Brown et al. (2002) proposed that a nowadays often abandoned variable 'Attitude toward Using' is a critical factor in understanding mandatory use conditions. This because it represents the degree to which users are satisfied with an IS (Melone, 1990). In the original formulation of the TAM (1986, 1989) Davis included the variable 'Attitude toward Using'. In studies con

ducted in voluntary environments (e.g. Davis & Venkatesh, 1996; Venkatesh & Davis, 2000) it was demonstrated that the explanatory power of the model is just as good and the model is simplified without the intervening 'Attitude' variable. Thus, it has become the norm to exclude the 'Attitude toward Using' variable from TAM (e.g. Addams et al., 1992; Chau, 1996; Horton et al., 2001).

In this research, besides voluntary environments, probably mandatory environments will be encountered as well. Thus it was decided to measure the 'Attitude toward Using' as the final item of the dimension 'Information Use'. In this way the TAM applied to PM software can be examined in both voluntary and mandatory environments.

The item 'Attitude toward Using PM Software' will be represented by the overall willingness in the organization regarding the use of PM software. The attributes will vary in a seven point scale from 'very unwilling' to 'very willing', including a 'neutral' and 'no idea' attribute.

6.2.4 User Satisfaction

One of the most used dimensions to assess of 'IS Success' still is 'User Satisfaction'. In 1985 this measure already was commonly used (Mahmood & Medewitz, 1985). However as Melone (1990) notes there's a lack of agreement on the conceptual definition of the 'User Satisfaction' construct. As a result 'User Satisfaction' has been variously associated with terms such as *"felt need"* (Guthrie, 1974:22), *"system acceptance"* (Igersheim, 1976:979), *"the extent to which users believe the information system available to them meets their information requirements"* (Ives et al., 1983:785) and more generally *"attitudes and perceptions"* (Lucas, 1975:911).

Figure 41 Visualization of 'User Satisfaction' dimension

Many instruments have been developed to assess the construct 'User Satisfaction'. For instance, Bailey and Pearson (1983) measured 'User Information Satisfaction' (UIS) and Doll & Torkzadeh (1988, 1992) measured 'End-User Computing Satisfaction' (EUCS). Lots of researchers extended and/or modified existing instruments. As illustration, Saarinen (1996) extended the UIS with investment costs, while Ong and Lai (2007) created the USKMS instrument for measuring 'User Satisfaction' within the Knowledge Management Systems domain. The number of items which has been used to build the construct 'User Satisfaction' varies enormously. Bailey and Pearson used 39 items, Doll and Torkzadeh utilized 12 items, but others (e.g. Barett et al. 1968, Edmundson & Jeffrey, 1984; Hogue, 1987; Rai et al. 2002) even used one item.

4th Main Item – Overall Satisfaction with PM Software

Although Ives et al., (1983) stated that single-item scales provide little information as to what the users find dissatisfying (or satisfying) and thus are of limited value outside a research setting, in this research the dimension 'User Satisfaction' will be measured with a single item (Figure 41). The reason for this is that the interest in capturing a global measure of 'User Satisfaction' and the concerns about survey length are considered more important.

The fourth main item 'User Satisfaction' will be represented by the 'overall satisfaction with PM software' in the organization. The attributes will vary in a seven point scale from 'very unsatisfied' to 'very satisfied', including a 'neutral' and 'no idea' attribute.

6.2.5 Individual Impact

The fifth dimension that will be considered in order to assess the variable 'PM Software Success' will be 'Individual Impact'. As was mentioned previously in the D&M Model (Section 5.1.1), 'Individual Impact' refers to the effect of information on the behavior of the recipient. Of all the dimensions of 'IS Success' 'Impact' is, according to DeLone and McLean (1992), probably the most difficult to define in a non-ambiguous way. This dimension is closely related to performance. Examples of empirical measures of this dimension are 'User Confidence' (Aldag & Power, 1986), 'Improved Personal Productivity' (Crawford, 1982), 'Cost Awareness' (Drury, 1982), 'Number of Alternatives Considered' (Hughes, 1987), 'Decision Quality' (Dickson et al., 1986) and 'Personal Effectiveness' (Millman & Hartwick, 1987).

Figure 42 Visualization of Individual Impact dimension

Many of these measures can be assigned to personal efficiency or effectiveness impacts by an IS. As a consequence, it was decided to employ both an 'Efficiency' item and an 'Effectiveness' item in order to assess the dimension 'Individual Impact' (Figure 42).

5th Main Item – Efficiency by PM Software

Improvements of the tasks performed by the individual users of an IS, i.e. 'Efficiency by PM Software' will be the first measure of the 'Individual Impact'.

The item 'Efficiency by PM Software' will be represented by how the respondent estimates the influence of the PM software on his/her productivity. The attributes will vary in a seven point scale from 'very negative' to 'very positive', including a 'neutral' and 'no idea' attribute.

6th Main Item – Effectiveness by PM Software

The 'Individual Impact' of a PM application could also be indicated by the providing of a better understanding of the user's decision context. This may lead to alterations in the way a user fulfills his/her job. Therefore the 'Effectiveness by PM Software' will be the second item of the dimension 'Individual Impact'.

The item 'Effectiveness by PM Software' will be embodied by how the respondent estimates the influence of the PM software on the quality of her/his work. The attributes will vary in a seven point scale from 'very negative' to 'very positive', including a 'neutral' and 'no idea' attribute.

6.2.6 Organizational Impact

The sixth and final dimension that will be judged in order to assess the variable 'PM Software Success' will be the 'Organizational Impact'. As mentioned earlier in the D&M Model (Section 5.1.1) 'Organizational Impact' directs to the effect of information on the organizational performance. DeLone and McLean (1992) note that attempts to measure the impact of IS on overall organizational performance were least undertaken. They're blaming the difficulties in isolating the contribution of IS functions from other contributors to organizational performance for this.

Most empirical studies use quantitative economic measures to assess the performance of IS at the organizational level. Examples of these economic measures are 'Cost Reductions' (Chervany et al., 1972), 'Profit Contributions' (Rivard & Huff, 1984), 'Overall Cost Effectiveness of IS' (Miller & Doyle, 1987) or 'Traditional Cost/Benefit Analysis' (Johnston & Vitale, 1988; Mahmood & Mann, 1993). But some studies proposed alternative measures, such as 'Improvements in Business Processes', 'Changes in Organizational Structure' (Bakos, 1987) and 'Contribution of IS to Meeting Goals' (Perry, 1983).

Figure 43: Overview of Organizational Impact dimension

In 1996 Grover et al. still believed that measuring the specific contributions of information systems to organizational effectiveness has remained a critical concern of both academic and practitioner communities. Keeping their judgement in mind, it was clear the dimension 'Organizational Impact' should sufficiently be represented in the variable 'PM Software Success'. As a result this dimension will be assessed by as much as four items (Figure 43). The first item will symbolize the relative cost aspect of PM software, since there are enormous differences in prices between PM applications. The second item will evaluate the implementation time of PM software, given the fact that it's often being complaint about. The third item will measure the support of the PM processes by PM software, this item can be seen as a variation on the TTF Model (Goodhue & Thompson, 1995). And final, the fourth item will evaluate if the PM software stimulates the organization in developing itself in the field of PM.

7th Main Item – Costs of PM Software

Seeing that often economic measures are used to assess the 'Organizational Impact' of IS (see subsection above), it appears to be proper to use a similar measure for PM software as well. Ideally this should be cost/benefit analyses. Nevertheless it's impossible to assign the exact benefits PM software contributes to an organization. Therefore it was decided to measure the cost aspect of PM software with a just rudimentary approach. The item 'Costs of PM Software' will be represented by how the respondent thinks about the total costs of the PM software. This will lead to a comparative judgment. The respondent will compare the costs with his expectations (can be intuition or earlier experiences) about the costs.

The attributes will vary in a seven point scale from 'much worse than expected' to 'much better than expected', including a 'neutral' and 'no idea' attribute.

8th Main Item – Implementation Time of PM Software

Besides a relative evaluation of the costs of PM software, a relative evaluation by the respondent of the 'Implementation Time' of the software will be measured in order to the dimension 'Organizational Impact'. A longer than expected implementation time will most likely have a negative influence on the organizational performance. A shorter time is expected to result in a positive contribution. Think of less training hours, faster increased efficiency/effectiveness and new/better information.

The attributes will, the same as in case of the costs, vary in a seven point scale from 'much worse than expected' to 'much better than expected', including a 'neutral' and 'no idea' attribute.

9th Main Item – 'PM Process Support'

The third item that will be measured in order to assess the 'Organizational Impact' of PM software will be the 'PM Process Support'. This item is loosely based on the Task-Technology Fit (**TTF**) model of Goodhue & Thompson (1995). As was described previously (Paragraph 5.3) the 'TTF' can be conceptualized as the ability of an IT to support a task. The 'TTF' is considered higher when the gap between the task need and the functionality of the technology is reduced. The 'TTF' is lower as tasks become more demanding or technologies offer less functionality. A higher 'TTF' will lead to an increased behavior to 'Utilization' (i.e. 'Use') and positive 'Performance Impact'. Consequently a lower 'TTF' will have a negative influence on these variables.

While the TAM (Davis, 1986) typically focuses on 'Intention to Use' or 'Actual Use' at the middle of the outcome chain of IS success research, the **TTF** Model concentrates on 'Actual Use' or 'Individual Performance' measures, which are at a later point of the outcome chain (Dishaw & Strong, 1999). This later positioning is similar to the location of the dimension 'Organizational Impact', as it was put at the end of the D&M Model by DeLone and McLean (1992). An extra attractiveness of the TTF Model is it emphasizes it's not the technology in isolation that affects the performance (Goodhue et al., 2000).

However the 'TTF' concept evidently was designed to act on the level of individuals and their tasks. Thus for employing it in behave of the dimension 'Organizational Impact of PM Software' it will have to be accustomed to the organizational level and applied to the specific context of PM. As a result 'Tasks' will be replaced by 'PM processes' and 'IT' by 'PM Software'.

According to these new adjustments a positive organizational performance impact will occur when the ability of a PM application to support the PM processes within an organization is sufficient. If the ability is insufficient then the organizational impact will be negatively influenced.

The attributes will, same as in case of the 'Costs' and 'Implementation Time' items, vary in a seven point scale from 'much worse than expected' to 'much better than expected', including a 'neutral' and 'no idea' attribute.

10th Main Item – Organizational Development by PM Software

The fourth and final item that will be measured to assess the 'Organizational Impact' of PM software will be the 'Organizational Development'. This item refers to the possible assistance PM software may offer organizations in professionalizing their PM.

While the first two items 'Costs' and 'Implementation Time' lay more emphasis on contributions to the organization in the (recent) past and the third item 'PM Process Support' in general accents the present, this final item 'Organizational Development' highlights potential future impacts. This fourth item bears great resemblance to the measure 'Changes in Organizational Structure' as suggested by Bakos (1987). PM software that shows the way to enhanced managing of projects (e.g. abandoning pure functional structures), most likely will

lead to increased organizational performance. The item 'Organizational Development' will be appraised with asking the respondent to what extend he believes the PM software encourages the organization to grow in the field of PM.

The attributes will be the same as in the three previous items, varying in a seven point scale from 'much worse than expected' to 'much better than expected', including a 'neutral' and 'no idea' attribute.

6.3 Final Scheme

In the previous two paragraphs of this chapter the Final Framework was build. These paragraphs as well clarify why particular variables, items and attributes were selected. Where needed, explanations and descriptions were provided.

This Final Framework embodies four main elements. Three of them are contingency factors, recapitulated these are 'PM Organization', 'PM Methods' and 'PM Software', which in sum count four main variables. Further the framework includes the constructed variable 'PM Software Success'. This construct will be assessed with ten items that represent five dimensions of the D&M Model. Finally eleven supplementary variables/items were added to the framework. These serve the purpose to gain additional information about the main elements. Three of these supplementary items were assigned to the dimension 'Information Use' of the D&M Model.

Concluding the refined Final Framework is schematically presented (figure 44). This scheme includes all the mentioned elements and their underlying associations. The supplementary items are depicted in bright gray boxes with dotted frames.

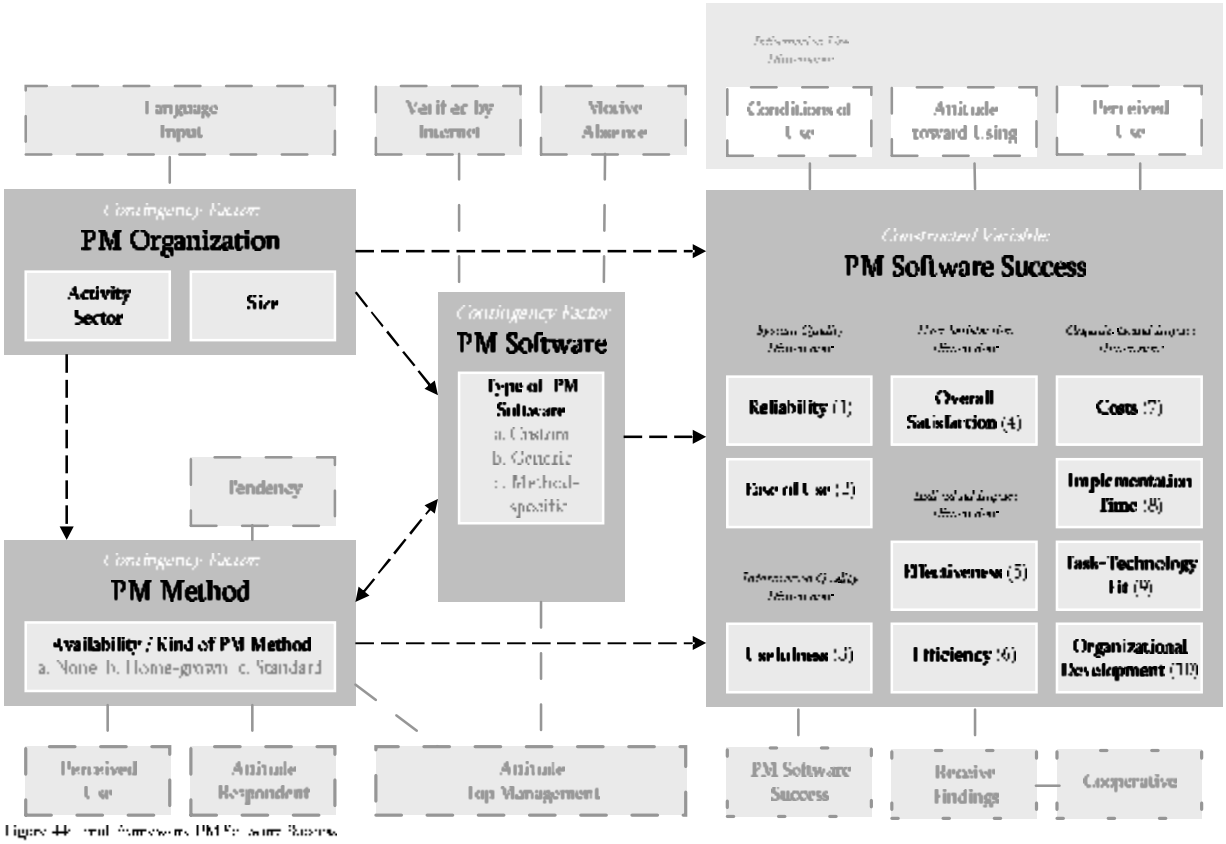

Figure 44: Final Framework PM Software Success

6.4 Scale Construction

As is displayed (in figure 44) the constructed variable 'PM Software Success' incorporates ten items. With all these items together a composite measurement of 'PM Software Success' will be created. Each of these ten items is measured at an ordinal level, containing seven ranked attributes. For instance the attributes of the item 'Overall Satisfaction' will be 'very

dissatisfied', 'dissatisfied', 'somewhat dissatisfied', neutral, 'somewhat satisfied', 'satisfied' and 'very satisfied'. An eighth attribute 'no idea', which isn't rank ordered, can be chosen in case the respondent doesn't have a clue about the item.

For the scaling of the items the semantic differential format will be used. Of each item the polar extremes were determined. For example 'very dissatisfied' and 'very satisfied'. All the lowest ranked attributes will receive a score of 1 point. The highest attributes will be assigned a maximum score of 7 points. The attributes in between will receive scores of 2, 3, 4, 5 and 6 points. Consequently the attributes 'neutral' will receive a score of 4 points. All the items will be equally weighted, since the burden of proof should be on differential weighting according to Babbie (2001).

The problem of missing data, in case a respondent answers 'no idea' or even skips the question completely, can be solved by several methods. First, when there are relative few cases with missing data, these cases could be excluded from the research.

Second, sometimes missing data can be treated as one of the available responses. When an item has several possible values, the middle value (here this is 4 points) could be assigned to those cases.

Other solutions are filling in the mean of all respondents, random values and values provided by software that computes more advanced approaches such as maximum likelihood and Bayesian multiple imputation (Schafer & Graham, 2002).

However in this research, where the constructed variable will be created out of ten items, a proportional score based on what is observed for the particular respondent will handle the missing data. If for instance in a particular case only eight of the ten items were measured, then the score will be calculated by dividing the total number of points through eight instead of ten. Downey and King (1997) proved with their study that handling missing data this way provides a very good representation, if the percentage of missing data remains less than 20%. Later on (Section 9.2.3) this appears to be the case in the present study.

Concluded, a PM application will be considered successful in a particular case, as soon as the mean score of all the measured items has a value of 4 or higher. Accordingly it will be judged unsuccessful when its mean score has a value lower than 4.

6.5 Single-Item Test Variable

In scheme of the Final Framework (figure 44) a few variables still have remained unexplained. On these is the 'Test Variable PM Software Success'. This variable simply is assessed with one item. The respondents will be asked straightforwardly the next question: "is the software considered a failure or a success within your organization?"

The attributes of this item will vary in a seven point scale from 'very unsuccessful' to 'very successful', including a 'neutral' and 'no idea' attribute. The attributes of this single item will be scored in the same way as those items that belong to the constructed variable.

By comparing the scores of the constructed variable 'PM Software Success' with the scores of this single item variable, the validity of the construct can be tested. Hopefully these scores are in most cases equal or almost equal.

6.6 Exit Items

Figure 45 Single-item test variable and exit items in the framework

Completely at the right bottom of the framework two final items are depictured (Figure 45). These last two items will be measured at the end of the survey.

The first item represents the willingness of the respondents to receive the research findings. The attributes of this item will differ from an empty field, meaning the respondent doesn't wish to obtain the findings, to a filled in e-mail address, which means the respondent is interested.

The second item is contingent to the first item. Respondents, who filled in their e-mail address, will be asked if they may be contacted if additional information might be needed. The two attributes of this item will be 'yes' and 'no'. The attribute 'no' will be pre-selected. In this way the chance of respondents, who answered 'yes' and therefore are prepared to cooperate if needed, actually have read this question should be increased.

7 Development of Instrument

Since the Final Framework, which includes all the items and their attributes, has been finished the next step in this research will be to develop an instrument. This instrument has to be capable of measuring all the attributes that belong to the Final Framework, as has been presented in the previous chapter.

This chapter will start with describing the selection process of an appropriate instrument. Next it describes the development phases of this instrument. These phases are the design, the construction and finally the operational phase.

7.1 Justification

Prior to the design of the instrument, it is important to consider what kind of instrument would be suitable to measure the success of PM software. In a previous section (Section 1.4.3) already was decided this research would become a quantitative study. It wouldn't be a case study, an experiment, content or meta analysis, but a large sample study with asking questions to respondents. There are at least three forms for asking questions. These are unstructured interviews, semi-structured interviews and structured questionnaires (Clark Carter, 2004). Because earlier was decided the research would be quantitative, explanatory and should be statistical significant it was decided to develop a survey.

There are a number of practical advantages of this approach to asking questions. Firstly, respondents can fill in the questionnaire themselves. There is no need to spend time at the organizations by the researcher to administering the surveys (Yauch & Steudel, 2003). Further the responses can be tabulated by a computer within a short timeframe. This saves the researcher time both in interviewing and traveling. Secondly, conducting interviews by one researcher can only be done sequential while surveys can parallel be operated. This can result in a lot of respondents and data in a short time. A third advantage of the survey as instrument is that the standard format can minimize the effect of the way in which a question is asked influences the respondent.

Besides these conveniences, some of the figures gathered by this particular survey could perhaps be compared with similar surveys about PM. Hopefully in this way estimations could be made about how well the sample of respondents represents the whole population.

In addition to these advantages a survey can also have several disadvantages. The most important ones can be the threats that respondents interpret the questions wrongly or that they fake answers. Also the possibility that a survey will reveal novel variables and relations is very small.

Summarizing, the arguments that justify the use of a survey instead of interviews are threefold. The first argument is the mentioned practical advantage of deploying a survey. Second, the possibility of comparing the data with other surveys may lead to improved validity (Section 9.1.3). Third, because there are promising assumptions of what could influence the success of PM software - the variables are already fixed - the small chance of revealing new variables is here acceptable

7.2 Design Phase

Before the actual design phase was started, several books and articles about surveys and in particular Web surveys were studied (e.g. Rossi et al., 1983; Schmidt, 1997; Cho & LaRose, 1999; Cook et al., 2000; Babbie, 2001; Gosling et al., 2004; Iarossi, 2006). In these writings many practical hints, benefits, potential problems and solutions were described about designing surveys. This paragraph will provide the blueprint of how the survey was created. The first section briefly explains which basic requirements lead to most design choices. Each further section in this paragraph describes in more detail why certain choices were made.

7.2.1 General Requirements

In order to get some feeling, about how many respondents were needed for a statistic significant survey research, a rough and ready rule was used. According to this rule the size of

the sample should at least be the total number of cells multiplied with 25 (Baarda et al., 1995). In this research the most important presumption is that 'PM Software Success' is associated with the use of 'standard PM methods' and 'method specific PM software'. Therefore the total number of cells in this research is 4 (non-standard versus standard PM methods and none method specific versus method-specific PM software). Consequently the size of the sample should at least be 100 respondents. Baarda et al. note that less than 25 cases per cell better can be avoided if possible. Less than the minimum of 25 cases for each cell can only be permitted if the time and financial circumstances are very limited.

Obtaining more than 100 filled in surveys, without direct means to compensate the respondents for their invested time, would become quite a challenge. Especially, since the respondent were limited to those people who work in project environments. Based on these challenging requirements the survey design will have to be as easy accessible and attractive as possible, without threatening scientific validity. How this was attempted will be explained in the subsequent sections of this paragraph. Each section will highlight a particular aspect of the design.

7.2.2 Distribution Form

There are several ways to collect survey data. In general there are two main categories, the interview surveys and the self administered surveys. Interview surveys can be conducted face to face or by telephone. Self administered surveys were traditionally done on paper and sent by mail. The use of surveys even goes as far back as the Old Testament (Numbers 26: 1-2). More recent forms of self-administered surveys are conducted by e-mail or online on the World Wide Web. After comparing all the advantages and problems of each method publishing a survey on the Web seemed the best choice for this research.

Major benefits of conducting online surveys are the very low costs in terms of both time and money compared to the more conventional survey methods (Schaefer & Dillman, 1998). Further the chance of data entry errors occurring is smaller, due to less handling and the automated transferring of data between different applications (e.g. online survey tools, MS Excel, SPSS). An additional benefit of Web surveys is that they can interactively provide participants with customized feedback (Schmidt, 1997). Depending upon the survey content it may be desirable to give feedback about the respondent's individual results, summary statistics of all respondents to date or present the respondent with a specialized set of questions based on the responses (i.e. different routing). Perhaps the greatest benefit of publishing a survey on the Web is access to an extreme large population of individuals. Nowadays many people have access to the internet. The earlier preconception of internet samples being not diverse - these samples would for example be dominated by relative young and depressive people (Kraut et al., 1998) - is now certainly behind the times.

But Web surveys have a number of potential pitfalls as well. A first potential problem is incomplete form submissions. Often respondents overlook or intentional skip questions. An additional potential problem could be unacceptable responses. Respondents that do not meet certain criteria (in case of this research working in projects) could fill in the questionnaire, making up responses (e.g. Azar, 2000). A third danger is that respondents may submit their responses more than once. Multiple responses typically occur through intentional attempts to foil the survey, entry errors or just out of curiosity (e.g. Buchanan, 2000).

Many of these possible problems can be avoided or minimized with, adequate survey design, using reliable survey tools and accurate data management. Further Gosling et al. (2004), who compared 361.703 Web surveys with 510 traditional paper and pencil methods, found evidence that internet survey methods were at least as good quality as the conventional methods. Taking these solutions, findings and the significant benefits in consideration it was decided to conduct an online survey.

7.2.3 Questions

In this section the most important options that were available in creating the questions will be discussed. In each subsequent subsection the selection, style, format and sequence of the

questions will be determined.

Question Selection

The questions and the predefined answers of the survey will correspond with the variables and items and their attributes as presented in Chapter 6. Besides these questions one extra question will be added in the last part of the survey. This question will be put there to determine if the respondent is prepared to cooperate, in case additional information might be needed. Further will the questionnaire be ended with two extra open answer fields. One for comments and suggestions, and one for the respondents to submit their e-mail address, when they want to receive the research results.

Question Style

All the questions in the survey will be closed-ended questions. The respondents will be asked to select an answer from among a pre defined list. The reason for using closed ended questions instead of open ended questions is they provide a greater uniformity of responses and are far more easily processed. Fowler (1995) advised that the construction of closed ended questions should be guided by at least two structural requirements.

Figure 46: Example of multiple choice question with open text field.

First, the response categories should be exhaustive. The answer options should include all possible responses. Therefore in 8 of the 20 questions, besides the pre defined answers, an open text field will be available (Figure 46). The in these open text fields submitted answers will be coded later on (Section 8.1.2). In addition 15 questions included the option 'no idea', 'no opinion' and 'I don't know'.

The second requirement of closed ended questions is that the response categories should be mutually exclusive. The respondent should not feel forced to select more than one answer. In some cases multiple answers could be a solution. But findings presented by Smyth et al. (2006) suggest that the single-response question format encourages deeper processing of response options. Therefore they state that single response questions are preferable to the check all format questions. As a result all the questions in this survey will be single-response questions. In some cases where the answers aren't mutually exclusive by definition, for example the questions about PM software and PM methods, the respondent will be asked to select the most used or most obvious for use.

Importantly too, the survey will not make use of the forced answer option. Online respondents will, similar as in case of traditional paper questionnaire, be free to skip over questions and leave specific items in the questionnaire incomplete.

Question Format

In this survey three different kinds of multiple choice question formats will be used. This section will briefly describe each format. These descriptions will be accompanied with some example figures. In the Appendix I the final versions of the questions can be observed.

Figure 47: Example of single response question with radio buttons.

Questions 1, 2, 3, 4, 5, 9, 10, 11 and 14 will be single response questions. All these question use the so-called radio buttons (Figure 47). These buttons are similar to genuine boxes in paper surveys. They can be checked by the mouse button.

Figure 48: Example of drop box question.

For two questions, 6 and 15, drop boxes (Figure 48) will be used. The drop box will in this case display only one option initially, until the respondent clicks on the box. Then all the possible answers will become visible. This type of drop boxes uses less screen area and is safer to use than the scroll drop box type, where some but not all response options are visible without scrolling first (Couper et al., 2004).

Figure 49: Example of 7 category rating scale.

For the remaining questions 7, 8, 12, 13, 16, 17, 18, 19, and 20 rating scales (Figure 49) will be used. Experiments (e.g. Miller, 1956; Firn, 1972; Cox, 1980; Leigh & Martin, 1987) showed that it is preferable to use between 5 and 9 categories. Because of the homogeneous of the respondents a relative high frequency (7 categories) was adopted. The middle option of these 7 categories will be a neutral response. Consequently these questions will not force the respondents to a positive or negative answer. Besides these 7 category rating scale the questions also include an extra option, which will be the 'no opinion' or 'no idea' category. This

almost certainly will reduce the number of neutral answers, as respondents who actually don't know what to respond most likely otherwise would select this answer.

Importantly, too, the Web-based questionnaire did not make use of the forced-answer option. Online respondents were as free as their paper questionnaire counterparts to skip over questions and leave specific items in the questionnaire incomplete.

Finally the appearance of all the questions became monochrome, almost like a traditional paper questionnaire, black text on a light grey background.

Question Sequence

The question sequence design will be determined by three aspects, these are contribution to relevance, variance of difficulty and contingency questions.

The order in which questionnaire items are presented should contribute to the respondent's perception of the survey's relevance. This is why the sequence of questions corresponds with the order of the items in this thesis, i.e. from the contingency factors to the constructed variable. In addition the series of questions about the PM Software Success exactly follows the chain of dimensions as presented in the D&M Model.

Besides, that the sequence should contribute to the perceived relevance, the difficulty level of the questions should vary to obtain as much as possible completed questionnaires. Warwick and Lininger (1975) stated that opening questions should be kept relative easy to answer. Thus in this survey the opening questions will consider some general aspects about the respondent's organization, such as the 'Size' and 'Activity Sector'. The more difficult questions will be asked in the middle part of the questionnaire. Examples of questions that are probably more complicated to answer are those that ask the respondent to estimate the importance of the PM method (question 7) and about the type of PM software (question 11). At the final part of the survey the questions will once more be relative easy. This last series of questions verifies the respondent's willingness to cooperate further if necessary and offers the opportunity to comment on the survey.

Finally the sequence will be determined by some contingency questions. Certain questions will be relevant to some of the respondents and irrelevant to others. For instance question 6, where the responders are asked to give an estimation about how often PM methods are being used, is only relevant to those respondents who earlier have answered that PM methods are being used within their organizations. The different routings through the questions in the survey can be viewed in Appendix I (questionnaire version 2).

7.2.4 Layout

In this section the remaining aspects about the appearance of the survey will be discussed. These aspects are the length and accessibility of the survey, the way of moving through the survey and finally the design of the header.

Length

The length of a questionnaire normally is determined by three facets. These are the length of individual questions, the number of questions and the format of the questions. A review of literature by Bogen (1996) finds no clear association between questionnaire length and survey participation. Sitzia and Wood (1998) analyzed 210 surveys and also didn't find any relation between survey length and response rate. Whereas others, like Roszkowski and Bean (1990), indeed found proof of a relation.

Despite this ongoing discussion of length and response rate being associated, it is decided to design a relative short survey. It appears logical that the chance of obtaining enough completed surveys will be higher if the survey takes only little time of the respondents.

Each question will have to be as short as possible, without getting ambiguous and imprecise. Respondents should be able to read the questions quickly, understand its intent and consequently select or provide answers without difficulty.

In addition the maximum number of questions will be limited to 20. In this way the argument, that it takes no more than 5 minutes of the respondent's valuable time, can be used to

promote the survey.

As a final point, the format of the questions will be designed as compact as possible. Same sorts of questions will be clustered (Figure 50) and in a few cases answer drop boxes (Figure 48) will be used. By employing these question formats the survey will appear less lengthy.

Accessibility

The best way to make sure the respondents belong to the target population is to provide a password to limit the access to only those people in the sample (Heerwegh & Loosveldt, 2002). This only can be achieved if lists of e-mail addresses (belonging to for instance project managers) can be obtained and used to invite participation. Since these lists can't be acquired free of costs, the access will not be controlled with a password. Consequently the survey will become a non probability survey, where the members of the target population don't have known nonzero probabilities of selection (Couper, 2000).

Paging and Scrolling

An important choice in the design of online surveys is whether to place the survey questions in a multitude of short pages or in long scrollable pages. At one extreme, the paging design involves a separate page with a submit button for each survey question. Each response has to be submitted prior to receive the following question, much like a survey interview. At the other extreme, a scrolling design has all the survey questions displayed in a single Web page. This page is periodically scrolled by the respondent in order to read, select, and finally submit the responses, much like the act of mailing a paper questionnaire. Both approaches have advantages and disadvantages.

Figure 50: Example of the used matrix scales

There is some evidence from simple surveys that the scrolling design takes less time. This probably is caused by the fact that between the questions no submit buttons are necessary and no new Web pages have to be downloaded (Vehovar et al. 2000). On the other hand Peytchev et al. (2006) found out in their study that the item non response was slightly lower in the paging version. They suggested that the chance of questions accidentally being missed is higher when the screen moves.

Taking these findings in consideration this survey will be a mixture of paging and scrolling. Nevertheless the design will be dominated by paging, as this is inevitable to the use of contingency questions (Section 7.2.6). In addition it appears that the speed in which the Web pages are loading is adequate enough. This will diminish the chance of respondents dropping out halfway due to waiting periods.

Header Functions

A third layout design that needs some notice is the header of the survey. The header will include the title of the survey, the logo of the University of Twente and a progress indicator. The header will be visible at the top of each survey page.

The logo of the University of Twente will be part of the header as it may give the appearance of the questionnaire some extra cachet. The prominent status of university research and/or helping a student instead of a commercial research centre could increase the response. This assumption matches the 'Leverage-Salience Theory of Survey Participation' of Groves et al. (2000). This theory postulates that what is made salient in a survey (e.g. reputable sponsor) will stimulate the positive predispositions of the sample persons. As a consequence the response rates will be positively influenced. The University logo will be positioned on the right side in the header (Figure 51).

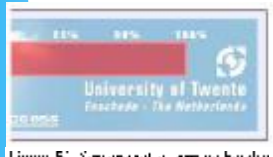

Figure 51: Screenshot of survey header with university logo

In the hope of motivating respondents, who had started, to complete the survey also a progress indicator was added. The indicator can show the respondents approximately how much more time it will take to complete the survey or which part already is completed.

Several studies (e.g. Dillman & Bowker, 2001; Umbach, 2004) recommended the use of such indicator, as it decreases the percentage of break offs. Still, indicators should be used with caution, as is being illustrated by a study of Crawford et al. (2001). The use of a progress indicator in their questionnaire (containing 45 questions of which some were open ended)

showed an increase of break-offs. Probably the combination of putting most open-ended questions in the early part of the survey and showing the amount of questions left to complete led to this negative effect. In an earlier study (Couper et al., 2000) a graphical progress indicator, in the form of a pie chart showing percentage complete, was found to increase completions by 3,4 percent. This difference did however not reach traditional levels of significance. The authors suggested that the additional download time, associated with the progress indicator graphics, might have dampened the potentially positive effect of the indicator.

Since this survey will only count 20 questions and will have no open ended questions at the beginning a progress indicator will be added. Especially ever since the download time of the indicator pictures (after several tests on different locations) appears to be negligible, the benefits of adding an indicator seem to outweigh the risks. In this survey the indicator will have the shape of a bar chart, showing the percentage that has been completed (Figure 52).

Figure 52: Screenshot of survey header with progress indicator

7.2.5 Pre-testing

Presser et al. (2004) stated that conventional pre testing is essentially a dress rehearsal. Conventional pre tests are based on the assumption that questionnaire problems will be signaled by the answers that the questions bring forth (e.g., 'don't knows' or refusals), which will show up during the data analysis of a small test sample. Usually it's not necessary that these pre test subjects compromise a representative sample, although the questionnaire should at least be relevant to them. Survey researchers have shown remarkable confidence in this approach. One well acknowledged expert even claims: *"It usually takes no more than 12–25 cases to reveal the major difficulties and weaknesses in a pre test questionnaire"*(Sheatsley, 1983:226).

The survey, which was built for this research, was tested in two rounds. The first round of test runs was carried out by its designer. This resulted in quite some improvements. The most important one was fixing a gap in the routing. When respondents filled in they didn't use PM software, they were straight forwarded to the final 'thank you for your cooperation' text. Even the designer of this survey experienced this as quite an abrupt ending. Thus a couple of questions about why no PM software was available were included to the survey.

The second round of test runs was executed by a dozen of test respondents. These tests should expose the possible remaining errors, such as ambiguous questions, questions that can not be answered and the use of wrong terms. The test sample compromised acquaintances and some practitioners in the PM software field (i.e. managing director, product development manager, senior implementation consultant, also a former project manager and a sales manager of PM software). Finally, the survey was reviewed by two scientists of the School of Management and Governance of the University of Twente. Except some minor changes of word use, the removal of a double-barreled question and an alteration in the sequence of two questions, the survey in general survived the test respondent's examinations.

7.3 Construction Phase

Now the blueprint of the survey functions, the content and the appearance have been designed the concrete Web survey can be created. In this paragraph the actual building, the translation and the evaluating of the questionnaire will be described.

7.3.1 Building

The first offline versions of the survey were built in Microsoft Word (Appendix I, survey versions 1 and 2). These versions served the purposes of exercising with items, question styles, coding and pre-testing.

After the coding version was completed, the next step was to select a tool that can be used to create the online version of the survey. Six different providers of online surveys were evaluated. These were LimeSurvey, NetQ Surveys, ProxymiT, SurveyMonkey, Survey.Net and ThesisTools. Their products were judged on several aspects such as the costs, the access period, the amount of questions per survey, the number of responses allowed and the profes

sionalism of appearance. Some providers offered online questionnaires free of costs, but sadly their questionnaires were accompanied with numerous advertisements or lacking profession alism looks. Others offered basic versions free of costs; however these versions had limited number of responses and/or questions.

The free basic version of ThesisTools didn't have these restrictions, except for the access period being restricted to three months. As the operational phase was planned to span a period of two months, this restriction wouldn't be problematic. Another advantage of ThesisTools is that it had no advertisements during the completing of the survey. It only had a single modest advertisement at the end of the survey. Because of these advantages, the fine appearance, the numerous customizable features and compatibility with Microsoft Excel it was decided to use ThesisTools for creating the online survey. The use of ThesisTools appeared to be very intuitive and easy.

The first online version was built within a week with help of the offline coding survey. In this week the progress bar (Figure 52) was created too. It was built with MGI PhotoSuite, Microsoft Paint and Excel. The progress bars pictures, each with a different percentage, were hosted on ImageShack. This online photo storage Web site had the benefits of storing photos at their original resolution and the ability of linking directly to the original photos instead of thumbnails. This first testing version of the Web survey that included the header with progress bar was eventually online at June 17, 2007.

7.3.2 Translation

Chapman and Carter (1979) analysed several translation techniques. They suggested that detailed information about translation processes should be provided in reports. Since the instrument of this research will exist in two language versions, this paragraph will start with the description of the addressed translation process.

The first offline version of the survey was created in the native language of the writer of this thesis. This original Dutch version isn't included in this paper, but it's quite similar to the English coding version of the survey (Appendix I). This version was translated forward in an English offline version by the writer of this paper. This was done with help of existing PM literature, PM practitioners, dictionaries and translation Web sites. This English offline version was used to create the first online survey.

The foreign English language of this first online survey could be a barrier to many of the in principally targeted Dutch respondents. Therefore it seemed essential to create a Dutch online survey as well. Thus the English online version had to be (back) translated in Dutch. It's extremely important that both language versions of the survey will measure the items in the same or at least almost the same way. In order to establish verification and adequacy of translation between the two versions a professional British interpreter of law acts, who has control over the Dutch language as well, was asked to compare the English online version with the Dutch offline version. This led to a more correct English version and some fine tuning modifications between both versions.

These fine-tuning modifications resulted from a conversation between the professional interpreter and the writer of this paper. These little modifications in both language versions bear great similarity with the 'decentering' procedure as noted by Brislin et al. (1973). 'Decentering' refers to a translation process in which the original and the target language versions are both subject to alteration. This procedure allows the adjustment of words and concepts that have no clear equivalents in the other language. An example of fine tuning in this survey was question 20, which concerns the test variable. At first it was the idea to ask the respondent to estimate the 'mean' opinion within the whole organization about the PM software. As this sentence became too confusing in English it was altered in both versions.

Once the fine tuning between both versions was completed, the most recent (back) translated Dutch online survey was put side by side with the original Dutch offline version. Since there were no major discrepancies found, the Dutch online version could safely be approved. As a result the first operational Dutch version of the survey was online available at July 4, 2007.

7.3.3 Evaluating

Since a comprehensive prior instrument was not available to measure the PM Software Success from the general viewpoint of a whole organization, a new instrument was designed and constructed in this current work. This process was described in the previous sections.

The concluding procedure of the tool's construction phase will be its evaluation. This evaluating stage will comprise the content and face validity of the online survey. As well as some last test runs.

Content Validity

The content validity of an instrument refers to the degree to which it provides an adequate measure of the conceptual domain that it is designed to cover (e.g. Cook & Campbell, 1979; Hair et al., 1998; Babbie, 2001). In the case of content validity, the evidence is subjective and logical, rather than statistical. Establishment of content validity calls for sound logic, good intuitive skills and a great deal of effort on the part of the instrument designer (Kaplan & Scauzzo, 1993).

The content validity can be guaranteed if the items representing the construct, in this case PM Software Success, are being substantiated by a comprehensive review of the relevant literature (Bohrnstedt, 1983). The survey designed in this paper has been developed on the basis of detailed reviews and analyses of prescriptive, conceptual, practitioner and empirical literature. The items which will be used to measure the construct 'PM Software Success' primarily originate form the well acknowledged and validated theoretical models (Chapter 5) and many other relevant studies about IS success. By using the right combination of validated items from earlier research, the measure in this survey will hopefully cover the range of meanings within the concept of 'PM Software Success'. If so the content validity is ensured.

Face Validity

Face validity is the subjective and logical assessment of the correspondence between the individual items and the concept through rating by expert judges. A review of the instrument by experts in the field can establish the validity 'on its face' (e.g. Hair et al., 1998, Babbie, 2001). Generally, a measure is considered to have face validity if the items are reasonably related to the perceived purpose of the measure, whether or not it's adequate (Kaplan & Scauzzo, 1993).

The questionnaire of this paper was given to three groups of experts in the area, namely ten PM software customers/software users, five PM software vendors/developers and two academics. They had been briefed about the purpose of the study and its scope. These experts were asked to scrutinize the questionnaire and to give their impressions regarding the relevance and contents of the questionnaire. They were asked to critically study the questionnaire, and to give objective feedback and suggestions with regard to comprehensiveness/coverage, redundancy level, consistency and number of items in each variable. Their comments, remarks, suggestions and criticisms were discussed and some were used to improve the instrument.

The convergent validity, the correlation with other tests that measure the same (IS success) has not been investigated. This hasn't been assessed because of the time constraint (Section 1.2.3) and the fact that the used items in this survey originated from earlier well established and repeatedly validated tools.

Test Runs

It may be noted that the content validity and face validity were assured from the initial stages of questionnaire development until the actual operational phase. Besides these validations extensive test runs on numerous different computers and locations at different times were executed.

No problems of any kind were found during these tests. The survey worked without visible faults in each situation and no long download times were experienced. After these final tests the quality of the survey was considered sufficient. Thus the survey could enter its opera

tional phase.

7.4 Operational Phase

So far the design and construction of the survey have been discussed. As important as these tasks are, the labor involved will be wasted unless the survey produces data. This means that respondents actually have to complete the questionnaire. In this last paragraph of Chapter 7 the steps and choices involved in operating the survey will be described and explained.

7.4.1 Promoting

Eventually three different methods of administering the survey to samples of respondents were used. However, initially just one preferable approach was in mind. The idea was to invite respondents belonging to the targeted population by e-mail. This e-mail would include an invitation accompanied with a unique hyperlink or a common hyperlink with a personal password. Couper (2000:485) called this method the *"list-based samples of high-coverage populations approach"*.

A major benefit of this probability-based method is that, with knowledge of all the invited respondents and with information on the process of recruitment, these approach permits measurement of the sources of non response. A second important benefit of this approach is that the right of entry to the survey can be controlled. This minimizes the chance of data being contaminated by multiple completions of single respondents or completions by respondents that do not belong to the target population. Unfortunately two weeks before the distribution of the invitation e-mails was planned, the mailing list containing the approximately 2500 e-mail addresses of project managers appeared to be unavailable. Since e-mailing an introductory letter was no longer an option, promptly alternative approaches had to be studied.

A frequently used alternative way to electronically distribute an online questionnaire is by placing a general request for respondents in an electronic communication environment (e.g. newsgroups, forums) or on a Web page (Van Selm & Jankowski, 2006). This approach was referred to by Couper (2000:478) as a *"self selected Web survey"*. According to him this is probably the most prevalent form of Web survey today and potentially one of the most threatening to legitimate survey enterprises because of the claims for scientific validity that are sometimes made. Often these surveys have no access restrictions and little or no control over multiple completions.

Despite these risks it was decided to try to get the survey promoted on dedicated PM Web sites. Hopefully in this way the attention of many potential respondents could be attracted. By only promoting the survey on devoted PM Web sites the likelihood of respondents trying to frustrate the research by providing nonsense answers would with any luck be diminished.

Figure 53: survey invitation in the PMI newsletter of August 2007

Invitations by Newsletter and Web Site of Project Management Institute Netherlands

At July 11 2007 an e-mail was sent to a board member of the Project Management Institute of the Netherlands (PMI) with the request to promote the online survey. This e-mail is enclosed in Appendix II. Within a week the request was approved.

Consequently, the survey was promoted on the Web page of the PMI and by their newsletter of August, which was sent to the 1800 PMI members (Figure 53). The exact text in this newsletter can be found in the Appendix II.

Invitations by E-mail to Acquaintances within PM Field

Besides promoting the survey by the PMI, the social contacts of the writer of this paper were used to boost the number of respondents. The invitation was sent to them at July 15 2007 and contained different hyperlinks than those which were used for the PMI. In this way the source of the respondents could be distinguished afterwards.

Invitations by E-mail to Random Invited Project Managers

As an experiment a search engine was used to find e-mail addresses of Dutch project manag

ers. These addresses were often discovered in online curriculum vitae's of project managers. Initially 25 e mails were sent with an invitation to the questionnaire.

In these invitations (Appendix II) the potential respondents were personally addressed. Further they were informed about the short time (5 minutes) it would take to complete the survey. The invitation ended with the noticing that the respondents, if they would like to, could receive the results of the research. This personalization, the mentioned short time and the promised reward all should contribute to a higher response rate.

Personalization has been reported by Dillman (1978, 1991) as an important element in increasing the response rate in surveys. According to him a personalized letter or e mail addressed to a specific individual shows the respondent that he or she is important. In the contrary Heerwegh (2005) suspected there could be a chance that personalization, by decreasing the level of anonymity and perceived privacy, may have a negative influence on a response rate. This chance was expected to be minimal in this research, since the questions were not considered sensitive. As a result all the e mails were started with a personal salutation. Only one respondent seemed to be surprised at first and asked questions about how he was selected. After answering his questions satisfactory he completed the survey.

The second idea for increasing the response rate came from Crawford et al. (2001). They proved with their study that when a shorter time to complete a survey was mentioned in an e mail invitation this would result to less non response. As a result the short time to complete was highlighted in the invitation.

Finally, often monetary incentives (e.g. money, mp3 players) are used to increase the response rate. Since no resources of this kind were available and it was assumed that project managers would be eager to know which PM software is often used and is considered best, the respondents will be rewarded with receiving the research findings.

Besides these three methods of improving the response rate frequently the method of using multiple contacts is being suggested. Indeed, evidence exists that multiple contacts by e-mail invitations increases response rates as well (e.g. Kittleson, 1997; Cook et al., 2000). However, this way of increasing the response rates seemed inappropriate, as the respondents were selected randomly instead of having applied for the survey themselves.

The first 25 invitations resulted in 9 completed surveys. No complaints were received, even several positive contributions returned by e mail and in the comment field of the survey. Since this first test was this fruitful, a second batch of invitations was sent to 75 additional obtained e mail addresses. The total response rate can be found in the last section of this chapter (Section 7.4.3).

Figure 54: Screenshot of All PM Web site

Figure 55: Screenshot of Gantthead Web site

Figure 56: Screenshot of PM Startpagina Web site

Invitations on Web Sites of All PM, Gantthead and PM Startpagina

Finally the survey was promoted on several dedicated PM Web sites. All PM (Figure 54) and Gantthead (Figure 55) are English forum sites, both are attracting many visitors. Since there also did exist an English version besides the Dutch version it would be a pity not to promote this language version. The PM Startpagina Web site (Figure 56) serves as a starting point for Dutch people who search information about PM.

At these three Web sites invitation messages were placed with a direct link to the survey. Besides these three sites, several other organizations such as Association for Project Management (APM) and International Project management Association (IPMA) were contacted. These eventually didn't promote the survey as some didn't reply to e-mails and others asked for financial contributions.

7.4.2 Operating

The first completed surveys were retrieved in the second week of July 2007. From the day that PMI promoted the survey and added the hyper link on their Web site surveys started to come back. In the beginning only a few surveys were returned weekly. Probably these low numbers were caused by the summer vacation period. But when in August the survey was promoted in the PMI's newsletter the number of respondents increased enormously.

Since in the first couple of weeks the number of completed questionnaires were little disap

pointing, the survey was also promoted on other Web sites and by invitations (as described in the previous section). Eventually the survey was promoted by seven different channels at the same time. In the best week 37 completed surveys were received, this was in the third week of September.

Second half of October the numbers declined drastically to only a few per week. Therefore at the end of October the Web survey was put offline. In total the PMI questionnaire, which had been online for the longest period, was available for almost four months. During the operational phase no problems were encountered. As far as can be verified all the questionnaires did operate 24 hours a day.

7.4.3 Retrieving

This final section of Chapter 7 will describe the statistics of how the online surveys were filled in. These statistics include the number of returns, the completion rate, the number of respondents who wishes to receive the research findings and the number of respondents willing to cooperate.

An often noted problem with Web surveys is the impossibility of calculating the response rate as there is no way of knowing how many individuals might have seen the survey or its invitation but declined to participate (e.g. Groves & Couper, 1998; Kay & Johnson, 1999). Only the number of completed and partly completed questionnaires is known and not the number of refusals. One possible solution for this problem can be estimating the frame population by keeping track of number of invitations that had been successfully sent or the number of times the Web page is accessed. Unfortunately this wasn't possible for all used promoting methods. This means that the measurement or evaluation of non response rate is tractable only in some conditions, while others only can be guessed (Table 2).

The estimated non-response rates in case of PMI, All PM and Gantthead are the lowest possible rates. Fortunately these worse scenarios can only be true if every member of PMI did actually read the newsletter of August and all the people who accessed the particular Web pages of All PM and Gantthead truly read the invitation and visited these pages only once. Even if some of the non-response rates would be really this worse, one has to take into consideration that non response rates to sample surveys are increasing in most industrialized countries (De Leeuw & De Heer, 2002). However, fortunately, recent case studies show only very modest relationship between non-response rates and non response error (Curtin et al., 2000; Keeter et al. 2000; Abraham et al., 2006).

The success of a survey as a data collection tool will not depend just on getting a sufficient, representative number of returns. It depends, as well, on getting returns that have been entirely completed by the respondents. The quality of the data will suffer when questionnaires are returned with various items not completed and significant questions left unanswered. Other prevalent causes for not completed Web surveys are, according to Jeavons (1998), break offs or abandonments. The completion rate, for this reason, is a key factor in relation to the overall quality of the data (Denscombe, 2006). Only fully completed surveys will be further administered in this research. It should be remembered that the facility to insist on answering each question before proceeding further through the survey hadn't been used (Section 7.2.3, 'Question Style'). Despite this the total completion rate was relative high (91.6%).

Apart from PM Startpagina all the completion-rates were about the 90 percent. It's very likely that the accessibility of the hyperlink to the survey at the PM Startpagina is responsible for this disparity. On the PM Startpagina the hyperlink was directly visible on the first opening screen, while on the other Web sites the respondents had first find their ways to the forum part that was devoted to PM software.

Particularly high completion rates were found in case of the by PMI promoted and the by e-mail invited respondents. The single acquaintance, who abandoned the survey after answering only a few questions, motivated his break off by stating he didn't read the invitation carefully and thus didn't know the survey was meant strictly for people who work project based.

The percentages of the respondents, who are willing to receive the research findings or even are prepared to cooperate with eventual further research, could be good benchmarks of the perceived quality of the survey and its importance. Although an important benefit of Web surveys is according to Cho and LaRose (1999) the privacy protection of the respondents, this protection has to be sacrificed when respondents want to receive the results or cooperate. Since the respondents would have to fill in their e mail address. Of course they could use alias e mail addresses, which give no information about their real identity. Based on the retrieved list of e mail addresses at least 8 of the 128 respondents who filled in their addresses used a fictitious name. Both these last statistics (Table 2) seemed satisfactory. Alas no similar data was found of other surveys to compare these percentages with.

Respondents Source	Invitation Method	Survey Language	(Estimated) Frame Population	Number of Returns (Response-rate)	Number of Completed Surveys (Completion-rate)	Number of Willing to Receive Results	Number of Prepared to Cooperate
PMI NL	Newsletter Website	Dutch	*1800	84 (4.7%)	80 (95.2%)	58 (72.5%)	38 (37.5%)
Random Invited Project Managers	E mail	Dutch	100	44 (44.0%)	41 (93.2%)	27 (65.9%)	20 (48.8%)
All PM Forum	Website	English	*378	46 (10.5%)	40 (87.0%)	19 (47.5%)	15 (37.5%)
PM Acquaintances	E mail	Dutch	30	23 (76.7%)	22 (95.7%)	20 (90.9%)	17 (77.3%)
Ganttheaд PM Forum	Website	English	N/A	33	28 (84.8%)	12 (42.9%)	7 (25.0%)
PM Startpagina	Website	Dutch	N/A	25	17 (68.0%)	11 (64.7%)	5 (29.4%)
Total				**249**	**228 (91.6%)**	**147 (64.5%)**	**102 (44.7%)**

* Estimated (based on) maximum frame population

Table 2 Descriptive statistics of respondents' samples

After the operational phase of the survey was finished, the processing of the obtained data could begin. In the next chapter some aspects of this process will be explained and illustrated with various examples.

8 Data Processing

A major advantage of online surveys is that data often can be used more or less directly for analysis (Selm, 2006). When the respondents fill in a questionnaire, they enter data directly into an electronic file, thus there's is no need for a separate phase of data entry by hand. This reduces costs and time. Another benefit of online surveys is the possibility of automatic coding of close-ended questions by the computer. In this way the occurrence of errors by incorrect manual input will be diminished.

Nevertheless open ended questions still will have to be manually coded. In addition the labelling and in some cases the recoding will have to be done (partly) by hand. Finally the editing and cleaning of false data entries will need to be processed manually. This chapter will describe most of these procedures and some of the choices that had to be made.

8.1 Coding

Moser and Kalton (1971) noted that coding data is the process of summarizing survey answers into meaningful categories to identify patterns. In this present research the coding could be divided in two parts. Before the Web survey went online all the questions and the predefined answers were labeled. After the online survey was closed nearly every open-ended answer was recoded and in some cases ranges of numeric values were recoded into new labels.

8.1.1 Numeric Labeling

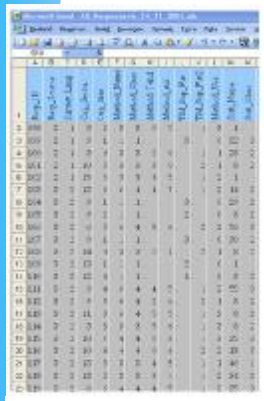

Figure 57: Screenshot of survey data sheet in MS Excel

The first action in the data process was the coding of all the survey's items and their attributes. All the items were referred to by a combination of three or more abbreviated words that covered best the meaning of each particular item. The attributes that belonged to each item were referred to by numeric values.

From the online survey Web site (ThesisTools) the data was retrieved several times a week. This data was obtained in a MS Excel files. All the newly brought in cases were eventually copied in a master Excel file. Each respondent (corresponding with a distinctive case) was referred to by a unique number. Every row in the Excel table comprises all the attributes belonging to a particular case. For every item a column was reserved (Figure 57).

Besides all the columns that corresponded with the items in the questionnaire two extra columns were inserted in the Excel table. The first extra column contained the respondent source (e.g. PMI, PM accuaintances, Gantthead). The second additional column enclosed the language version of the completed survey.

8.1.2 Recoding

Once this original numeric labeling was finished the Excel file was imported to the SPSS application (Figure 58). This application will be used for the statistical analyses later on. But in order to make the data more suitable for these analyses some of the data values had to be recoded. Some of these changes were done manually while others were executed by SPSS.

Figure 58: Screenshot of data editor in SPSS

First the texts, which were inputted by the respondents in the open answer fields that accompanied the 'other' answer options, were analyzed on their contents. Then similar contents were recoded, by hand, into existing or new values in order to be appropriate for later analysis (Chapter 9). For instance all the other reasons, besides the three pre defined reasons, of why PM software was not available (survey question **10**) were recoded in to four additional values. With these additional values all the other open answers contents could be covered.

In addition to these manual recoding procedures some automatic recoding was executed by SPSS. This automatic recoding will also be illustrated with an example. Automatic recoding was in some cases used to classify highly differentiated attribute values in to lesser values that compromised larger ranges of attributes. For instance the attributes of the item 'Perceived Use of PM Software', which varied in **10** ranges from 10% to 100%, were recoded into 3 ranges that varied from: **10%-30%, 40%-60%** and **70%-100%**.

After all the data entries were labeled and in some cases were recoded the data was studied on possible errors and invalid entries. This will be described in the next two paragraphs.

8.2 Editing

In this paragraph the process of editing will be described. First it will be explained how the obtained surveys were reviewed in order to uncover errors. This will be illustrated with some examples. Then the second section will give details on how some of these errors, if this was possible, were repaired.

8.2.1 Detection of Errors

Before the main data file was imported in SPSS all entries were scanned on data errors. The errors that were discovered can be categorized in two types.

The first category is the kind of error that occurred when a respondent has selected the option 'other', while the answer also was corresponding with a pre-defined answer as well. For instance one respondent answered he/she was working for a bank, instead of selecting the pre-defined 'financial and insurances activities' answer.

The second category is the kind of error was caused by a defect routing through the questions. By the inspection of a particular data file it became apparent that many respondents omitted large series of questions. Some of the participants even reported they suspected something had gone wrong as they came surprisingly abrupt to the end of the survey.

8.2.2 Correction of Errors

Obviously it was tried to solve all detected errors. How this was achieved will be explained by examples of both earlier mentioned (Section 8.2.1) categories of errors.

The errors that were the consequence of incorrect answers provided by the respondents could simply be corrected by altering the open answers to the corresponding answers. For instance the participants who used the text field to point out they used MS Excel were altered to the pre-defined answer 'tool based on MS Excel/Access/SharePoint'.

The errors that were caused by the defective question routing were more difficult to fix. First had to be determined if the participants filled in these defective surveys could be traced back. Fortunately the amount of participants who filled in these incomplete surveys was limited to only 15. Of these participants the majority (13) had submitted their e-mail addresses in the open text fields. After the problem in the routing was repaired the participants were politely asked by e-mail if they would complete a renewed version of the survey. This e-mail with the request and apology is included in the Appendix #.

8.3 Cleaning

This paragraph will explain how false data was removed. The paragraph starts with describing how all received surveys were filtered on possible invalid entries. It commences with what actions were taken to maintain the quality of the data.

8.3.1 Identification of Invalid Entries

By evaluating the Excel date file two different kinds of invalid entries were discovered. The first kind of invalid entries, which also appeared by far most frequent, were those entries that didn't complete any or only the first few questions. Some of these were probably caused by those respondents that had no binding with PM and had just entered the survey coincidently or out of curiosity but decided not to complete the survey. Some of these respondents could be identified as they left their regrets in the comment field. Other possible reasons that caused these incomplete surveys could be the accidental loss of the respondents' attention or IT related issues (e.g. broken down internet connection, incorrect Windows Explorer settings).

The second kind of invalid entries were those entries, which after carefully being studied, seemed to be completed falsely on purpose. No more than three of these cases could be identified with almost 100 percent certainty. In one case the participant had replied every question by selecting the first pre defined answer. The other two cases of deliberate obstruction were probably caused by one and the same participant. As he/she completed the survey two times in a very short time, as both retrieved surveys had subsequent identity numbers.

This participant rated the PM software with only the most positive answers and submitted an e-mail address that matched up with the name of this software.

8.3.2 Removing of Invalid Entries

The percentage of invalid entries can be calculated (with help of Table 2) by subtracting the total number of completed surveys (228) from the total returned surveys (249) and then divide this number though the total returned surveys (249). This percentage (8%) is quite modest, considered the current surveys were non probability based (Section 7.2.4).

All the invalid entries that had been carefully identified were removed from the Excel file. As a result they were not imported into the data file of SPSS and thus were left out of the analysis, which will be described in the next chapter.

9 Data Analysis

This chapter will describe, categorize and analyze the data that has been obtained by the survey. It will look at the data of the isolated contingency factors and the constructed variable 'PM Software Success'. It also will focus on the associations between the contingency factors, and in particular between each factor and the variable 'PM Software Success'.

The analysis informing this paper will use SPSS and Microsoft Excel for the computations and presentations. The chapter will be divided in three paragraphs. Each paragraph will focus on analyzing a particular subset of the data. These subsets will correspond with the elements (i.e. three contingency factors, constructed variable or presumed associations) that together form the Final Framework (Figure 44).

9.1 Primary Analysis

Figure 59 Primary Analysis in the Final Framework

This Primary Analysis will concentrate on the left part of the Final Framework (see highlighted area in Figure 59). Various data of each of the three contingency factors will be studied. The paragraph will start with evaluating nearly all the sample frequencies of the earlier described attributes (Paragraph 6.2). These analyzes will frequently be visualized in pie and bar charts. Then the attributes, which belong to two contingency factors 'PM Methods' and 'PM Software' will be classified. Subsequently the frequencies of these clusters will be described and analyzed. Finally, many of the frequencies will be judged against the results of four earlier conducted surveys about PM.

9.1.1 Sample Frequencies

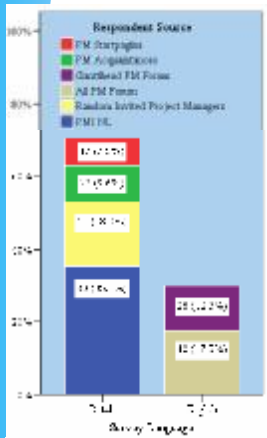

Figure 60 Respondents' survey language Frequencies by language (N = 228)

In this section several relative and absolute frequencies of the sample will be described and discussed. The section is divided in four subsections. The first subsection will be dedicated to the respondent demographics. Each following subsection will be dedicated to the frequencies within one of the three contingency factors. Some frequencies that stick out will receive special notice. Several interesting charts, in which the frequencies are displayed, will be included. Additional frequency charts and tables can be found in Appendix VI

Respondent Demographics

In total 228 fully completed surveys were received. The majority of the respondents (70%) completed the Dutch language version of the survey (Figure 60). Half of the Dutch versions (80 out of 160) were filled in by respondents that had used the hyperlink promoted by the Project Management Institute Netherlands (PMI NL). The PMI NL is also by far the largest source of all respondents (35%), if considered irrespective of the language. A minority of the respondents (30%) completed the English version of the survey.

This is not so surprising, since the attention was first exclusively focused on the PMI NL. In addition this Dutch promoter counts a lot of members (about 1800), who all received the newsletter with a hyperlink to the survey.

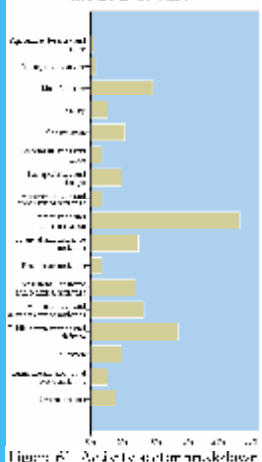

Figure 61 Activity sectors (breakdown of respondents' organizations) (N = 228)

PM Organization Frequencies

A large proportion (23%) of the respondents worked for organizations in the information and communication industry (Figure 61). Although a wide variety of other sectors were also well represented, including, for instance, public administration and defense (14%), manufacturing (10%), administrative and support service activities (6%). A complete overview of the distributed percentages of every sector can be found in the Appendix VI (Table 8).

The respondents represented organizations varying in size from more than 10.000 employees (13%) to 50 or fewer employees (21%). Many respondents (47) represented small organizations with 50 or less employees (Figure 61).

Notice that many small (fewer than 50 employees) organizations (51%) were found in the information and communication sector (Appendix VI, Table 8). The majority of the very large (more than 10.000 employees) organizations were represented in public administration and defense (24%) and in the manufacturing (20%) sectors.

The relative large proportion of respondents working in the information and communica-

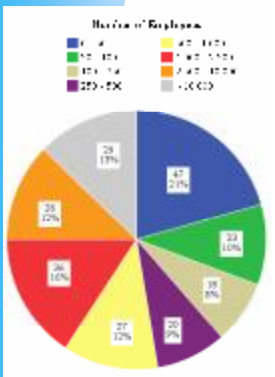

Figure 63: Distribution of sample employed in researched organizations (n=228)

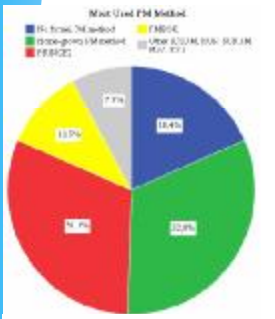

Figure 63: Distribution of most used PM Methods (n=228)

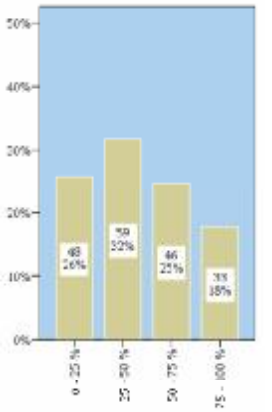

Figure 64: Distribution of usage of most used PM Methods (n=228)

tion sector corresponds with the content of most online discussion forums. Often IT projects are being discussed on these Web sites. A plausible explanation could be that as IT projects are often very complex many project managers in this sector are seeking for useful information about PM tools. In addition it's plausible that many project managers in this sector are working on freelance basis, which could explain the relative large amount of small organizations in this sector. This assumption was based on the fact that a large portion of the by Google found online résumés of project managers belonged to freelance IT professionals (Section 7.4.1).

The striking high amount of respondents from very large public administration, defense and manufacturing organizations could be caused by the urgent need for appropriate PM solutions by project managers in these sectors. Public administration and defense organizations are frequently characterized by hierarchical management structures. These structures often appear problematic in combination with the management of projects. A similar situation regularly can be found in manufacturing organizations. Their operational processes, which are typically mass productions, are the extreme opposite of running projects.

PM Method Frequencies

Only 18% of the 228 respondents reported that no formal PM methods are used within their organization (Figure 62). In addition, less astonishing, the largest part of the 228 respondents (32%) reported that home grown or in house developed PM methods (e.g. Cheatra of Siemens. Probaat of KPN) are the most used methods within their organization. A close second large amount of respondents (31%) filled in PRINCE2 is the most used PM method. PRINCE2 is followed at a relative distance by PMBOK (11%). A relative small amount of the respondents (8%) state they use other standard PM methods, such as DSDM. MSP and XP (see Appendix III for brief descriptions of these standard methods).

The relative small amount of respondents claiming no formal methods are used is probably caused by this particular sample. Respondents who are prepared to complete a survey about PM software are likely to be more than average interested in PM. Therefore it's likely these respondents are fascinated and involved more often with PM methods in PM as well.

Although if one searches for PM methods on the internet one most often will come across PRINCE2, it was not anticipated that this many, about one third (31%), of the respondents would report this standard method as most used. Later on (Section 9.1.3) these found proportions will be compared with the findings of other studies.

Besides this primary item's attributes several supplementary attributes concerning PM methods were measured. These were explained earlier (Section 6.2.1). Merely the most surprising measurements will be briefly described here. All the other measured attributes can be found in the Appendix VI (Tables 9-15).

A large part of the respondents (45%), who reported no formal PM method are used within their organization, stated that top management of their organization nonetheless wishes to introduce a PM method in the future (Appendix VI, Table 10).

In general organization's top management has a positive attitude toward the most used PM method (Appendix VI, Table 11). Only 7 percent of the respondents reported a negative attitude of top management toward the most used PM method. The three mostly often cited reasons (Appendix VI, Table 12) for this negative attitude are: top management doesn't see the value of the method (31%), top management is still searching for a more appropriate method (23%) or top management prefers PRINCE2 (23%).

The estimated percentage of all the projects within an organization that has run according the prescribed procedures, processes and documentations of the (most used) method is varying nearly continuous from 0% to 100%. Only a slightly bigger proportion of the respondents (32%) reported an estimated use in the range of 25% to 50% (Figure 64).

The last two items regarding PM methods are the perceived importance of the most used PM method and the attitudes of the respondents themselves about the method (Appendix VI, Tables 14 & 15). The largest part of respondents (63%) believes that the importance of the most used PM method within their organization is increasing, while a minority of the

respondents believes the importance stays even (21%) and or decreases (15%). This perceived increasing importance of the PM method was accompanied with a positive attitude of the respondents toward the method. The bulk of the respondents (82%) reported they had positive thoughts about working with the PM method.

PM Software Frequencies

The number of different PM software providers (developers and vendors) as was reported by the respondents proved to be very large. There were found 56 different application providers by this research (Appendix VIII, Table 62). A relative small amount of the respondents (16%) reported that no PM software at all was used within their organization. The most often cited reasons for the absence of PM software (Appendix VI, Table 16) were the small size of the project organization (39%), top management doesn't see the value of utilizing PM software (19%) and previous had experiences with PM software (14%).

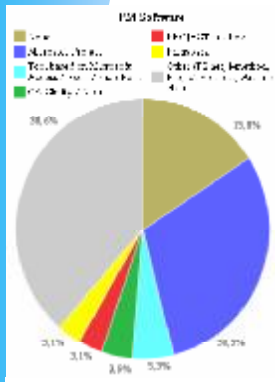

Figure 65: Analytical hybrid of most used PM software (N=228)

The respondents, within whose organizations PM software was used, most often reported Microsoft as the provider. With applications such as MS Project and tools based on MS Excel, MS Access and MS SharePoint, Microsoft had by far the largest market share (42%). Nearly a third (30%) of the 228 respondents indicated that the most obvious for use PM software within their organization was MS Project. MS Project was followed by tools based on MS Excel or MS Access (5%). All other PM software providers represented percentages less than 5% (Figure 65).

Although it was expected beforehand that MS Project would be the most used PM software, it wasn't anticipated the difference in proportion compared to other 'leading' PM applications, would be this immense.

The final interesting frequencies of PM software reflect on the commitment of top management toward the implementation of the software. In a substantial proportion of the cases (34%) the respondents estimated that top management wasn't committed toward the implementation of the PM software (Table 18). This proportion quite sounds the alarm, since it was mentioned earlier by many other studies (Section 3.1.6) that top management commitment proved to be a very important critical success factor for 'IS success'.

9.1.2 Cluster Frequencies

Since the available data, which was obtained by the survey, is so immense it had to be reduced in order to be analyzed in a sensible way. This will be done by clustering the data objects. Clustering is the process of classifying data objects into different 'sensible' groups (Halkidi et al., 2001). These groups (clusters) ideally share some common trait. Clustering principally is a subjective process, the same set of data objects often can be partitioned differently to serve different goals (Jain et al., 1999). By partitioning of a data set into subsets patterns may be discovered within an exploratory context. Then, instead of processing the data set as an entity, the representatives of the defined clusters can be adopted in the analysis.

Earlier the clusters of PM methods and of PM software were defined (Sections 4.2.3 & 4.3.3). The detailed clustering algorithms were described in the 'Final Framework' chapter (Sections 6.1.2 & 6.1.3).

In this section the frequencies of all these predefined clusters will be described and evaluated. Later on, the associations between these clusters and their influence on 'PM Software Success' will be analyzed (Paragraph 9.3.4). Optimistically this will result in the discovery of patterns, which in their turns can be meaningful in optimizing the performance of PM software.

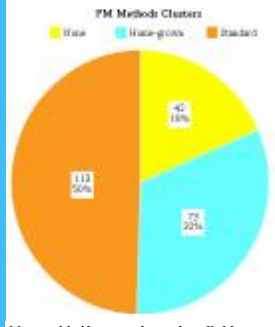

Figure 66: Descriptive statistics of most used PM Method clusters (N=228)

PM Methods Clusters Frequencies

Three different groups (clusters) of PM methods were distinguished (Section 4.2.3). Half of all the 228 respondents (50%) reported that 'standard PM methods' were most used within their organization (Figure 66). Nearly a third of the respondents (32%) indicated most common in their organization were 'home-grown PM methods'. The surplus of the respondents (18%) stated that 'no PM methods' were used.

Within the 'standard PM method' cluster PRINCE2 was by far the most frequent used method (63%). The second most cited standard method is PMBOK (21%). All other standard methods were much less reported, they all kept below the threshold of 3 percent (Appendix VI, Table 20).

Summarized, the reported widespread use of formal PM methods (82%), which includes both 'home grown and standard methods, was quite surprising. Hopefully further analyses (Paragraph 9.3), which evaluate possible discrepancies in for instance the perceived importance, the amount of use and the respondent's attitudes, will reveal interesting differences.

PM Software Clusters Frequencies

Likewise the three PM methods clusters there was made a distinction between three clusters of PM software (Section 4.3.3). As had been anticipated, the mainstream (69%) of the 192 respondents who reported PM software is used in their organization indicated this software belonged to the 'generic PM software' cluster (Figure 67). The 'method-specific PM software' cluster represent a modest fraction (22%), while the 'custom built PM software' cluster embodied the tiniest part (9%).

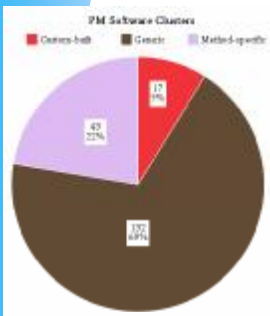

Figure 67 Distribution of most used PM Software clusters (N=192)

Within the large 'generic PM software' cluster (Appendix VI, Table 24) MS Project was reported in more than half of the cases (52%), followed at a large distance by tools based on MS Excel, Access and Sharepoint (9%) and CA (7%). PROJECT in a box (16%), P2.net (12%) and i-method (12%) were the most reported software applications belonging to the 'method specific PM software' cluster (Appendix VI, Table 23). To conclude, applications belonging to the relative small 'custom built PM software' cluster (Appendix VI, Table 22) were developed by companies like Centric (18%), Exact (12%) and Baan (12%).

Even though the 'generic PM software' cluster is by far the largest cluster, it will be fascinating to investigate how this subset scores on aspects such as use, top management commitment and perceived IS success, when compared with both the smaller PM software clusters. These analyses will be made later on (Paragraph 9.3.1 & 9.3.4).

9.1.3 Frequencies Comparisons

Many types of analyses of non-response bias can be conducted. A predominant approach is comparing the characteristics of the achieved sample, usually the demographic characteristics, with a benchmark survey (Duncan & Hill, 1989).

Given that most relative frequencies of this present survey been analyzed, it's time to compare these with frequencies presented by several other studies. In trying to keep the comparison as less complicated as possible, only surveys were studied that used the same cross-sectional evaluation time frame (see for commentary, Appendix V).

Unfortunately, the methods of administering the survey to samples of respondents were dissimilar. Only the survey of White and Fortune (2000) was a probability survey, while the other three were non probability surveys. Two surveys were more traditional pencil and paper surveys (White and Fortune survey and almost certainly PSO survey), while others were face-to-face (KPMG survey) or internet (PM survey 2006/2007) surveys. Despite these differences, the goal of making comparisons is, with anticipation, to increase the external validity of this current survey.

In each of the following four subsections various frequencies of this present survey will be put side by side with a related survey. After these comparisons a final evaluation will be given of how this current survey relates to the others surveys.

Survey of White and Fortune

The paper of White and Fortune (2002) reported the findings of a survey designed to capture the 'real world' experiences of people active in PM. This survey took the form of a traditional paper and pencil questionnaire. It was sent to 955 project managers. The questionnaire achieved a response rate of 23.7 percent, resulting in 236 respondents. Unfortunately the response rates can not really be compared, since the overall response rate of this current survey is not known (Section 7.4.3). Nevertheless it is quite surprising that their response rate

is lower than the response rate belonging to the random invited project managers (Table 2).

The frequencies of the survey of White and Fortune that can be compared with the ones of this present survey are those of the activity sector, the employee ranges, the use of PM methods and the use of PM software. Merely some interesting evaluations will be summarized here. A complete overview of the (absolute) frequencies can be found in Appendix VI (Table 25, Figures 114 & 115).

First, many of the activity sector frequencies of the respondents' organizations were nearly the same. For instance during this present survey many respondents (14%) reported they worked within the 'public administration and defense' sector. White and Fortune also reported here a similar proportion (14% plus 2%). Sadly, some sectors were more troublesome in comparing, as both surveys used different categorizations. Nevertheless the only manifest difference was found between both 'financial and insurance activities sectors'. In the survey of White and Fortune this sector was reported as the largest sector (17%). In this current survey only 7% of the respondents indicated they were working in this sector.

Second, the number of employee ranges had quite similar frequencies in the middle ranges (from 100 to 1000 employees). But significant dissimilarities were found in the ranges of small (less than 100) and large (more than 1000) organizations. In the survey of White and Fortune a large part (66%) of the respondents worked in large organizations with 1000 or more employees. Only a modest proportion (8%) of the respondents worked in organizations that employed 100 or less employees. While in this current survey this proportion is considerably higher (31%).

Third, the questionnaire of White and Fortune reported that the majority of the respondents were using PM methods (87%) and PM software (77%). In this present survey both these relative frequencies (respectively 82% and 84%) didn't vary much from the frequencies as were presented by White and Fortune. Although the frequencies of particular kinds of PM methods, such as home-grown (or in-house developed) methods and PRINCE2 showed substantial variances. White and Fortune reported that more than half (56%) of all the respondents' organizations used in-house developed PM methods and only a small amount used PRINCE or PRINCE2 (16%). Whereas this current survey showed that just in nearly one-third (32%) of the cases home-grown methods were used and that an almost similar frequency (31%) was found for PRINCE2.

Survey of PSO PRO Consultants

This second questionnaire had been conducted during a symposium that was organized by PSO PRO Consultants (further abbreviated as PSO) in 2005. This survey assessed the smallest number of participants; these were 90 professionals who worked in project organizations. Unfortunately, there is no information available about the exact method of administering, neither are any response statistics known. However PM related surveys with Dutch respondents are quite rare, which makes this survey interesting for making comparisons.

The frequencies of the survey of PSO that can be compared with the ones of this present survey are those of the employee ranges, the use of PM methods and the use of PM software. A complete overview of these (relative) frequencies can be found in Appendix VI (Figures 116-118).

First, the number of employee ranges had quite similar frequencies in the middle ranges (from 50 to 1000 employees). But, in a similar way as with the White and Fortune survey, significant dissimilarities were found in the ranges of small (less than 50) and large (more than 1000) organizations. Only in this time the survey of PSO reported that a relative large part (38%) of the respondents worked in small organizations with 50 or less employees and just above one-fourth (28%) respondents worked in organizations with more than 1000 employees.

Second, the PSO survey indicated that a majority (84%) of the respondents' organizations were using PM methods. This frequency is just in between the proportions reported by the survey of White and Fortune (87%) and this present survey (82%). Similar as to the White and Fortune survey, PSO reported a relative high frequency (48%) of home grown PM

method use and a low frequency (16%) of PRINCE2 use. In their report consultants of PSO acknowledged that they were surprised as well by this low frequency. They implied that most home grown methods might be based on PRINCE2. Possibly most respondents were too reserved to report they used PRINCE2, since this might lead to tricky questions.

Third, on the subject of the use of PM software PSO only provides a single bar chart (Appendix VI, Figure 118). This bar chart illustrates that the number of PM software providers seems very diverse, as the cluster 'other' is very large (60%). In addition many respondents reported the use of MS Project (36%). This is quite similar as the proportion that had been indicated in this present research (30%).

Survey of KMPG

The third survey that will be studied is the global IT PM survey of KPMG (2005). Interviewers of KPMG member firms conducted face to face interviews in more than 600 organizations in 22 countries. The survey included 51 questions; these were multiple choice and open response questions. The respondents were a wide range of organizational representatives, varying from CEOs to program and project managers. Additional response statistics are unknown. This survey is most interesting for making comparisons by its solid base of data and its global coverage.

It's a pity that only two frequency types of the KPMG survey can be compared with the ones of this present survey. These are those of the participant by industry and the use of PM methods. A complete overview of these (relative) frequencies can be found in Appendix VI (Figures 119-120).

First, the KPMG survey uses a much less differentiated way of categorizing the organizational activity sectors. Only five main industry clusters were used. Of these clusters only the relative frequency of government (i.e. 'public administration and defense') sector was almost equal (KPMG reported 16%, this present survey reported 14%). All other sectors showed greater differences.

Second, the KPMG survey indicated that only a minority (15%) of the respondents' organizations were using no formal PM methods, leaving the main part (85%) for formal PM methods. This frequency increases the validity of the frequencies measured by all previous surveys (87% and 84%) and this present survey (82%), as they all are pretty similar. Further KPMG reported that one fourth (25%) of the respondents indicated they were using home-grown PM methods. This frequency is less than the proportions reported by the surveys of White and Fortune (56%), PSO (48%) and this present survey (32%). This could be explained by the relative large (36%) cluster of hybrid (mixture of home grown and standard) PM methods. Besides this explanation KPMG stressed that many comments profiled the increased influence from generally accepted methods or bodies like PMI's PMBOK and OGC's PRINCE2. Still the frequencies of these standard methods were reported relative small (respectively 11% and 6%). It seems very plausible that the different continents of the participants (Figure 68), accounted for the low frequency of PRINCE2. Since PMBOK chiefly is used in the North American region and PRINCE2 is used most often in the European region.

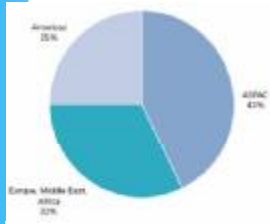

Figure 68 Distribution of participants by region in KPMG survey

PM Survey 2006/2007

The final and most recent questionnaire was carried out by a collaboration of three organizations (Vrije Universiteit Amsterdam, Business and IT Trends Institute and Bisnez Management). This survey was a non probability Web site survey. It was promoted on a Web site. The survey was completed by 220 Dutch participants. No further information was provided about the response statistics or other ways of inviting the participants.

Three frequency types of the PM survey 2006/2007 could be compared with the ones of this present survey. These are those of the employee ranges, the participant by industry and the use of PM methods. A complete overview of these frequencies can be found in Appendix VI (Figures 121-123). Unfortunately the use of PM software was not measured by this survey.

First, the PM survey 2006/2007 clustered most of the organizational activity sectors in a

different way when compared to this present survey. Therefore only limited clusters could be judged against the current survey's clusters. Many of these clusters reported similar or almost similar frequencies (e.g. public administration and defense 11% and 14%, financial and insurance activities 9% and 8%, retail and wholesale both 3%). Nevertheless few large differences of frequencies were also measured (e.g. manufacturing 3% and 10%).

Second, the PM survey 2006/2007 used an almost same way of categorizing the employee ranges. The employee ranges had nearly equal frequencies in all ranges. The only noticeable difference found was that the PM survey reported little more (38%) large organizations (from 1.000 to 10.000 employees) than this current survey (28%).

Third, in contrast to the findings of the other surveys, which reported relative high frequencies (82% 87%) of formal PM method use, the PM survey 2006/2007 measured a remarkably lower proportion (65%). Of this proportion practically three fourth (72%) of the respondents indicated they worked with PRINCE2 and merely one-fifth (20%) reported they worked with home grown methods.

By referring to a survey of KPMG (2004), which reported the use of PRINCE2 (61%), the authors of the PM survey 2006/2007 postulated that the use of PRINCE2 still kept increasing. Finally, the writers highlighted that respondents who work with standard PM methods are more satisfied about these methods than those who work with home grown methods.

Overall Comparison

The lion's share of the relative frequencies (i.e. employee ranges, PM method use and PM software use frequencies) reported by this present survey bears much resemblance with frequencies obtained by the other four PM related surveys. In particular those frequencies that correspond with the use of formal PM methods appear to be quite similar. All these relative frequencies showed relative high percentages (82%-87%), except for one survey which reported a much lower percentage (65%).

On the other hand, some disparities (i.e. frequencies of home grown methods and PRINCE2) have been observed as well. These differences were probably caused by the respondents' geographical regions. Therefore, as far as can be anticipated, the external validity of the survey doesn't give the impression to be in great danger. The organizational activity sector and the employee ranges frequencies of this present survey show no atypical high or low frequencies when compared with the other four surveys. This congruence of frequencies indicates that the sample population actually might represent the actual world, unless all surveys suffered sample errors. Therefore, as far as can be anticipated, the external validity of the survey doesn't appear to be in great danger.

9.2 Secondary Analysis

Figure 69 Secondary Analysis area in Final Framework

The Secondary Analysis will focus on the right part of the Final Framework that corresponds with the constructed variable 'PM Software Success' (see highlighted area in Figure 69). The paragraph will start an evaluation of all the attribute frequencies. These attributes belong to the items which together were used to asses the constructed variable (see for explanation Paragraph 6.4). Then the reliability (i.e. internal consistence) of the constructed variable 'PM Software Success' will be examined with help of Cronbach's Alpha and the test variable (Paragraph 6.5). The paragraph will end with analyzing the frequencies of the 'PM Software Success'.

9.2.1 Attribute Frequencies

The variable 'PM Software Success' eventually was constructed of 10 items (Paragraph 6.2). In this section first all the frequencies of every attribute that belong to these 10 main items will be studied. Besides these main items 3 supplementary items were assessed with help of the survey. These were not used for the constructed variable, but were measured to gain additional information about the use of PM software. These 3 supplementary items will be studied in the second part of this section. A complete overview of all (main and supplementary) attribute frequencies can be found in the Appendix VI (Tables 26-35).

Main Items

In the table below (Table 3) all the valid observations (N), the minimum (most negative) and maximum (most positive) values, means and standard deviations of each main item are summarized. Of the in total 192 respondents (who reported the use of PM software within their organization) 121 observations had valid responses in all the 10 items. This means that 121 respondents answered all 10 items without answering 'no idea'/'no opinion'.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Main Item 01 - Reliability of PM Software	191	1	7	5,43	1,25
Main Item 02 - Ease of Use of PM Software	191	1	7	5,25	1,39
Main Item 03 - Usefulness of Functionality of Features of PM Software	191	1	7	5,42	1,32
Main Item 04 - Satisfaction of PM Software	185	1	7	5,42	1,45
Main Item 05 - Efficiency of PM Software	186	2	7	5,67	1,17
Main Item 06 - Effectiveness of PM Software	189	1	7	5,31	1,19
Main Item 07 - Costs of PM Software	149	1	7	5,05	1,30
Main Item 08 - Implementation Time of PM Software	156	1	7	3,99	1,30
Main Item 09 - PM Process Support by PM Software	189	1	7	5,07	1,47
Main Item 10 - Organizational Development by PM Software	171	1	7	3,57	1,35
Valid N (listwise)	121				

Table 3: Descriptive statistics of main items PM Software Success

The table above (Table 3) shows some interesting findings. First, the questions about the 'Estimated Costs' (item 7) and 'Implementation Time' (item 8) were most often answered with 'no idea' (N is low). This isn't much surprising, as it seems logical that for instance merely users of the software don't have access to information about costs or new users don't know how long it took to implement the software.

Second, the relative high mean values of the 'Efficiency' (item 5) and the 'Reliability' (item 1) demonstrate that in general the respondents were positive about these aspects of PM software. The positive answers in regard to the 'Reliability' were somewhat anticipated, as available test reviews often reported PM software to be reliable. On the other hand the high mean of the 'Efficiency' item were not expected. The accompanying low standard deviation (1,17) reveals that the respondents were the most unanimous about this answer as well.

The relative low mean of 'Stimulation of Organizational Development' (item 10) was as well predicted. Since when PM software encourages the organization to grow in the field of PM, the software has to possess special abilities or the PM organization has to be relative immature.

An extensive version of this table is enclosed in the Appendix VI (Table 39). This table also shows the medians (middle value after ranking in order) and modes (numbers that occur most frequently) of all the main and supplementary items.

Supplementary Items

Besides the 10 main items 3 supplementary items were measured about the use of PM software. The argumentation of why these items are not components of the constructed variable was given earlier (Section 6.2.3). Although these supplementary items will not be used to construct the variable 'PM Software Success', they still are important as they hopefully will give more insight about the use itself and the factors that can be associated with the amount of use (see later Sections 9.3.2 & 9.3.3).

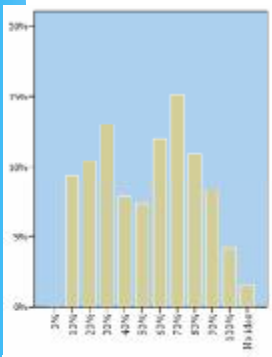

Figure 70: Perceived use of PM Software (responses N=192)

The first supplementary item is the 'Condition of Use' item. Only a slight majority of the respondents (59%) reported that the use of the PM software could be characterized as principally voluntary (Appendix VI, Table 36). This was rather surprising, as it had been presumed that a substantial majority would be voluntary. The basis for this presumption was that PM applications regularly aren't perceived as crucial for managing projects as for instance salary systems are for the payment of wages.

The second supplementary item is the 'Perceived Use of the PM Software'. The by the respondents estimated usage of the software differs proportionally from 10 to 100 percent (Figure 70). Noteworthy, two seemingly random peaks emerge at 30 and 70 percent. A closer look showed what possibly caused these modest peaks. After the percentages of perceived PM

software use have been split by the obligatory and voluntary conditions (Appendix VI, Figure 124), it became clear that the first peak of 30 percent is inherent to the voluntary condition and the second peak of 70 percent is inherent to the obligatory condition. Consequently it seems that PM software that is used in an obligatory environment is significantly used more often than when used in a voluntary environment.

The final supplementary item PM, which remains to be analyzed, is the attitude of the respondents toward the use of PM software (Appendix VI, Table 38). The largest part of the respondents (52%) reported they were willing to use the PM software. A considerable part had a neutral attitude toward using the PM software (22%). But remarkably almost a fourth part was unwilling to use the PM software (24%). Perhaps this unwillingness could be interpreted with help of the TAM (Paragraph 5.2), later on when TAM will be administered in the context of PM software (Section 9.3.2).

9.2.2 Reliability of Construct

The reliability of a construct is the accuracy or precision it's measuring the same results the same way each time (Straub, 1989). It refers to the degree to which a variable or set of variables is consistent in what it is intended to measure. If multiple measurements are taken, the reliable measures will all be very consistent in their values. Reliability differs from validity in that validity is concerned with how well the concept is defined by the measures (Section 7.3.3). The reliability on the other hand relates to the consistency of the measures (Hair et al., 1998).

There are several methods to establish the reliability of a constructed variable. These include the test retest method, the equivalent forms, the split halves method and the internal consistency method. Of all these methods the internal consistency method is considered as the most effective, particularly in field studies. The biggest advantages of this method are that it requires only one administration and that this method is considered to be the most general form of reliability assessment.

The internal consistency of the current constructed variable will be estimated using the reliability coefficient called Cronbach's Alpha (Cronbach, 1951). An Alpha (α) value of 0,80 or above is considered to be the criterion for indicating strong internal consistency of established indexes between 10 to 15 items (Swanborn, 1982; Van Wijk, 2000). In the case of exploratory research, such as is here the case, an Alpha value of merely 0,60 or higher is considered as significant (Hair et al., 1998).

Using the data collected from the respondents to the survey, the reliability of the construct has been checked by computing Cronbach's Alpha (α) value for all the main items with SPSS. Given the exploratory nature of the study, the result seems very satisfying as the measured Alpha's value of 0.898 (Table 4) is much higher than 0.60. It's even higher than the prestigious value of 0.80.

Reliability Statistics

Cronbach's Alpha	N of Items
.898	10

Table 4: Cronbach's Alpha of PM Software Success construct

When one of the items will be deleted, the Cronbach's Alpha will range from 0,878 (for overall satisfaction) to 0,895 (for implementation time). Since the Alpha in case of item removals doesn't come above the original Alpha (0,898), all items safely can continue to be part of the construct (Table 5).

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Main Item 01 - Reliability of PM Software	57,79	67,563	,597	,887
Main Item 02 - Ease of Use of PM Software	57,49	70,667	,595	,887
Main Item 04 - Usefulness Functionalities Features of PM Software	57,66	73,161	,685	,878
Main Item 05 - Overall Satisfaction of PM Software	57,83	73,072	,772	,878
Main Item 05 - Efficiency by PM Software	57,17	67,789	,634	,887
Main Item 06 - Effectiveness by PM Software	57,47	67,103	,693	,849
Main Item 07 - Costs of PM Software	57,34	67,305	,703	,883
Main Item 08 - Implementation Time of PM Software	57,68	68,351	,517	,895
Main Item 09 - PM Process Support by PM Software	57,71	70,107	,732	,881
Main Item 10 - Organizational Development by PM Software	57,57	70,663	,685	,849

Table 5: Cronbach's Alpha if item would be deleted

9.2.3 Frequencies of Construct

Since internal consistency of the current construct 'PM Software Success' appears to be satisfactory this section will take a closer look into the frequencies of this variable.

First the frequencies of the total scores of all ten items will be analyzed. Then these scores will be classified into a lower hierarchical level of measurement, i.e. 'unsuccessful' and 'successful'. And concluding, the frequencies of this new dichotomous constructed variable 'PM Software Success' will be evaluated.

Mean Item Score Frequencies

In a previous paragraph (9.2.1) was demonstrated which number (N) of 192 cases within each had valid scores (Table 3). Valid refers here to answers with scores from 1 (i.e. very negative) to 7 (i.e. very positive). For instance item 4 ('Overall Satisfaction') had a valid score of 185. This means that in 7 (192-185) cases an invalid score was registered. Thus 7 respondents answered they had 'no idea' about the overall satisfaction. If all the invalid scores belonging to each main item are summed up the total number of invalid scores is 128. This results in a frequency of missing data of 6,7 percent (128/192^10).

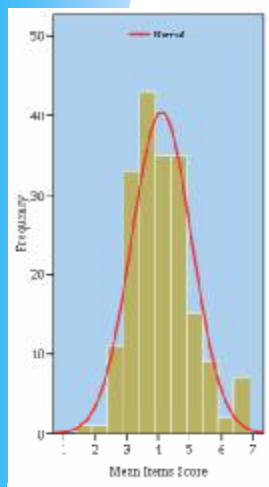

Figure 71: Histogram 'mean item scores' PM Software by means and N=192

Since this percentage of missing data is less than 20% a proportional score based on what is observed for the particular respondent should be an appropriate method of handling the missing data (Downey & King, 1997). As has been mentioned earlier (Paragraph 6.4), when for instance within an individual case instead of all 10 items, only counts 8 items were scored, then the mean item score of all items of this case will be calculated by dividing the sum of all item values by 8 instead of 10. The frequencies of these mean item scores are graphically demonstrated in a histogram chart (Figure 71).

This histogram shows that the majority of the respondents (79%) rated the PM software within their organization in such a way this resulted in a calculated mean item score between 3 and 5. In addition it can be seen that the distribution of the scores almost equals the normal distribution curve.

Dichotomous Variable Frequencies

This subsection will describe how the various mean item score values (which ranges almost continuous from 1,9 to 6.9) will be transformed in only two possible values. Besides describing this transformation, the frequencies of this new dichotomous variable will be analyzed.

For later analyses it was decided to transform the almost continuous variable to a dichotomous variable. A dichotomous variable is a discrete categorical variable with two possible values (Van Wijk, 2000). In this research the constructed variable 'PM Software Success' will have the values 'unsuccessful' and 'successful'. All cases with a mean main item score of less than 4 will be transformed in 'unsuccessful' and all cases with a score of 4 or higher will be transformed in 'successful'.

By this transformation much of the information will be lost. Nevertheless a dichotomous variable will make discoveries of possible patterns easier as the data (within the cross-tabulations cells, see Section 9.3.4) will be less spread out. Besides this analytic advantage of a dichotomous variable, the values 'unsuccessful' versus 'successful' will, though less realistic, be more appealing and easier to comprehend for a future audience.

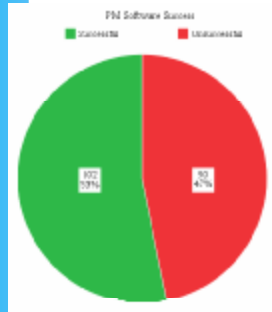

Figure 72: Frequencies distribution of variable PM Software success N=192

The (relative) frequencies of the dichotomous variable 'PM Software Success' are shown in the pie chart (Figure 72). As was mentioned earlier in 192 cases, within the total of 228 cases, PM software was available. In no more than 53 percent of these cases the PM software is considered as a success. This percentage seems not as worse as it was reported in 2006 by Ernst and Young (then only 23% was completely successful). Bear in mind though that these percentages can not be compared unerringly with each other, because this present research only evaluates PM software which is still available, earlier failed PM software implementations were not included.

9.2.4 Test Variable Frequencies

At present the attribute frequencies of the constructed variable are known. Consequently a

logical step should be to compare these frequencies with the attribute frequencies of the single-item test variable (Paragraph 6.5). This item was placed at the end of the questionnaire. It measured how the participants rated the overall successfulness of the PM software in their organization (Appendix VI, Table **41**).

Hopefully the comparison between this single-item and the constructed variable will demonstrate merely little variances in frequencies. Since differences in frequencies would imply that either the constructed or the test variable, or even both are incorrect.

For the majority of the variances between both variables (73%) the calculated difference was less than 1 point (Figure 73). In 12 cases the difference couldn't be calculated as the single-item was answered with 'no idea'. Within the three variances where the difference was larger than ( ) 2, only one variance included opposing (unsuccessful versus successful) attribute values. The proportion of cases (51%) where the attribute value of the test variable was higher than the one of constructed variable is almost equal with the proportion of cases (49%) where the test variable attribute had higher values. As can be seen in the Appendix VI (Table 42) no more than 5 attributes had opposing values (unsuccessful versus successful), while in 133 cases the direction of the attributes (i.e. both unsuccessful, both successful) was equal. In 54 cases the difference couldn't be calculated as the single-item was answered with 'no idea' (12) or 'neutral' (42).

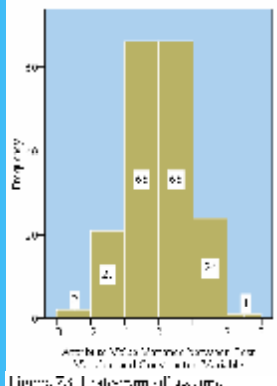

Figure 73: Histogram of assumed constructed variable variances (N=180)

Fortunately it can be concluded that the attribute values of the constructed variable 'PM Software Success' and the single item test variable are quite congruent. In those cases the values of the attributes were contrasting (unsuccessful versus successful) it was evident that the attribute value of the constructed variable should be the determinant. Since this variable, as has been estimated earlier (Section 9.2.2), had a very high internal consistency.

9.2.5 Ranking List

Although, it's not one of this research's objectives, but many of the participants will probably be curious to know how all the different PM applications have been rated by their fellow participants. In Appendix VIII a ranking list can be found (Table 62). This list includes all by the respondents entered PM applications. The list includes the records of how often each application was entered as well. The software is ordered by total main item score, but all the scores of each particular item (e.g. 'Reliability', 'Usefulness') are included as well.

9.3 Tertiary Analysis

Figure 74: Tertiary Analysis areas in Final Framework

In the Tertiary Analysis the center of attention will be at the presumed associations between the components of the Final Framework (see highlighted lines in Figure 74).

The paragraph will start with analyzing some assumed associations between interesting items in the framework. Examples of such associations are the possible relations between 'Top Management Commitment' and 'PM Software Success' and between 'PM Method Use' and organizational 'Size'. Then the paragraph will commence with employing the TAM and TTF Model. It will be interesting to evaluate if these models can be applied successfully in the context of PM software. The paragraph will end with evaluating if the earlier hypnotized associations (Section 3.2.1) between the contingency factors and the 'PM Software Success' really exist.

9.3.1 Associative Items

In this section several assumed associations between items will be described and discussed. The section is divided in five subsections; each subsection is dedicated to investigate a particular interesting association. The possible associations will be investigated by determining the correlation between the individual items. Correlation is a bivariate measure of association (strength) of the relationship between two variables (Maris, 2006). It varies from 0 (random relationship) to 1 (perfect linear relationship) or -1 (perfect negative linear relationship). Here it is reported in its correlation coefficient value, interpreted as percent of variance explained. For instance, if the correlation coefficient value is 0,250, then the independent variable is said to explain 25 percent of the variance in the dependent variable.

Correlation as measure of the strength of associations has also some common pitfalls. Correlation is symmetrical, not providing evidence of which way causation flows (Liebetrau, 1983). Since in this present cross sectional research (only at one point of time a survey was conducted) the objective was just to explore associations instead of causal relations this inability of proving causalities will not give any troubles. Dependent on if the items attributes are nominal or ordinal distributed, respectively Phi and Cramers V or Kendall's tau b and tau c as effect size measures will be computed. Additional charts and correlation tables can be found in Appendix VI.

PM Organization Correlations

In this first subsection the significance levels and correlation coefficient values between PM organization (and respondent) related items will be discussed. These items are the 'Respondent's Source', 'Survey Language', 'Organizational Size', 'Organizational Activity Sector' and 'Willingness to Cooperate'. All these items were included in the correlation table (Appendix VI, Table 44). Here only the interesting associations or the nonappearance of these will be mentioned. Some of these variables consist of nominal data, which has no order, and the assignment of numbers to categories is purely arbitrary (ex., 1=Dutch 2=English). Because of this lack of order or equal intervals, the Contingency Coefficient, Pearson's C will be used to evaluate if the presumed associations do exist.

Only one significant association was found in this correlation table. This is the association (0,651) between the 'Respondent's Source' item and the 'Survey Language' item. This was anticipated as within each source (e.g. PMI, All PM, Gantt Head) only surveys with the same language (Dutch or English) were retrieved.

The fact that no other associations were found demonstrates that between all these other items no significant (linear) relations exist. For instance, there are no significant differences in 'willingness to cooperate in a later stage' between respondents who completed the Dutch version of the language and the ones who completed the English version. In addition there are no significant associations between the activity sector and size of organizations. Since no further significant associative relations were found the likelihood will be reduced that of later exposed findings could be ascribed to one of the PM organization related item correlations.

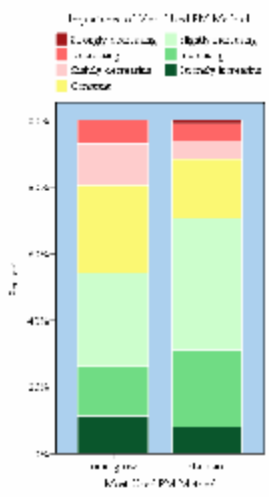

Figure 75 Impression of PM Method by Kind of PM Method, N=185

PM Method Correlations

In this second subsection the significance levels and correlation coefficient values between PM method related items will be discussed. These items are the 'Kind of PM Methods', 'Attitude of Top Management toward PM Method', 'Attitude of Respondent toward PM Method', 'Perceived Use of PM Method' and 'Importance of PM Method'. All these items were included in the correlation table (Appendix VI, Table 45). Merely the interesting associations or the absence of these will be mentioned here.

The 'Perceived Use of PM Method' and 'Importance of PM Method' are the only two items that are correlated (respectively -0,199 and 0,160) with 'Kind of PM Method'. The direction of the first association, which is negative, demonstrates that the prescriptions and procedures of home grown PM methods are better lived up to than those of standard PM methods. Most respondents (55%), who work in organizations where home grown PM methods are mostly used, declare that these methods are actually being used in at least half (50%) of the projects. When standard PM methods are the most used methods this percentage is much lower (35%).

The second association, which has a positive correlation coefficient, reveals that the importance of standard PM methods increases more than the home grown methods (Figure 75). Many of the respondents (71%), who work according standard methods, indicate the importance of this method in their organization is increasing. In case of home-grown methods this percentage is substantial lower (54%). Besides these associations all other items are unrelated to the 'Availability/kind PM Method' item.

The 'Attitude of Top Management' is positively correlated (0,277) with the 'Importance of PM Method'. Consequently more top management commitment is associated with higher perceived importance of the most used PM method. No further items were correlated with

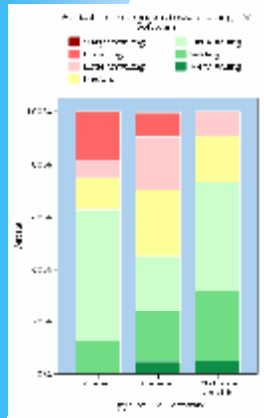

Figure 75: Attitude of respondent toward PM Software by type of PM Software (N=189)

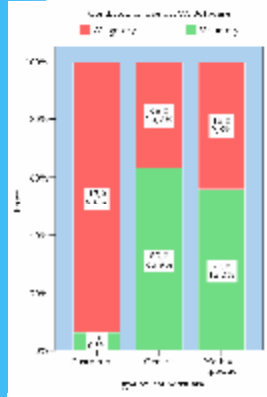

Figure 77: Condition of use vs. Type of PM Software (N=182)

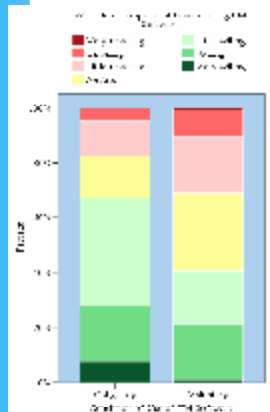

Figure 78: Attitude of respondent toward using PM Software by condition of use (N=182)

the top management's attitude toward PM methods.

The 'Importance of PM Methods' item is also correlated with the 'Attitude of Respondent toward PM Methods' item (0,388) and the 'Perceived Use of PM Method' item (0.209). It's not surprising at all that these attitudes (of top management and respondents) and the use are associated with the importance. Hence positive thoughts and high usage typically identify a tendency (increased importance).

Somewhat surprising is that the 'Attitude of the Respondent toward PM Method', which of course is associated with the 'Perceived Use' (0,194), is not associated with the 'Attitude of Top Management'. Therefore it seems that the participants of the survey, who normally don't have a top management position, often have different attitudes about the most used PM method in their organization than the top management. This gives a quite alarming impression.

PM Software Correlations

In this third subsection the significance levels and correlation coefficient values between PM software related items will be discussed. These items are the 'Type of PM Software', 'Attitude of Top Management toward PM Software', 'Attitude of Respondent toward Using PM Software', 'Condition of PM Software' and 'Perceived Use of PM Software'. All these items were included in the correlation table (Appendix VI, Table 46). In this subsection only the interesting associations or the absence of these will be mentioned.

The 'Type of PM Software' item is correlated with the 'Attitude of Respondent toward Using PM Software' item and the 'Condition of Use of PM Software' item. Both these significant associations have positive correlation coefficients (respectively 0,180 and 0,158). This means that each type of PM software is in some way associated with more positive or negative attitude of the respondent and will more or less often appear in a voluntary or obligatory setting. Since the item 'Type of PM Software' has three attributes (custom-built, generic and method specific PM software), no statements about the exact associations can be made by just judging the correlation coefficients. Two bar charts (Figure 76 & 77) clarify both associations.

The 'Attitude of Top Management toward PM software' is positively correlated (0,473) with the 'Attitude of Respondent toward Using PM Software'. Consequently, more top management commitment is associated with a higher willingness by the respondent to use the software. Or both attitudes of top management and respondents will be the same negative. Either way, there seems to be a lot of consensus.

Quite unexpected is that top management's and respondent's 'Attitudes' both are negatively associated (respectively -0,377 and -0,223) with the 'Condition of Use'. This demonstrates that in an obligatory use environment both attitudes toward PM software are more often positive than in a voluntary environment (Figure 78).

Finally the commonsense association between the 'Condition of Use' and 'Perceived Use of PM Software' has a very high negative correlation (-0,581). Indeed mandated PM software is far more being used than in a voluntary environment. In a later section (Section 9.3.2) the conditions of use will further be studied.

PM Software Success Correlations

In this last subsection the significance levels and correlation coefficient values between PM software success related items will be discussed. These items are the 'PM Software Success', 'Attitude of Top Management toward PM Software', 'Attitude of Respondent toward PM Software', 'Condition of PM Software' and 'Perceived Use of PM Software'. All these items were included in the correlation table (Appendix VI, Table 47). In this subsection only the interesting associations or the absence of these will be mentioned.

The correlation table shows that all the mentioned items are correlated to the item 'PM Software Success'. A negative correlation coefficient (-0,163) is restricted to the item 'Condition of Use'. It's very interesting that the way in which PM software is used seems to influence the success of the software. Even more striking is that mandated PM software is more can be associated with success (62%) than PM software which usage is voluntary (44%).

As was already said, between the three other items and the item 'PM Software Success' all correlation coefficients are positive. These findings are not that surprising, since it sounds quite logic that, for instance, the amount of 'Use' and 'Success' of PM software are positively correlated (0,274), despite the possible distortional effect of the condition (voluntary versus obligatory) of use.

In addition it's no surprise either that both attitudes have strong associations with 'PM software Success'. Commitment, both of users and top management, was mentioned by many authors as a critical success factor for software implementations. Nevertheless by these positive correlation coefficients (0,444 and 0,468) it is demonstrated that commitment of top management during the implementation trajectory and the willingness of the respondents towards using of the PM software seem to be excellent predictors of the PM systems success as well. The stronger the commitment the higher is the success rate. To illustrate this, when top management is uncommitted the success rate of PM software is about one-third (36%), when management neither is committed or uncommitted, little more than half (54%) of all the software is successful and when management is committed the success rate increases to almost three quarters (74%).

9.3.2 Administering TAM

In this section will be analyzed if the TAM of Davis (Paragraph 5.2) successfully can be applied in the context of PM software. For this purpose, some of the model's elements had been enlisted as single-items in the survey. All highlighted elements in the TAM (Figure 80) correspond with items in the survey (Figure 79). The strength of each presumed association between these items will be evaluated with help of Kendall's tau_b correlation measure.

Figure 79: TAM elements in Final Framework

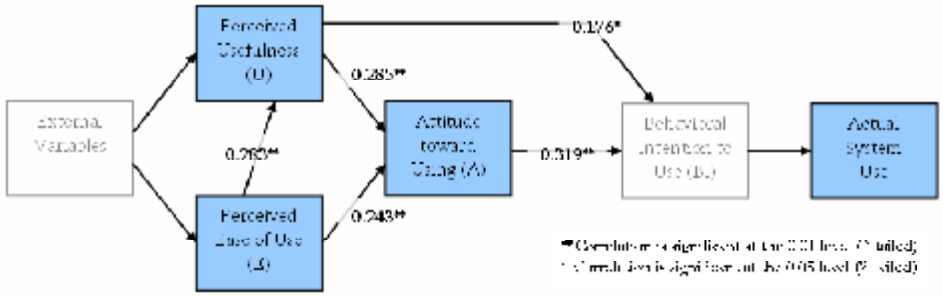

Figure 80: TAM with by survey measured items and correlation coefficients

The correlation table in the Appendix (Table 48) shows the by SPSS computed strengths and significances of all presumed associations. All the correlation coefficient values are added to the TAM scheme above (Figure 80). Every by the model assumed relation or missing relation (i.e. very low insignificant correlation coefficient between 'Perceived Ease of Use' and 'Actual System Use') within the TAM is confirmed. Even the link between 'Perceived Ease of Use' and 'Attitude toward Using', which has been proved by some (Calisir & Calisir, 2004) while argued by others (e.g. Chau, 1996; Szajna, 1996), is being confirmed. Although the strength between these two items has the smallest covariance (0,243).

Extensive research supports the notion that 'Usefulness' and 'Ease of Use' are primary drivers of 'User Intentions' to adopt new technologies. However, this research has been conducted mostly in environments in which the adoption was voluntary. When technology use is commanded, as it is in many organizations, Brown et al. (2002) expected that the underlying relationships of traditional technology acceptance models will be different. Since both conditions, 'voluntary' and 'obligatory' use of PM software have been measured by the survey, it was decided to see if the correlations between the TAM elements differ in both conditions.

Deeper analyses of both use conditions seems especially intriguing, since in the previous section it already had become clear that PM software in mandated conditions is relative more often successful than PM software in voluntary conditions.

The scheme of TAM below (Figure 81) demonstrates all computed correlation coefficients of

both use conditions (Appendix VI, Tables 49 & 50). The green values represent the voluntary conditions, while the red values represent the obligatory condition.

First the attention will be at the voluntary condition. Most correlations remain significant, with the exception of the 'Perceived Usefulness' and 'Actual System Use' association. Remarkably the correlation coefficient between 'Usefulness' and 'Attitude toward Using' decreases, while the coefficient between this last element and 'Ease of Use' increases. It seems that the in a voluntary environment the 'Ease of Use' of PM software is more crucial for the 'Attitude toward Using' PM software than 'Usefulness'. In literature no explanation was found for this finding.

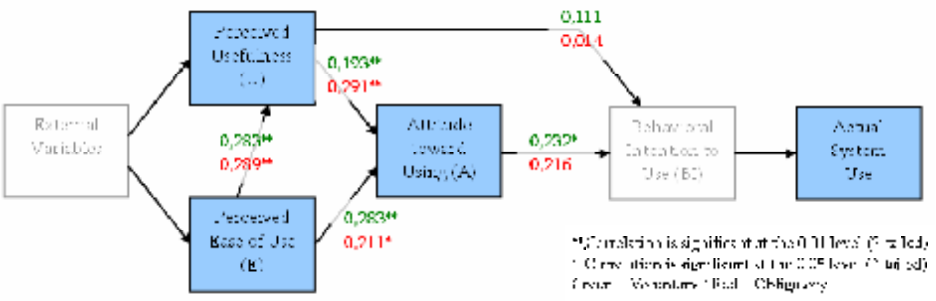

Fig. 6.8: TAM for voluntary and obligatory conditions

The most striking differences between the mandated condition set and the voluntary condition are the no longer significant correlation between 'Attitude toward Using' and 'Use' and a decreasing coefficient value between 'Ease of Use' and 'Attitude toward Using'.

The first difference can easily be explained as the 'Use' within a mandated condition almost certainly is primarily determined by the sanctions involved, instead of by the 'Attitude toward Using' the PM software.

There is no idea about what caused the second difference. It looks just as inexplicable as the crucial 'Ease of Use' in the voluntary condition. These findings even entirely contradict the results of the research that was conducted by Brown et al, (2002). They examined the TAM in the context of one particular mandated system within a subsidiary bank. Their results showed that in a mandated environment 'Ease of Use' was the primary determinant of 'Attitude toward Using'. According to them this was in contrast with much prior research in voluntary settings, which suggests 'Usefulness' emerges as the primary antecedent to 'Attitude toward Using'.

After reading most comments, that accompanied many of the completed surveys (Appendix II), a possible explanation came to the surface. A reason for the present findings being the opposite of Brown et al. earlier findings could be caused by the different characteristics of banking and PM software. Some of the respondents mentioned that it's hard to use the PM software by the abundance of bells and whistles that are usually built in. This comment supports the earlier statement about PM software (Section 3.1.2), which stated that the majority of the PM software includes all common useful functions and features of PM. It's very likely that the amount of functions and features has become truly an overkill by which the 'Ease of Use' of PM software frequently suffers. So consequently, the 'Ease of Use' of PM software has become the primary determinant of the user's 'Attitude toward Using' this software.

Summarizing, the TAM seem to be applicable for PM software and it provides more insight in how the user's behaviour and determinants of 'Use' differ in voluntary and mandated situations. However, this examination of the TAM in the PM software context is not without limitations. As the survey measures the elements of TAM with merely single items, it would be far too pretentious to assume that based on the presented correlations values the power of TAM is validated in this context. Besides these restrictions it has to be stressed that the 'Actual Use' element in TAM was the represented by the 'Reported Use' in the survey and that the elements 'External Variables' and 'Behavioral Intention to Use' weren't incorporated

in this research.

With taking all these shortcomings into account, but by keeping in mind the explorative nature of this research, the findings stated above at least strongly indicate that TAM might be valid here.

9.3.3 Administering TTF Model

After the determining of the validity of TAM within the context of PM software this section will be devoted to analyzed if the TTF construct of Goodhue and Thompson (Paragraph 5.3) is applicable here. For this purpose, some of the model's elements had been enlisted as single items in the questionnaire.

All highlighted elements in the TTF model (Figure 83) correspond with items in the survey (Figure 82). Except for the 'Performance Impact', this element was constructed by combining the equally weighted 'Efficiency' and 'Effectiveness' items. In addition the element 'Beliefs' was replaced by the 'Attitude toward Using' item and the 'Utilization' element was represented by the 'Use' item. The strength of each presumed association between these items will also be evaluated with help of Kendall's tau_b correlation measure.

Figure 82 TTF Model elements in final framework

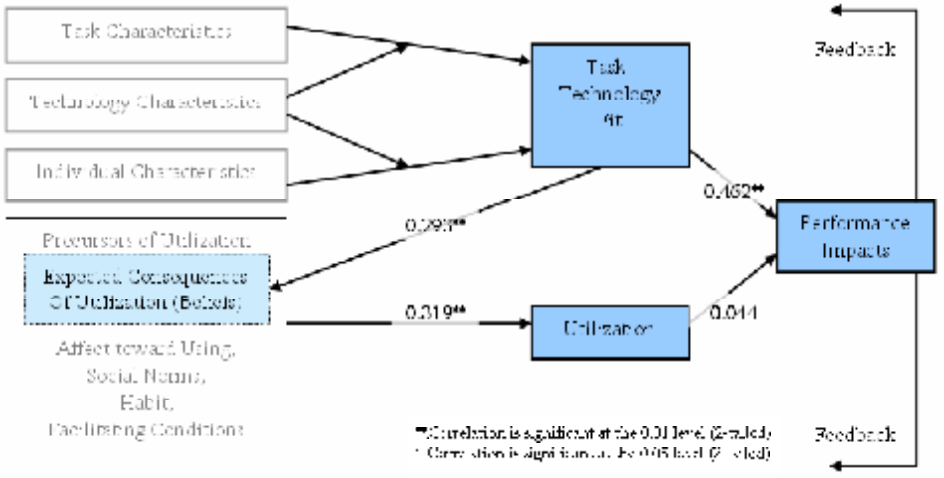

Figure 83 TTF Model with survey measured items correlation coefficients

The correlation table in the Appendix (Table 51) shows the by SPSS computed strengths and significances of all presumed associations. All the correlation coefficient values are added to the TTF model scheme above (Figure 83). Almost all by the model assumed relations or missing relations (i.e. very low insignificant correlation coefficient between 'Task-Technology Fit' and 'Utilization') within the TTF model are confirmed. Except for the link between 'Utilization' and 'Performance Impact', this association appears to be insignificant. Perhaps the way in which 'Performance Impact' is constructed and/or that 'Utilization' is represented by 'Perceived Use' plays an important role here.

It has to be noticed as well that the 'TTF' construct was measured with only one single item (PM Process Support by Software) and 'Performance Impact' was measured by just two items (Efficiency and Effectiveness).

Nevertheless, a higher 'TTF' of PM software can be associated with to an increased behavior to use ('Utilization') the software. And higher TTF is linked with positive 'Performance Impact' (i.e. increased 'Efficiency' and 'Effectiveness') of PM software as well.

Despite the mentioned limitations and the fact that even Goodhue and Thompson (1995) admitted it can be very complex or even impossible to assess the 'TTF' and 'Performance Impact', there are strong indications that TTF model is for the most part applicable within context of PM software.

9.3.4 Evaluating Final Framework

By now most associations between the items of the framework have been studied and both the theoretic models TAM and TTF have been applied to PM software. But the relations that were postulated in the Preliminary and Final Framework (Figures 17 & 44) haven't been analyzed up till now.

For this reason this last section of the Data Analysis Chapter will concentrate purely on studying the presence of associative relations between the three contingency factors 'PM Organization', 'PM Methods' and 'PM Software' and the constructed variable 'PM Software Success'.

First the correlations between all contingency factors and the constructed variable will be computed. For correlation calculations a sufficiently large sample size is assumed, as in all significance tests. Applying chi square to small samples exposes the researcher to an unacceptable rate of Type II errors (Clark-Carter, 2004).

In trying to keep the samples as large as possible in each square, the two variables of the contingency factor 'PM Organization' will be recoded into variables with fewer categories. The organizational 'Size' attributes are recoded in 'small' organizations with less than 100 employees, 'medium' organizations with between 100 and 1.000 employees and 'large' organizations with more than 1.000 employees.

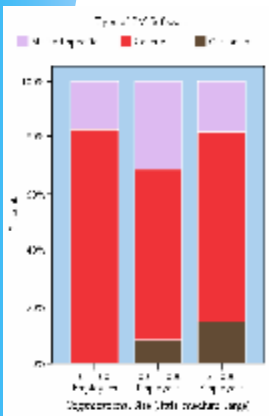

Figure 85: Type of PM Software by organizational size (N=52)

In addition the organizational activity sectors will be recoded in three groups of sectors, which will become 'tangible craft', 'intangible craft' and 'intangible intellect' sectors. This way of differentiating project organizations was suggested by Shenhar and Wideman (1997). The supposed order in these values should represent the ranking of project's product and routine. The distinguishing features of the routine to produce the project's product seem to be governed by craft versus intellect (routine) and tangible versus intangible (product).

The 'tangible-craft' group includes those activity sectors which products are tangible and are the result of craftwork. Examples of such sectors are construction and energy organizations. The 'intangible-craft' group includes the activity sectors which products are intangible and the result of craftwork. The main value of the product is intangible but the effort to accomplish it is effectively routine craftwork. Examples of such activity sectors are the information and communication sector and the financial and insurance activities. The final group, 'intangible intellect' sector includes those activity sectors which products are intangible and the result of intellect work. The main value of the product is in its intangible content and which is the result of intensive intellectual work. Examples of these activity sectors are professional, scientific and technical activities. In the Appendix can be seen which particular activity sectors is assigned to which sector group (Appendix VI, Table 52).

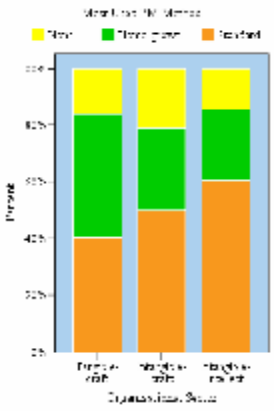

Figure 86: Most used PM Methods by organizational sector (N=52)

Using this rough classification will result in an enormous loss of information and an increased risk of making faulty generalizations. But, when all the activity sectors will be correlated individually, the sample squares would become far too small for calculating significant correlation tests.

Both other contingency factors, 'PM Methods' and 'PM Software' already were recoded earlier (Section 9.1.2) to ordinal variables with both just three values. The 'Availability/kind of PM Method' variable values were ranked on standardization of PM processes. The 'Type of PM Software' variable values were ordered in initial process support.

For the constructed variable 'PM Software Success' the dichotomous variable, as it has been constructed earlier (Section 9.2.3), will be used. This discrete categorical variable has only two possible values ('unsuccessful' and 'successful'). Since a dichotomous variable is the simplest type of nominal variable, the binomial distribution of this variable is thus the simplest type of sampling distribution. Because this dichotomous variable lacks ordering or equal intervals, the Contingency Coefficient, Pearson's C, will be used to evaluate if the presumed associations do exist.

All these recoded variables are demonstrated in a revisited Framework. The correlation table in the Appendix VI (Table 53) shows the by SPSS computed strengths and significances of all presumed associations. All these correlation coefficient values are added to the Revisited PM Software Success Framework scheme on the next page (Figure 86).

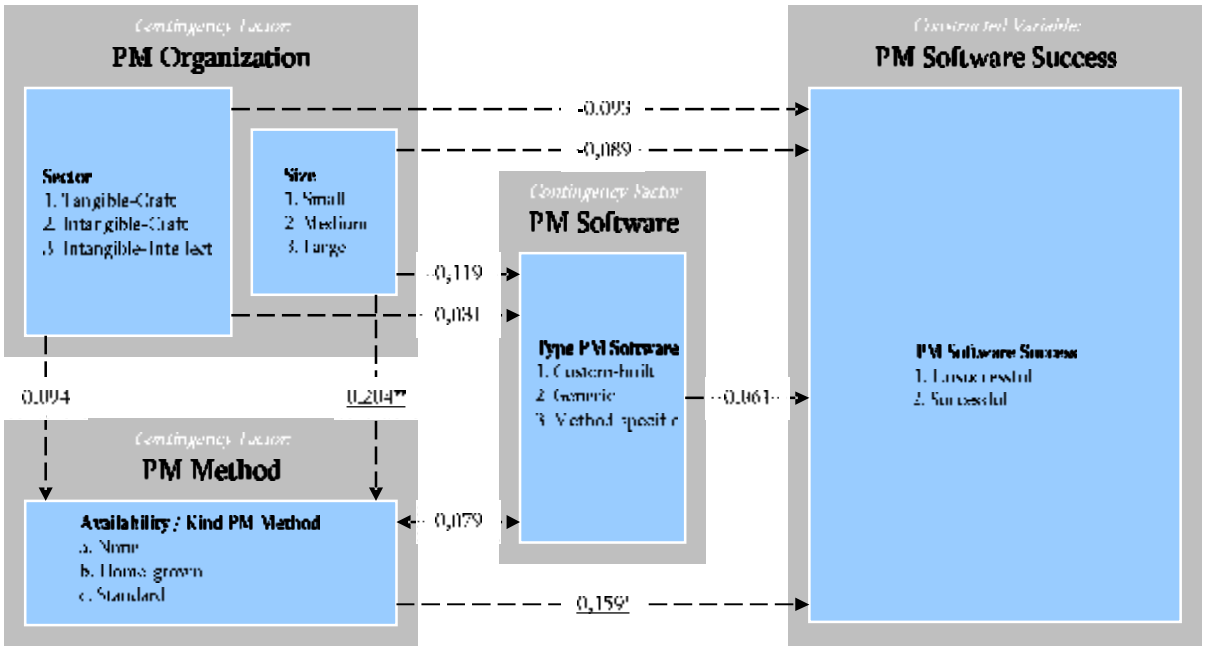

Figure 85 Revisited PM Software Success framework with Correlations

*Correlation is significant at the 0.01 level (2-tailed).
**Correlation is significant at the 0.05 level (2-tailed).

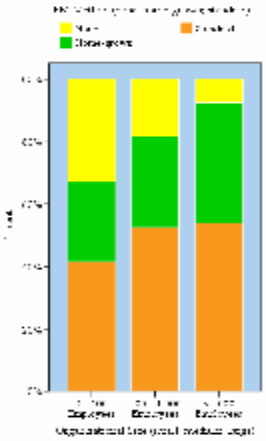

Figure 87 PM Method by organisation size

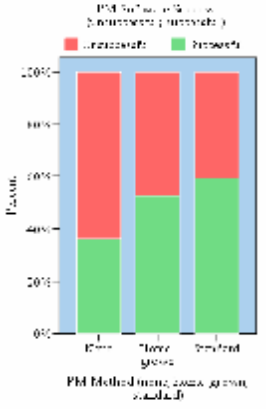

Figure 88 PM Software Success by PM Method

Before the analysis of the Revisited Framework will continue an important matter has to be addressed first. Every arrow in the model represents an assumed association. The causal directions that are suggested by the arrows are purely based on theory and/or face validity. For instance it's imaginable that the size of an organization may result in using a certain type of software. But it's much less obvious that the type of software determines the size of an organization. But as has been stated earlier (Section 1.3.1), this present research is in such a way limited that the objective is not to seek causal relations, but merely to discover associative relations.

The Revisited Framework shows that only two assumed associations are confirmed by the correlations test. The significant positive correlation coefficient (0,204) between the organizational 'Size' and the 'PM Method' variables indicates that large sized organizations often can be associated with formal (i.e. home grown and standard) PM methods. Since both variables have three categories no statements about the exact associations can be made by just studying the correlation coefficients. A cross-tabulation (Appendix VI, Table 54) and a bar chart (Figure 87) will help to reveal the precise association characteristics.

Of the small organizations, with less than 100 employees, 67 percent use a formal PM method. This percentage is 82 percent in medium-sized organizations, with 100-1.000 employees. And even 93 percent of the large organizations, with more than 1.000 employees, use a formal PM method.

The second positive correlation coefficient (0,159) between the 'PM Method' and the 'PM Software Success' variables points out that standard PM methods more frequently can be associated with successful PM software, than when home-grown or no methods are used. Both variables have three categories therefore no exact statements about the precise associations can be made by just evaluating the correlation coefficients. A cross tabulation (Appendix VI, Table 54) and a bar chart (Figure 88) will provide assistance here.

While the discussion about the supposed relation between standard methods and project success is still going on, the results of this current research show a statistic significant correlation between the variables 'PM Method' and 'PM Software Success'. Of the cases in which the most used method is a standard method, 59 percent of the respondents indicate the PM software is considered successful in their organization. If home grown methods are being used this percentage decreases to 53 percent. And finally, when no formal methods are used

the percentage even cascades to 36 percent.

Although the two discovered associations are fascinating, it is little disappointing that not more associations were revealed by the correlation table. Since there was no significant association found between the 'Type of PM Software' and 'PM Software Success' variables, all types of software demonstrate approximately the same success rates (Appendix VI, Figure 55). However, the success rate of each type of software could very well change when the software is being used in a specific (more or less appropriate) situation. For this reason it was decided to search for the possible effects of a third variable.

As has been described previously (Section 4.3.3), method specific PM software is especially designed to support the processes of a particular standard PM method. Therefore it is expected that this type of software will be more frequently successful when standard methods are being used within an organization. Since the 'Availability/kind of PM Method' conditions have been measured by the survey as well, it was decided to see if the correlations between the 'Type of PM Software' and 'PM Software Success' differ within the three different PM method conditions (i.e. no PM method, home-grown PM method and standard PM method).

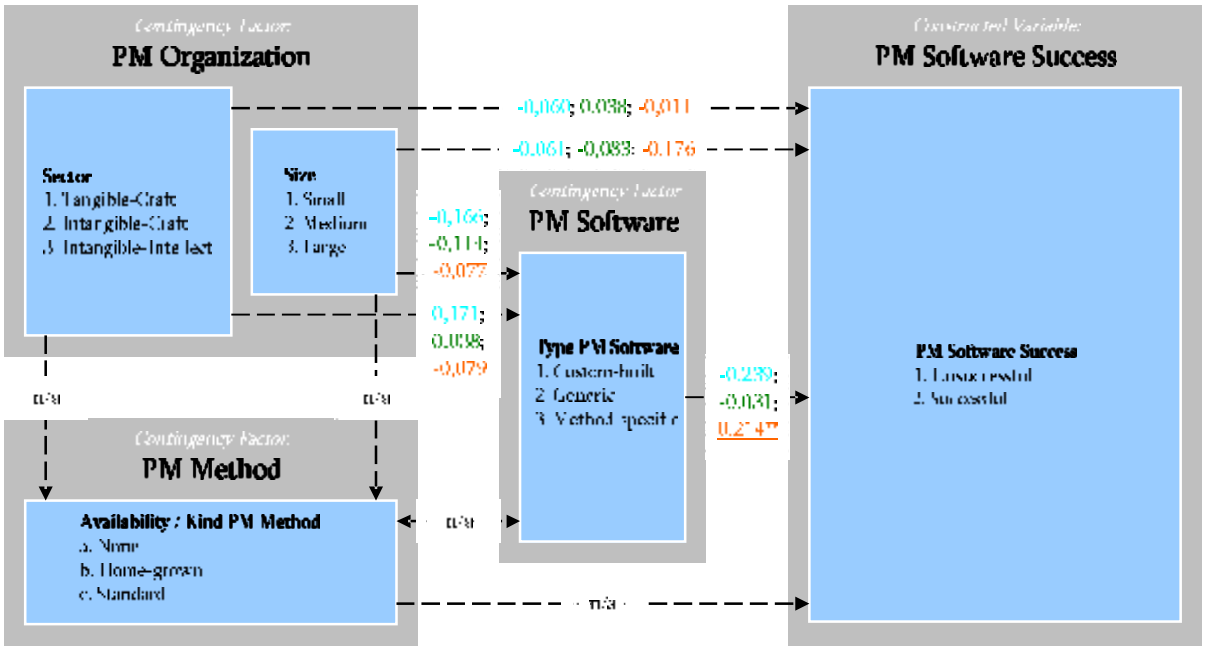

Figure 89: Revisited PM Software Success Framework with Correlations as Values

Turquoise: No PM Method Green: Home-grown PM method
Orange: Standard PM method n/a: Can not be calculated
*Correlation is significant at the 0.01 level (2-tailed)
**Correlation is significant at the 0.05 level (2-tailed)

The scheme of the Revisited Framework above (Figure 89) shows all computed correlation coefficients of all PM method conditions (Appendix VI, Tables 58-60). The turquoise values represent the conditions in which no PM methods were used. The green values represent the home grown PM method condition. And the orange values correspond with the standard PM method condition.

The attention is immediately drawn to the 'standard PM method' condition. In the situation standard methods are being used a significant and positive correlation coefficient appears between the variables 'PM Software' and 'PM Software Success'. Since both these variables include three categories no statements about the exact associations can be made by just studying the correlation coefficients. A cross tabulation (Appendix VI, Table 57) and a bar chart (Figure 90) will demonstrate the precise characteristics of the association.

On the previous page this section already was mentioned that there is a relation between 'PM Methods' and 'PM Software Success' (Figure 88). PM software which is implemented in organizations that work according to standard PM methods is more often being rated success

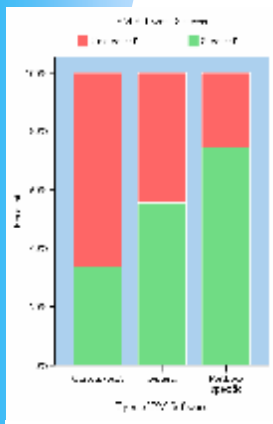

Figure 90: PM Software Success by PM Software in specific organizations

ful, than those which are implemented in organizations that use home-grown or no methods. But this relation even becomes much stronger when organizations, which use standard methods, work with method specific PM software. Then these method specific PM software has an increased success rate of 74 percent. While in this standard PM method situation generic and custom-built PM software are stuck at a success rates of respectively 55 percent and 33 percent (Figure 90). The possible causes that could explain this relation will be discussed later (Paragraph 10.2).

The eventual PM Software Success Framework below (Figure 91) demonstrates all the significant associations that were approved by correlation coefficients. Two of these relations are normal associative relations and one only appears by specification of the test variable 'PM Methods'. The fourth arrow, which remained dotted, seems to be a very weak (insignificant) association. The staggered bar chart (Figure 84) indeed shows that custom built PM systems only appear in medium and large organizations. Hence these systems are far too expensive for small organizations. However the sample of custom built PM systems is so dramatically small the significance level of 0,05 wasn't reached.

All the in this chapter presented analyses will give some impression about how huge the amount of data is that was obtained with the Web survey. Much more analyses could be made, which almost certainly would lead to the exposure of numerous other fascinating patterns. But the objective of this research was to discover important contingency factors of PM software success. As some important contingency factors were found, the next chapter and step in this research will be to discuss these results.

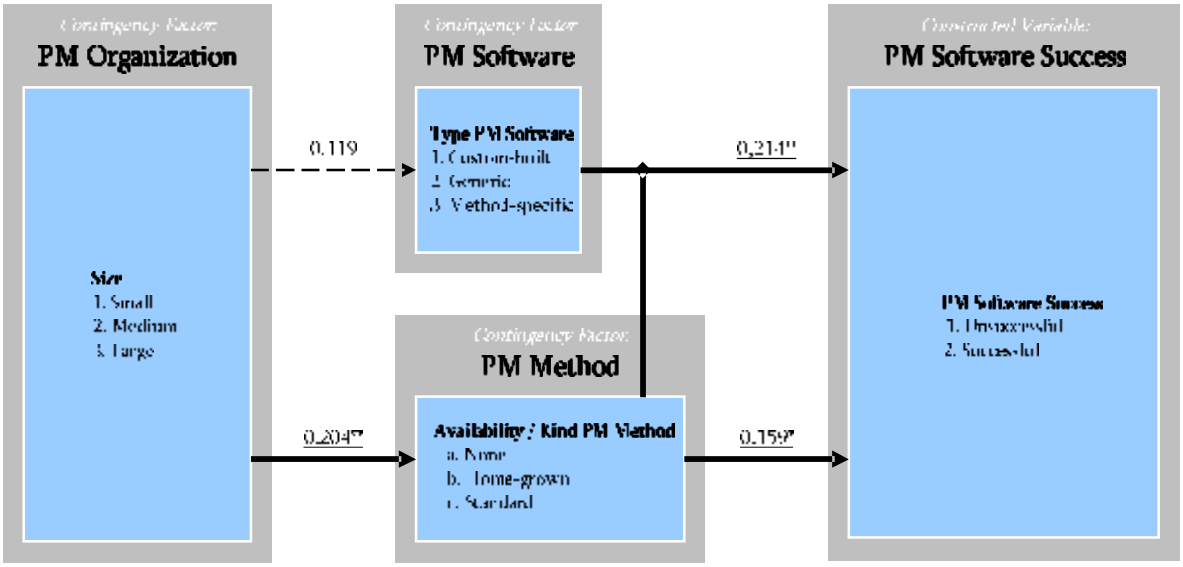

Figure 91: Approved PM Software Success Framework

*Correlation is significant at the 0,01 level. (2-tailed)
* Correlation is significant at the 0,05 level. (2-tailed)

10 Results

In this chapter the main research findings, which originated from the analysis of the data, will be described. Then assumptions will be discussed that could explain some of the findings. Afterwards the restrictions of this research will be underlined. Based on these findings, assumptions and limitations the conclusions will be unfolded, along with answering the central question. This thesis will end with directions for further research and the reflections.

10.1 Main Research Findings

Only the most important findings that resulted from all the numerous analyses in the previous chapter will be summarized in this paragraph.

PM Software is still disappointing to many

Indeed, the findings of this research validate that many project management applications are still being considered unsuccessful. Despite that almost every application includes an overwhelming amount of functions and features, just 53 percent of the respondents reported successful software. For the purpose of this research, this is quite an appealing percentage. Hence these figures show it how crucial the search for contingency factors of project management software success is.

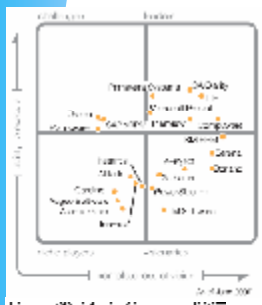

Figure 77: Magic Quadrant 2007
(Source: Gartner 2007)

Often used doesn't equal often successful

As had been anticipated, Microsoft Project is still by far the most used project management software, as it was reported by 36 percent of the respondents. Unfortunately, the majority of MS Project users (51 percent) rated this software as being unsuccessful (Section 9.2.3).

'Magic Quadrant or Bermuda Triangle?

Remarkably the project (portfolio) management software applications that are placed in the 'Leaders' quadrant of the Magic Quadrant 2007 of Gartner (Section 4.3.2 & Appendix VII), is not more often being considered successful (52,9%), than software which has not the honor of being in this 'Leaders' quadrant (53,3%).

Today formal methods rule PM

When it comes to project management methods, these seem well accepted by now. In this current study 82 percent of the respondents indicated that formal methods are being used in their organization. This percentage is quite similar with the frequencies found by other studies (Section 9.1.3). Of the standard methods, PRINCE2 is still leading, followed or a relative distance by PMBOK.

Standards for success

Standard project management methods (e.g. PRINCE2, PMBOK, SCRUM) often tout they increase the chance of projects becoming successful. But there still is no unambiguous empirical evidence for these statements (Section 2.3.8).

Although the discussion about the supposed relation between standard methods and project success keeps going on, the results of this research show that a statistic significant correlation exists between methods and project management software success.

Of the respondents who indicated these methods were used within their organization, 59 percent reported successful project management software. But even more fascinating is, when these respondents indicated they were using so-called method specific software, instead of generic or custom built, the success rate increased even to 74 percent.

Formal PM methods increase with the number of employees

So if you are part of a growing organization, just sit right and let the methods come to you. The data analysis of this study demonstrates that of the small organizations, with less than 50 employees, 69 percent is using formal methods. This percentage is 86 percent in medium-sized organizations, with 500-1000 employees. And even 96 percent of the large organiza-

tions, with more than 10.000 employees, are using a formal PM methods.

Success can be mandated

Is your business not growing and are your project team members reluctant to work with method-specific software? No problem at all, just make the software mandatory, since mandated use environments are associated with much higher success rates (62%) than voluntary ones (38%).

Top management proved to be important, again…

Less surprising, but very important, is top management commitment. Project management software that has the support of top management is successful in 73 percent of the cases.

Interestingly, is that more than a third of the respondents estimated that top management wasn't committed toward the implementation of the software.

Summarizing

The main findings can be recapitulated as follows; project management applications at their best should be method-specific, are admired by top management and should be used under mandated conditions within organizations that are using standard methods as well. Applications in these ideal situations turn out to be successful in 90 percent of the cases! (Figure 93)

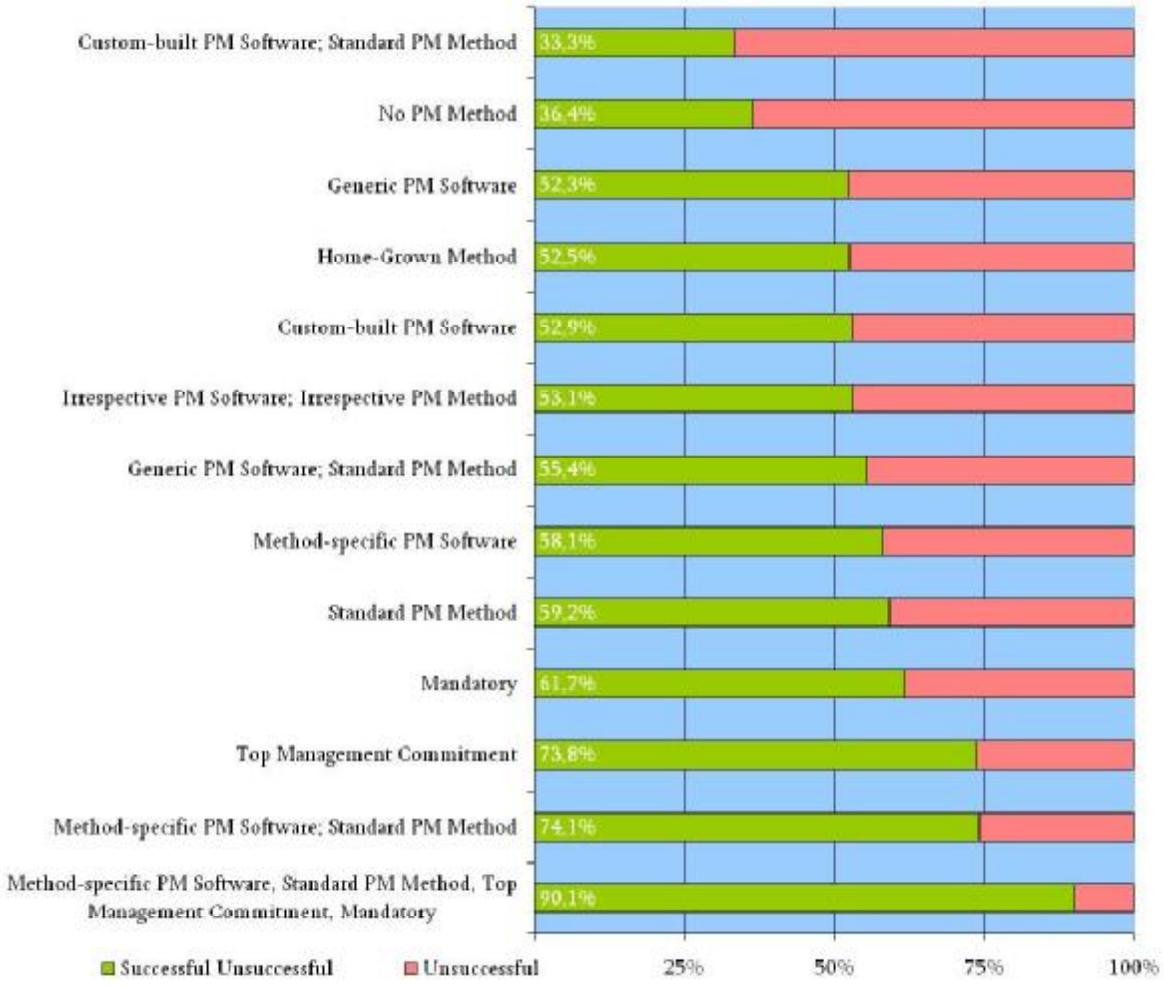

Figure 93 Various conditions (IT) software with accompanying success rates

10.2 Assumptions

There could be numerous causes that explain the relative high success rate of method-specific software within organizations that use standard PM methods. With help of the data that was collected during this research several explanations can be made quite reasonable

A first plausible cause could be that implementation trajectories of method-specific PM software often are relative short and inexpensive. Method-specific software (almost) doesn't need to be configured; hence the PM processes were already in place. As a result the process fit, implementation time and implementation costs of method specific PM software should score more often as expected or better if compared to generic software.

This first assumption is founded by the research results. The fit between the PM processes and the support of method specific software scores according 90 percent of the respondents as expected or even better, while this 55 percent in case of generic software. Also it appears that the implementation time of method-specific software is according to 70 percent of the respondents as expected or better, whereas this is 59 percent with generic software. However, the difference between the implementation costs is much less apparent, to be precise 63 percent for method specific software and 60 percent for generic software. Perhaps this modest difference can be explained by the difference in perception of what implementation costs overruns can be seen as acceptable. Overruns in implementations costs with the so called 'off the shelve' method specific software probably are less acceptable than with the more intensive to implement generic software.

A second possible motive for the high success rate of method specific software, within organizations that use standard methods, could be the increased chance of acceptation by the users. The users, who are already familiar with a certain standard method, will recognize the embedded process support probably immediately. This motive could be made convincible if the measures of 'willingness of the respondents toward using the software', the 'Perceived Usefulness of the Functions/Features' and the 'Ease of Use' of specific-method software are compared with those of generic software. It appears indeed that all these facets are considered as more successful with method specific software (70%, 78% and 67%) then with generic software (42%, 69% and 37%).

As a last explanation for the high success percentage, of method specific software within organizations that use standard methods, could be given the 'consensus of opinion'. In 79% of the cases top management supports the most used formal method. Therefore it is likely that PM software which is specifically built to support this method can count on more management commitment than software which isn't. The data reflects this postulation. Method specific software can count on management commitment in 69% of the cases, while this percentage is just 41% with generic software. As been made clear by several studies (e.g. Holland et al., 1999; Schmidt et al., 2001), this management involvement has in its turn a very positive influence on the successful implementation of software.

10.3 Limitations

Before discussing the implications of this work, it is appropriate to mention its limitations. This study relied on people working in the PM field, it was not restricted to project managers. The data involved self reported measures, not actual measures, concerning PM software.

External Validity

The external validity of an instrument is the extent to which answers based on the observations correctly can be generalized to other unobserved situations (Russ-Eft, 2005).

In the sample selection of this study was the activity sector 'information and communication' almost certainly over represented. Consequently, the use of standard methods which are relative often used in this sector is probably over represented.

Internal Validity

Another limitation of this study is the possibility the internal validity suffer by the two language versions of the survey. It was decided to conduct the survey in English and Dutch

because in this way more respondents would be reached. Even though both versions were compared and evaluated by a professional translator, the possibility of small varying interpretations between the two language versions never can be ruled out. Especially since Brislin (1970) recommended that an instrument should be back translated at least three times, each time by a different translator. As there was only one professional translator, free of costs, available this recommendation was not met. Consequently the verification and adequacy of the translation between both language versions of the instrument is not as optimal as could be when the back translation technique had been used more strictly.

It has to be mentioned as well that some of the variables were measured with just one single item. Since it was tried to keep the survey as short as possible, in order to increase the number of respondents. But consequently the risk of measuring errors was increased enormously by this choice.

Generalizability

Finally, this study focuses on limited countries as the questionnaire was only available in English and Dutch. Therefore it is difficult to know the extent to which the findings can be generalized to other countries throughout the world.

In addition it has to be highlighted that this research did not reveal or tested causalities between variables. This research had been given a more explorative character because of the earlier mentioned constraints (Section 1.4.2). The ambition level was adjusted to the studying of merely associative relations.

10.4 Conclusions

With these having limitations clear in mind, it's now the right time to go back to what started this research and see if the central question which was posted at the beginning can be answered. The central question was:

"What are important contingency factors of project management software success and how can this success be measured?"

To start with last part of the question, the measuring was done with the help of the widely recognized DeLone and McLean's Information System Success Model and two additional technology adoption models. Based on these models an extensive measuring tool in the shape of a Web survey was developed. With this tool the variable 'Project Management Software Success' could be assessed in a comprehensive and reliable way. Consequently this last part of the question seems rather satisfied answered.

The first part of the central question is somewhat more difficult to answer. Only a few of the assumed factors proved to be significantly associated with PM software success, other studied factors, such as PM software use, only resulted in more questions.

Hopefully the obtained insights, the findings and even the question marks that resulted by this research may be of value to both IS researchers and PM practitioners. Practitioners should be made aware of the frequently failing PM software. But with any luck the factors that positively can be associated with PM software success will be brought under their attention. Further may the questions that were left unanswered, encourage IS researchers to continue to direct attention towards understanding the context of PM Software Success and use.

10.5 Recommendations

First choose an appropriate PM method, preferable are standard methods, as was judged by the analysis, and then select a PM application that supports this method.

I would like to refer by analogy told by Martin. Martin is the president of the Georgia PMI Chapter. He compared PM methods with the condition of a football team and PM software with the equipment and training facilities. *"Consider a football team that is given equipment and training facilities that are far superior to those of any of their opponents. Still, just*

because they have the best equipment or facilities it doesn't automatically make them the best in their league, nor does it correlate to success. Unless a team first establishes the processes, methodologies, and discipline for practicing and working out consistently as a team, it doesn't matter whether the equipment is the state of the art or an antique. The result will probably be poor." (Martin, 2000)

This analogy applies to organizations that believe that simply buying sophisticated PM software will help them manage their projects better. According to Martin this can't be further from the truth. In fact, if a consistent method and processes aren't in place first, then the tools are nothing more than an attempt to hide poor PM processes.

The results of this present research indeed seem to support this idea. Organizations that use PM methods (home grown or standard) consider the available PM software more often successful than organizations which do not use PM methods.

Besides the method and a supportive PM application, strict agreements about the use, consider them as game rules (when keeping the football team story in mind) and a motivated team captain should increase the chance of successful PM software.

10.6 Directions Future Research

One feature that distinguishes this study from previous research is that a newly developed systematic indication, based on earlier research, of what the most important factors of IS success are from the perspective of practicing project managers. Thus the results reported here provide a useful foundation for other researchers seeking to improve our empirical understanding of IS success and in particular PM systems.

The list of influence factors identified in this study provides an excellent baseline for future researchers who wish to investigate PM Software Success. The reliability test showed enough evidence that these factors contributed to the success. More in depth analysis of specific influence factors could be fascinating. Questions could for instance be: "What are the countermeasures that project managers can employ against the lack of top management support toward PM software?" and "Which of these are deemed most effective, and why?" But also the found relation between 'mandatory use' and 'success rate' could be intriguing to analyze more advanced. Certainly, since it became obvious that this research demonstrates correlations in mandated environments that are partly divergent from the ones measured by Brown et al. (2002).

Another interesting angle for future research will be to extend this study by examining perceptions of PM Software Success from the point of view of other stakeholders, such as top management and PM software vendors. It is quite possible that different stakeholders will have opposing opinions regarding what the important critical success factors of PM software are (Boonstra, 2006). Also the extent to which these perceptions of PM Software Success change over time could be examined. Markus et al., (2000) concluded the different measures of success are common during a system implementation process.

The study also breaks new ground in providing systematic evidence that the success of PM software is affected by the availability and kind of PM methods. Combined with certain types of software this relation even becomes much stronger. Based on this evidence, I believe that cultural and individual elements which determine the use of certain kinds of methods further could be investigated. Similarly, the frequency of formal PM methods seems to vary across activity sectors, thus affecting their recognition and ranking. Probably this also influences the success of PM software in each sector. This evidently calls for model development and empirical studies that would seek to account for observed variation in PM methods and rankings due to cultural, individual and sector specific factors.

A next logical step in researching PM software should be a longitudinal study, which might reveal causal relations between the variables of this framework.

10.7 Reflections

In this final paragraph some reflections on the research project will be given. This is needed because the research was not performed as it should be. Indeed this paper is setup very

thoroughly and probably is much more extensive than the average master thesis. However it took about fourteen months, instead of the usual six months to finish it. And still this thesis is not at the highest quality.

The main reasons for these shortcomings are that a relative long period of time was spent to determine the exact scope and research method, a miracle was born on December 23rd, the enormous extra amount of time that was spent for writing in English and the framework, which was clearly set up too extensive. In the three sections of this paragraph each of these subjects will be clarified.

10.7.1 Cooperation

Overall the cooperation went well. The informal atmosphere, the mutual understanding and constructive discussions between the principal and supervisors, I really appreciated.

Though during the first months the research progressed relatively slow, since the proposed research objectives, method and action plan were changed several times. It took a considerable amount of time to get the scope clear. Here I probably should have taken additional initiative to bring all parties together more often, instead of wandering off all by myself for too long.

Another point of improvement should be the handing in of my provisional work in time. I admire the patience of the supervisors, as they sometimes only had few hours to read all my new writings. Many times my estimations about the time needed to finish a certain part of the work were completely mistaken. Writing this complete paper in English truly took much more time than I had estimated on before hand. Almost continuously I visited translation Web sites, searching for the right words and expressions. Disregard of this effort of writing in English some other factors made the period of time I have been working on this thesis quite long as well. The next section will describe roughly how the time was spent and why it took this long.

10.7.2 Time Schedule

The total time that has been spent at this research was approximately 14 months. This lengthy period was partly caused by that I had a job for 20 hours a week besides working on this thesis, since I already had used my study allowance. Further in this period a holiday break and the birth of my son were included. Even with taking these 'pauses' in consideration the time spend was much longer than the normally required six months. This paragraph will, in headlines, describe how the time was spent and why it took considerable longer than six months to complete this research.

In March 2007 the research was started by exploring literature and by determining what the objectives would be. The objectives and research methods were several times changed until the committee and I were satisfied.

Figure 94 Veiligheidsregio Zuid-Limburg, Sittard-Geleen, Netherlands

In April I presented the action plan and a concept of the paper's structure to my Master class. Also the scope of the research was set tighter and additional literature was gathered and explored.

During May numerous books and articles about quantitative research and about survey building were read. Also various Web sites that provided online surveys were compared. Subsequent some pilot surveys were built for practicing purposes.

In June the eventual versions of the Web survey were built. A professional translator was chartered to evaluate both language versions of the invitation and questionnaire on consistency. Then in the beginning of July, just before the vacation period started, the first Web surveys came online.

Early August, the first completed surveys were administered. At this time also a start was made with the writing of the context and theory chapters. At the end of August extra actions were taken, such as the random inviting of project managers and placing invitations on additional online PM forums, in trying to increase the number of respondents.

In the second week of October I decided the retrieved number of surveys was satisfying enough. After the surveys were put offline, the data was evaluated and roughly analyzed. The

first results seemed promising.

Throughout November and the first half of December the data set was analyzed more profoundly, and at the end of December the preliminary findings were presented to Fortes. Until this presentation I worked for 40 hours a week on this thesis at the office of Fortes, after December I continued my work from my desk at home.

On the December the 23rd my son was born in the hospital. In the first two months after his birth the research was given a low profile.

In March and April the research was fully resumed. In these months the chapters about the development of the survey, the data processing, analysis and the results were written. In addition all former written parts were reviewed. In order to make sure all chapters contributed to a central story line many adjustments were continuously made. The commentary and suggestions by the supervisors led as well to numerous improvements. Besides working on this paper also a presentation about PM software was prepared.

In May the remaining parts, such as the management summary, acknowledgements, discussion and reflections were written. As well all the references of books, articles, Web sites etc. were added. After most parts were completed it took quite some time to compose them into one thesis paper. In the last week of May the layout was finished.

In the first week of June the paper was for the last time checked on spelling and grammar errors. Despite all these checks it's most likely this paper still includes many errors. I only can hope future readers will understand that I tried my best in eliminating them. Finally the pages were ready to print out and to book bind.

10.7.3 Substantive Result

Looking back now, I am satisfied about the work I have completed, despites the in advance mentioned flaws. I am especially contented because the central question, which was posed at the start of this research, has been answered. Furthermore I believe that a very important objective, the results of this study should be valuable for several parties (Section 1.3.1), has been accomplished too.

The research findings may be important to both practitioners and science. Since the survey's participants will receive the research findings. These findings reveal what kind of PM software, considered the contingencies, is most frequently successful. These results in addition already have been useful for the company that facilitated this research. They published some of these findings.

Besides these practical significances, I think this research is a good starting point for future research. As it gives an extensive and up to date overview of many important writings about PM and IS success. And lastly this empirical exploration indicates that theoretical concepts, such as the IS Success model of Delone and McLean (1992) Davis' TAM (1986) and TTF of Goodhue and Thompson (1995), probably can be applied in the context of PM software as well.

I want to end this thesis by referring to the opening citation: "Success is not final, failure is not fatal: it is the courage to continue that counts (Winston Churchill)." You were right Churchill. At last by proceeding with studying, first Architecture and presently Business Administration, my life as a student will soon come to an end. Looking back in hindsight and knowing what I know now, there are many things I would have done differently in the past. But I have never regretted for a moment all nice people I have met and all the fascinating things I have learnt during my fourteen years of studying. The real die hards may proceed from this point on with flipping through the References and Appendixes. I myself stop here.

References

The references have been categorized in four groups of sources. The first group includes all printed sources such as articles, books, doctoral dissertations, government publications, pamphlets and brochures. The second group contains all used internet sites. The third group lists the Web sites of PM software providers. The fourth group lists all the applications that were used for accomplishing this research. Alas, no PM software was used to protect the objectivity of the researcher.

Since in the business science discipline the most influential writing and documentation style is that of the American Psychological Association (APA), this style was also used here. Consequently all the lists are alphabetized by author or for any anonymous works by institute or title.

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Web Sites of PM Software Providers

4c. 4c Systems. http://www.4csystems.co.uk
AMS REALTIME Projects, Advanced Management Solutions. http://www.amsrealtime.com
Artemis, Artemis International Solutions Corporation. http://www.aisc.com
AtTask, AtTask Enterprise. http://www.attask.com
Augeo, Augeo Software. http://www.augeo.com
Baan / SSA Global. http://www.ssaglobal.com
BugBox, IT Governance. http://www.bugbox.biz
cc Mpulse, Spherical Angle. http://www.sphericalangle.com
Changepoint, Compuware. http://www.compuware.com
Clarity / Niku, CA. http://www.ca.com/nl
Custom Solutions. Exact http://www.exact.nl
dotProject, The Open Source Project Management Tool. http://www.dotproject.net
Easy Projects .NET, Logic Software. http://www.easyprojects.net
eSAY Solutions. http://www.esay-solutions.co.uk

e-Synergy (e-Project), Exact. http://www.exactsoftware.com
GanttProject, SourceForge.net. http://ganttproject.biz
Huon IT, http://www.huonit.com
Hydra. Project Management Group (PMG). http://www.pm-group.com
i-method, Interactive methodologies. http://i-methods.co.uk
Lotus Software, IBM. http://www-306.ibm.com/software/lotus
Maconomy Resource Planning, Maconomy Enterprise. http://www.maconomy.com
Microsoft Project, Microsoft. http://office.microsoft.com/en-us/project/FX100487771033.aspx
MPMM, Method123. http://www.mpmm.com
OmniPlan, The Omni Group. http://www.omnigroup.com
One Fox. http://www.onefox.nl
Open Plan, Deltek. http://www.deltek.com
Open Workbench, SourceForge. http://www.openworkbench.org
OPX2 / Planisware 5, Planisware. http://www.planisware.com
P2.net, Concerto Support Services. http://www.concertosupport.co.uk
PeopleSoft Enterprise Service Automation (ESA), Oracle Enterprise. http://www.oracle.com
Planview, Planview Enterprise. http://www.planview.com
PM tool based on MS Access / Excel / Sharepoint, Microsoft. http://www.microsoft.com/en
PMO Tool, EDS. http://www.eds.com
Powerproject, Asta. http://www.powerproject.nl
Primavera, Primavera Systems. http://www.primavera.com
Principal Toolbox, Fortes Solutions. http://www.principaltoolbox.com/en
PROJECT in a box, Prosia Solutions. http://www.projectinabox.org.uk
PROJECT Insight. Metafuse. http://www.projectinsight.net
Project InVision, Project InVision International (PII). http://www.projectinvision.com
Project Management Jetpack, Mindjet. http://www.mindjet.com
Projectplace. Projectplace international. http://www.projectplace.com/en
ProjectProgress, Project Progress Limited. http://www.projectprogress.com
PSNext. Seiforma. http://www.seiforma.com
PTS Software. http://www.pts.nl
RPM, IBM. http://www-306.ibm.com/software/awdtools/portfolio
Share Lock, DataLeaf ICT. http://www.sharelock.nl
Software Engineering, Centric. http://www.centric.nl
Suite Cardinis, Cardinis Solutions. http://www.cardinis.com
Time Control, Heuristic Management Systems (HMS). http://www.timecontrol.com
Trac Project, Edgewall Software. http://trac.edgewall.org
VAE, Magenta Technology. http://www.magenta-technology.com
VakWare, Admicom Software. http://www.admicom.nl
VersionOne, VersionOne. http://www.versionone.com
xRPM / xPD, SAP. http://www.sap.com

Used Applications

Microsoft Office Word 2003
Microsoft Office Excel 2003
Microsoft Paint version 5.1
Microsoft Office Publisher 2003
MGI PhotoSuite version 4
SPSS 14 for Windows
SPSS 15 for Windows
Adobe Reader version 8
Adobe Writer version 8
Zapgrab Version 2
Thesis Tools Online Survey Builder

Appendixes

In the Appendixes are those documents included that were part of the research but were left out of the main text. The 1st appendix contains four different versions of the questionnaire. In the 2nd appendix the different invitations to the survey and some commentary on the survey are enclosed. Appendix 3 contains brief descriptions of most well known standard PM methods. The 4th appendix lists all the method specific PM software vendors that were found by the survey. Appendix 5 includes additional texts and explanations about the research method and report structure. The 6th appendix contains supplementary charts and tables that were outputted by SPSS. Finally, Appendix 7 encloses additional figures of theoretical models and charts by writing and studies of other authors.

1 Questionnaires

This 1st appendix includes four different versions of the survey. Each version represents a different phase in the design process. The initial concept version demonstrates the first efforts of trying to construct a questionnaire. The second coding version was based on the eventual theoretical framework as was described in Chapter 6. Then the final English online version illustrates how the survey looked published on the Web. Finally the fourth version shows the Dutch version, which was translated from the English edition.

Questionnaire Version 1 Initial Concept Version

This version was the earliest attempt. It covered almost all the elements of the chosen scientific models. Although it had became too extensive, the survey had to be easy accessible, it provided a neat overview of many important variables and it helped becoming familiar with building surveys.

General Information about Organization

1. In which industry sector is your organization operating?
   [list of sectors
2. In which country are the headquarters of your organization located?
   [list of countries
3. In which country do you work?
   [list of countries]
4. How many employees does your organization count?
   0-50
   50-100
   100-250
   250-500
   500-1.000
   1.000-2.500
   2.500-5.000
   5.000-10.000
   >10.000
5. What is your function?
   Corporate manager
   Project board executive
   Project manager
   Senior project member
   Junior project member

Project Management Method

6. What kind of projects do you run?
   Technical projects (new buildings, IT, engineering, systems etc)
   Organizational change projects (fusions, cooperation bonds etc)
   Business development projects (new business activities)

7. What is the average project budget?
   <75.000
   75.000 1.500.000
   1.500.000 3.000.000
   3.000.000 10.000.000
   >10.000.000

8. Does your organization use a project management method (this can be an in-house invented or standard method)?
   No, we are not using a project management method.
   Yes, we use an in-house invented method.
   Yes, we use a combination of an in-house invented method and a standard management method, like Prince2 and MSP.
   Yes, we are working according almost all the prescriptions of a standard project management method, like Prince2 and MSP.

9. Which of the following standard project management methods does your organization use?
   [list of standard PM methods

Project Management Software

10. Does your organization use project management software?
    No
    Yes, one program
    Yes, more than one program

11. How many project management programs does our organization use?
    [number]

12. For how many programs are you prepared to fill in this questionnaire? (costs about 5 minutes per program)
    [number]

13. What is the name of the project management software our organization is using?
    [name

14. Do you think this project management software, on the whole, is rated as a success within your organization?
    Yes
    No
    I don't know

15. Do you work with the software?
    Yes
    No

16. Since when does your organization use this software?
    - Shorter than half year
    - Between half year and year
    - Between year and three years
    - Longer than three years
    - I don't know

17. How was the top management commitment during the implementation trajectory of the software?
    - No commitment at all
    - Little commitment
    - Average commitment
    - Strong commitment
    - Very strong commitment
    - I don't know

18. Did you advocate the use of project management software before it was implemented? (RELEVANCE)
    - Yes, very much
    - Yes
    - Neutral
    - No

19. Is the software still being updated?
    - Yes
    - No
    - I don't know

20. How many employees are using the project management software?
    - < 5 employees
    - 5-25 employees
    - 25-100 employees
    - 100-250 employees
    - 500-1.000 employees
    - 1.000-2.500 employees
    - >2.500 employees

21. How do you estimate what was the ratio between configuration and license costs, when the software was implemented?
    - The configuration costs were less than 25% of the license costs.
    - The configuration costs were between 25% and 75% of the license costs.
    - All the costs were developing costs.
    - I am unable to give estimation about the ratio between the configuration and license costs.

22. How long did the implementation trajectory (time between signing the contract and actual use of the software) last?
    - Less than a month
    - Between a month and a half year
    - Longer than a half year

23. The software we use is:
    - Packaged software, nothing was changed to match our business processes.
    - Packaged software, it only required some minor tweaking when it was imple

mented.
Custom, it was specially built for our organization.
Hybrid, after the software was purchased a substantial part of it was tailored to suit our business processes.
I don't know.

Successfulness of the Project Management Software

Please score the software on the following items.
1 point = very bad
2 points = bad
3 points = insufficient
4 points = sufficient
5 points = good
6 points = excellent
0 points = have no opinion

System Quality (SQ) (MEANS)

24. The usability (ease with which a user can learn to operate, prepare inputs for, and interpret outputs) of the software is:

25. The response time (performance) of the software is:

26. The ability of the software to do the work for which it was intended (functionality) is:

27. The reliability (system is up and running correctly) of the software is:

28. The flexibility (changing ways of working) of the software is:

29. The ease with which the software can be modified to correct faults, improve performance or adapt to a changed environment (maintainability) is:

30. The way the software can integrate with other software is:

Information Quality (IQ) (INFORMATION)

31. The accuracy (truthful reflection of the real world) of the information that is provided by the software is:

32. The completeness (fullness in which the real world is reflected) of the information that is provided by the software is:

33. The timeliness (degree of actuality) of the information that is provided by the software is:

34. The preciseness (amount of details) of the information that is provided by the software is:

35. The verifiability (way it can be tested) of the information provided by the software is

36. The relevance of the information that is provided by the software is:

Service Quality (SQ) (MEANS)

Tangibles

37. The appearance of physical facilities, equipment (e.g. manuals) and personnel (e.g. instructors, consultants) is.

Reliability

38. The ability to perform the promised service consistently and accurately is:

Responsiveness

39. The willingness to help customers and provide prompt service is:

Assurance

40. The knowledge and courtesy of employees and their ability to inspire trust and confidence is:

Empathy

41. Providing caring and individualized attention to customers is:

System Use (U)

42. The use of the project management software is:
    Mandatory
    Voluntary
    I don't know

43. The software is being used as intended for [answer] % of the full functionality of the system.

44. The software is used by [answer] % of the planned users.

User Satisfaction (US) (ATTITUDE)

45. Are you satisfied with the project management software (Doll, 1988)?
    Yes
    No

46. How adequately do you feel the software meets the information processing needs of your area of responsibility (Ives, 1983)?
    Very well
    Adequately
    Marginally
    Poorly

47. How adequately do you feel the software meets the needs of the broader class of users it serves?
    Very well
    Adequately
    Marginally
    Poorly

Project management software can be judged on two criteria: efficiency and effectiveness.
Efficiency deals with how well it does what it does. Are reports on time? Are projects developed within budget?

Effectiveness takes a broader focus. Is it doing the right things? Are critical 'life-blood' project management processes supported? Does it really help managing projects?

48. How efficient do you feel the project management software is?
    Very efficient
    Fairly efficient
    Somewhat inefficient
    Very inefficient

49. How effective do you feel the project management software is?
    Very effective
    Fairly effective
    Somewhat ineffective
    Very ineffective

Individual Impact (II) (MEANS)

Task productivity (Torkzadeh, 1999)

50. The project management software saves me time (for example with automated report ing):
    I strongly disagree
    I disagree
    I agree
    I strongly agree

51. This application increases my productivity.

52. This application improves the quality of my work.

53. This software gives me a clearer view of the total context to which my work contrib utes.

Task innovation

54. This application helps me with new ways to improve my job performance.

Customer satisfaction

55. This software helps me meet (internal and external) customer needs

Management control

56. This software helps management to control the project management process.

Organizational Impact (OI) (MEANS)

Business processes

57. The project management software changed the way the organization conducts business.
    No
    Yes, little impact
    Yes, big impact

58. The project management software helps the organization to change its business processes and thereby create competitive advantage or reduce the existing advantage of its competitors
    No
    Yes, little impact
    Yes, big impact

59. The amount of processes the organization wanted to be improved by the software was (PROCESSES):
    Far too ambitious
    Too ambitious
    Exact right
    Too easy
    Far too easy

60. At this moment the software supports the processes that it was intended to before the implementation:
    not at all
    worse than intended
    as intended
    better than intended

61. At this moment the project management software supports the processes that belong to the project management methodology our organization uses:
    not at all
    worse than intended
    as intended
    better than intended

62. Overall, does the software support the project management methodology processes adequate (PROCESSES)?
    No, not at all
    Yes, but not adequate enough
    Yes, but just adequate enough
    Yes, very well

Organizational learning

63. The project management software helps the organization to mature its project management.
    No, not at all
    Yes, but not adequate enough
    Yes, but just adequate enough
    Yes, very well

64. The project management software helps to increase working according the project management methodology (can be an in house invented or standard methodology).
    No, not at all
    Yes, but not adequate enough
    Yes, but just adequate enough
    Yes, very well

Questionnaire Version 2– English Coding Version

This version was used to build the online version of the survey. It includes the headers, the instructions, the different routing sequences and all the predefined answers.

Page 1

"Questionnaire about Project Portfolio Management Software"

Total number of questions: 20

3 QUESTIONS ABOUT YOUR ORGANIZATION

Activity Sector

1. In which economic activity sector does your organization operate?
   a) Agriculture, forestry and fishing
   b) Mining and quarrying
   c) Manufacturing
   d) Energy
   e) Construction
   f) Wholesale and retail trade
   g) Transportation and storage
   h) Accommodation and food service activities
   i) Information and communication
   j) Financial and insurance activities
   k) Real estate activities
   l) Professional, scientific and technical activities
   m) Administrative and support service activities
   n) Public administration and defense
   o) Education
   p) Human health and social work activities
   q) Other, [open answer field]

Organizational Size

2. How many employees does your organization count?
   a) 0-50
   b) 50-100
   c) 100-250
   d) 250-500
   e) 500-1.000
   f) 1.000-2.500
   g) 2.500-10.000
   h) >10.000

Availability/Kind of Project Management Methods

3. Does your project organization work according to one or more project management methods, and if yes what is the name of the (most used) method?
   a) No > page 2
   b) I don't know > page 2
   c) Yes, a home-grown methodology -> page 3
   d) Yes, PRINCE2 > page 3
   e) Yes, MSP > page 3
   f) Yes, PMBOK > page 3
   g) Yes, RUP > page 3
   h) Yes, DSDM > page 3

i) Yes, CCPM > page 3
j) Yes, IPMA > page 3
k) Yes, other (please specify) [open answer field] > page 3

Page 2

4. Does top management in your organization have a positive attitude toward the future use of a certain project management method?

a) No > page 5
b) I don't know > page 5
c) Yes, (please specify which method) [open answer field] > page 5

Page 3

Top Management Commitment

5. Does top management in your organization have a positive attitude toward this method?

a) Yes
b) I don't know
c) No, they prefer (please specify which method) [open answer field]

6. Could you estimate roughly what proportion of all the projects within your organization are run according the prescribed procedures, processes and documentations of this (most used) method?

a) 0-25% -> page 4
b) 25-50% > page 4
c) 50-75% > page 4
d) 75-100% > page 4
e) No idea -> page 4

Page 4

Tendency

7. The importance of this method within your project organization is:

a) Strongly decreasing
b) Decreasing
c) Little decreasing
d) Neutral
e) Little increasing
f) Increasing
g) Strongly increasing
h) No idea

Attitude

8. What do you think about working with this method in your project organization?

a) Very negative > page 5
b) Negative > page 5
c) Little negative > page 5
d) Neutral > page 5
e) Little positive -> page 5
f) Positive > page 5
g) Very positive > page 5
h) No opinion > page 5

Page 5

1 QUESTION CONCERNING THE PPM SOFTWARE

Availability of Project Management Software

9. Is project management and/or project portfolio management software available within your organization, and if yes which one is the most obvious for use?

Note: Only a single answer is possible. If you want to fill in this questionnaire for more than one project management and/or project portfolio management tool you can use the hyper link which led you here again.

a) No, project management and/or project portfolio
b) management software is not available > page 6
c) I don't know > page 12
d) Yes, Artemis > page 7
e) Yes, Augeo > page 7
f) Yes, CA Clarity / Niku > page 7
g) Yes, Open Plan (Deltek) > page 7
h) Yes, i-method (Interactive Methodologies) > page 7
i) Yes, Microsoft Project -> page 7
j) Yes, OPX2 (Planisware) -> page 7
k) Yes, PlanView > page 7
l) Yes, Primavera > page 7
m) Yes, Principal Toolbox (Fortes Solutions) > page 7
n) Yes, PROJECT in a box -> page 7
o) Yes, Projectplace > page 7
p) Yes, xRPM and/or xPD (SAP) -> page 7
q) Yes, a tool based on Microsoft Access
r) Excel / SharePoint (could be made by yourself) > page 7
s) Yes, other software (please specify) [open answer field] > page 7

Note: In all the following questions PPM software refers to the project management and/or project management portfolio management software which you responded in the previous question.

Page 6

Reason Absence PPM Software

10. What is, in your opinion, the main reason for the lack of project management software and/or project portfolio management software within your organization?

a) I have no idea > page 12
b) The project organization is too small > page 12
c) Previous bad experience of PPM software > page 12
d) Other reason, (please describe) [open answer field] > page 12

Page 7

5 QUESTIONS CONCERNING THE PPM SOFTWARE (CONTINUED)

Kind of PPM Software

11. Which description best fits this PPM software?

a) Purpose built software: The processes belonging to a specific methodology were already in place. Only small adjustments were needed during the implementation.

b) Generic software: The standard software, with loads of functionality, had to be configured to fit the processes of our project organization, before it could be used.
c) Custom built software: The software was programmed exclusively for our organization.
d) Other, (please describe) [open answer field]

Management Commitment

12. How would you describe the commitment of higher management toward the implementation of the PPM software?

a) Very uncommitted
b) Uncommitted
c) Little uncommitted
d) Neutral
e) Little committed
f) Committed
g) Very committed
h) No idea

Software & Information Quality

13.1 How do you rate the usefulness of the functions and features of the PPM software?

a) Very bad
b) Bad
c) Little bad
d) Neutral
e) Little good
f) Good
g) Very good
h) No idea

13.2 How do you rate the reliability of the PPM software?

a) Very bad
b) Bad
c) Little bad
d) Neutral
e) Little good
f) Good
g) Very good
h) No idea

13.3 How do you rate the ease of use of the PPM software?

a) Very bad -> page 8
b) Bad > page 8
c) Little bad > page 8
d) Neutral > page 8
e) Little good -> page 8
f) Good > page 8
g) Very good > page 8
h) No idea > page 8

4 QUESTIONS REGARDING THE USE AND SATISFACTION

Use

14. How would you describe the use of the PPM software within your organization?
    a) Obligatory
    b) Voluntary
    c) Other (please specify) [open answer field]

15. In approximately what percentage of all the projects within your organization is the PPM software actually being used?
    a) 0%
    b) 10%
    c) 20%
    d) 30%
    e) 40%
    f) 50%
    g) 60%
    h) 70%
    i) 80%
    j) 90%
    k) 100%
    l) No idea

Motivation

16. How would you describe the overall willingness in your organization regarding the use of this PPM software?
    a) Very unwilling
    b) Unwilling
    c) Little Unwilling
    d) Neutral
    e) Little Willing
    f) Willing
    g) Very willing
    h) No idea

Satisfaction

17. How would you estimate the overall satisfaction in your organization with the PPM software?
    a) Very dissatisfied > page 9
    b) Dissatisfied -> page 9
    c) Little dissatisfied -> page 9
    d) Neutral > page 9
    e) Little satisfied > page 9
    f) Satisfied > page 9
    g) Very satisfied -> page 9
    h) No idea > page 9

Page 9

2 QUESTIONS ABOUT THE PERSONAL IMPACT

Efficiency & Effectiveness

18.1 What influence does the **PPM** software have on your productivity?
    a) Very negative

b) Negative
c) Little negative
d) Neutral
e) Little positive
f) Positive
g) Very positive
h) No idea

18.2 What influence does the PPM software have on the quality of your work?

a) Very negative > page 10
b) Negative > page 10
c) Little negative > page 10
d) Neutral -> page 10
e) Little positive > page 10
f) Positive > page 10
g) Very positive > page 10
h) No idea -> page 10

Page 10

4 QUESTIONS CONCERNING THE ORGANIZATIONAL IMPACT

Costs, Time, Quality & Development

19.1 What do you think about the total costs of the PPM software?

a) Much worse than expected
b) Worse than expected
c) Little worse than expected
d) As expected
e) Little better than expected
f) Better than expected
g) Much better than expected
h) No idea

19.2 What do you consider the implementation time of the PPM software?

a) Much worse than expected
b) Worse than expected
c) Little worse than expected
d) As expected
e) Little better than expected
f) Better than expected
g) Much better than expected
h) No idea

19.3 How well does the PPM software support the project management and/or project portfolio management processes?

a) Much worse than expected
b) Worse than expected
c) Little worse than expected
d) As expected
e) Little better than expected
f) Better than expected
g) Much better than expected
h) No idea

19.4 To what extent does the PPM software encourage the organization to grow in the field of PM and/or PPM?

a) Much worse than expected -> page 11
b) Worse than expected -> page 11
c) Little worse than expected -> page 11
d) As expected -> page 11
e) Little better than expected -> page 11
f) Better than expected -> page 11
g) Much better than expected -> page 11
h) No idea -> page 11

Page 11

1 QUESTION ABOUT THE SOFTWARE SUCCESS

Successfulness

20. Is the PPM software considered a failure or a success within your organization?

a) Very unsuccessful -> page 12
b) Unsuccessful -> page 12
c) Little unsuccessful -> page 12
d) Neutral -> page 12
e) Little successful -> page 12
f) Successful -> page 12
g) Very successful -> page 12
h) No idea -> page 12

Page 12

FEEDBACK / RESEARCH FINDINGS / CONTACT

If you have any questions, comments or suggestions you can post them here. [open field]

If you want to receive the research results, you can fill in your e-mail address here. [open field]

Note: This address will not be used to trace back your identity nor will it be published in any way.

May I contact you by e-mail in case I need additional information?

a) Yes -> page 13
b) No (pre select) -> page 13

Page 13

Thank you for filling in this questionnaire.

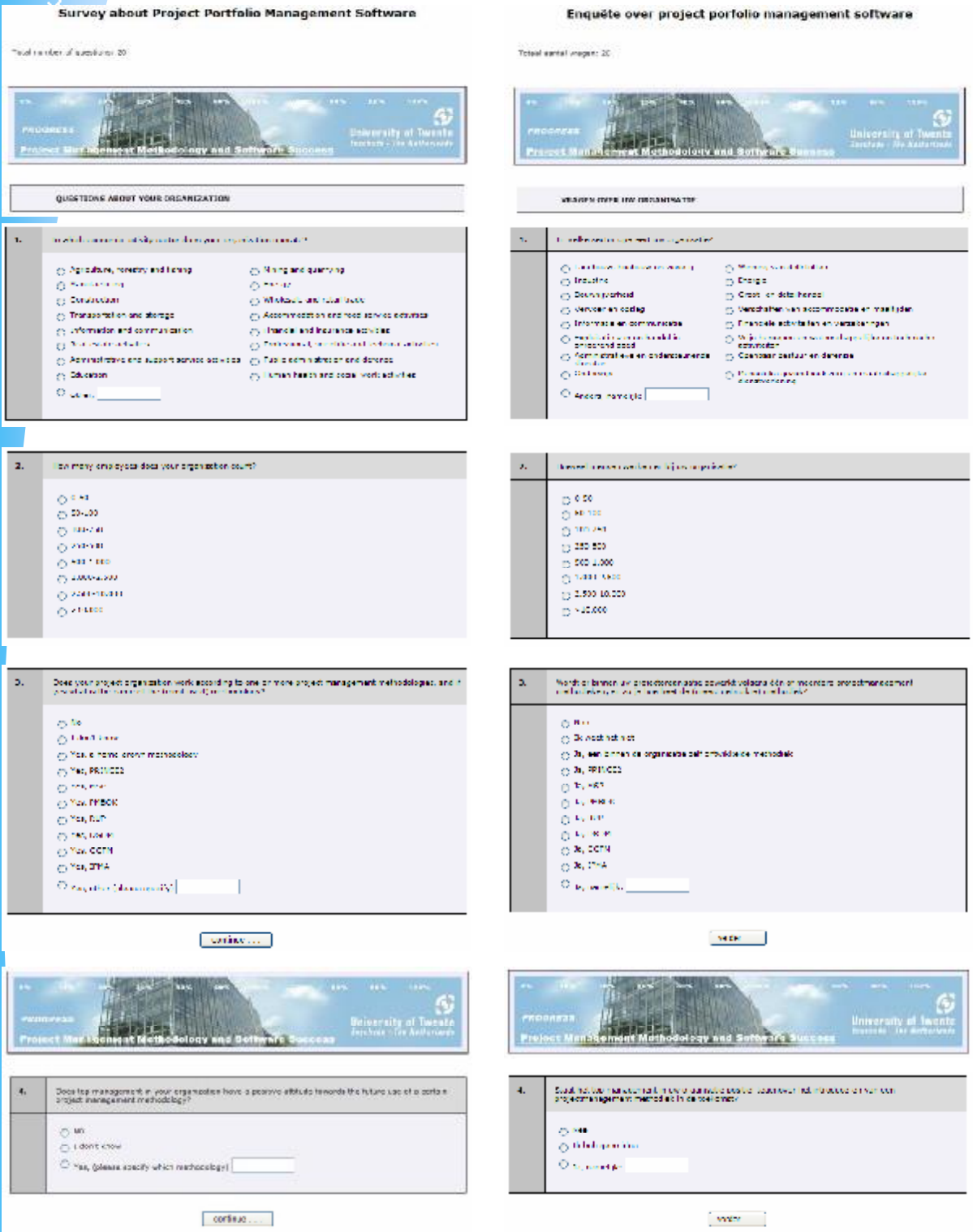
If you want to contact me for questions, suggestions or information, you can e-mail me at: j.vandewaal@student.utwente.nl

With kind regards,

Joost van de Waal

Questionnaire Versions 3 and 4 – English and Dutch Online Versions

These are the versions of the survey as they eventually were published on the World Wide Web. First the English version (left side) was made. This version then was translated in Dutch (right side). The Dutch version was published on July 4, 2007. The English version came online one week later.




Project Management Methodology and Software Success


Project Management Methodology and Software Success


Project Management Methodology and Software Success


Project Management Methodology and Software Success


15%
Project Management Methodology and Software Success

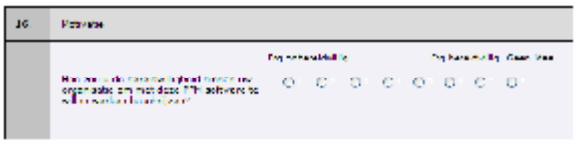

15%
Project Management Methodology and Software Success

QUESTIONS CONCERNING THE PPM SOFTWARE (CONTINUED)

VRAGEN OVER DE PPM SOFTWARE (VERVOLG)

QUESTIONS REGARDING THE USE AND SATISFACTION

VRAGEN OVER HET GEBRUIK EN DE TEVREDENHEID

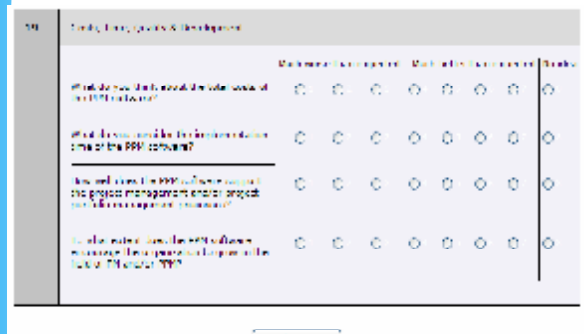


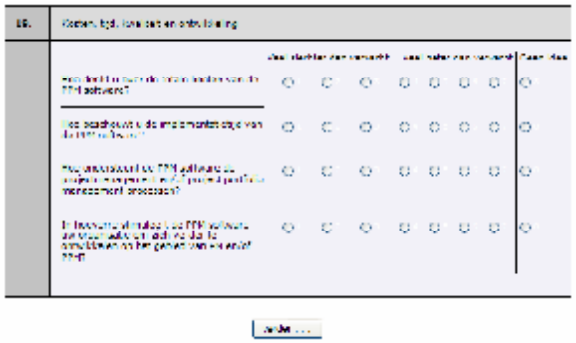
QUESTIONS ABOUT THE PERSONAL IMPACT

VRAGEN OVER DE PERSOONLIJKE IMPACT

QUESTIONS CONCERNING THE ORGANIZATIONAL IMPACT

VRAGEN OVER DE ORGANISATORISCHE IMPACT





QUESTION ABOUT THE SOFTWARE SUCCESS

VRAAG OVER HET SUCCES VAN DE SOFTWARE

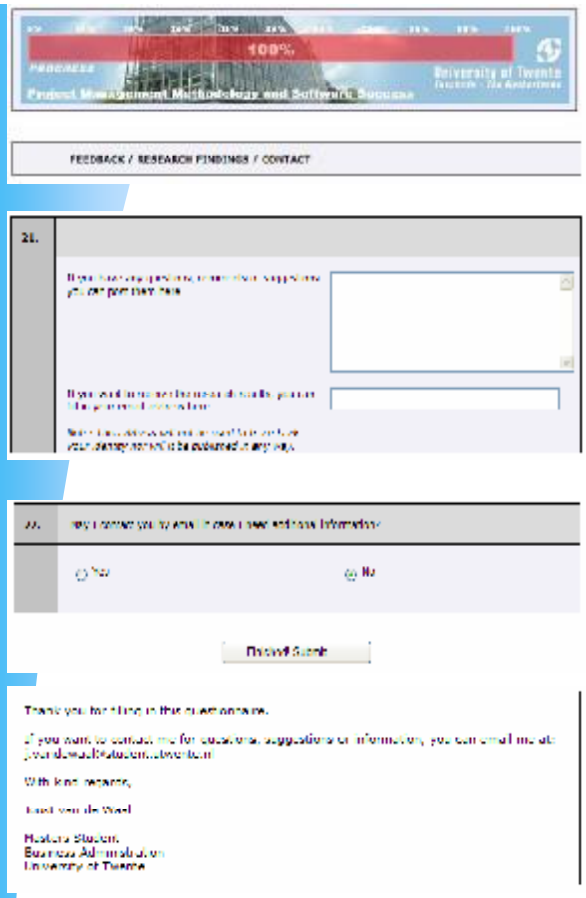


Figure 05: English version of the Web survey

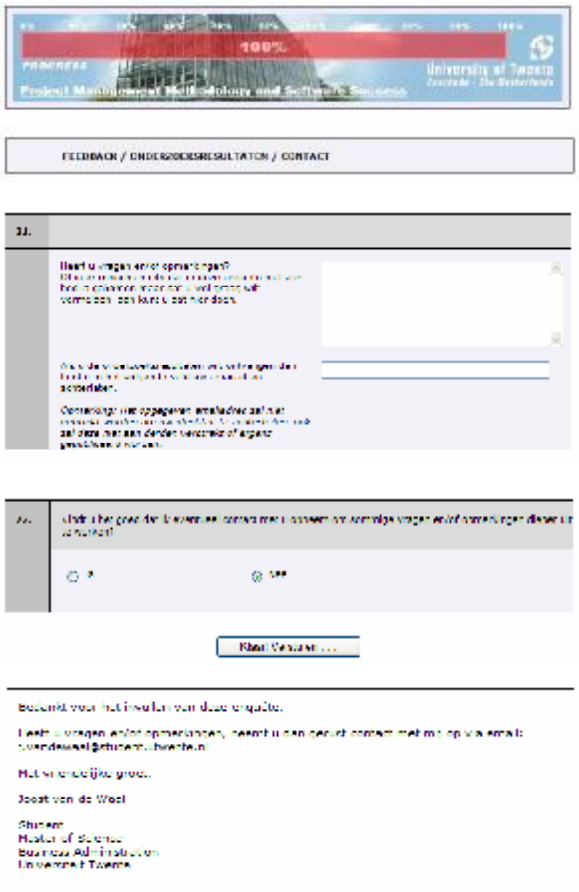


Figure 06: Dutch version of the Web survey

II Invitations and Comments

This 2nd appendix encloses the different invitation versions to the online survey. It as well contains a request for re-participating and several comments that were received by e-mail and the commentary field in the survey.

English Invitation

This invitation was used for promoting the survey at English Web sites and by e mail. The hyperlinks opened new windows in which the survey could be started in the English or Dutch language version.

Dear Sir / Madam,

How satisfied are you with the project management methods and supporting software within your organization? Or maybe you even haven't any of them yet, and are still searching for the right ones?

In a report of Ernst & Young (prominent Dutch accountancy organization) it was stated that implementations of project management software frequently fail.

As part of completing my Masters thesis at the University of Twente I am studying the success of project management software and methods. I made an online survey to measure the success of the software.

Gladly results of my survey are starting to come in. According to these MS Project is still the most used PM software. But it certainly is not the most successful in many cases.

You can help me with this study by filling in an online survey. It will only cost you 5 minutes (20 multiple choice questions).

What's in it for you?

After filling in the survey you will receive the research results. These results will give you a clear picture of which project management software and methods are leading at this moment. Moreover you can see at a single glance, depending on the circumstances, which type of project management software is the most successful.

Use this hyperlink for the English version of the survey:
http://www.thesistools.com/?qid=35185&ln=eng
You are NOT obliged to fill in your email address in the first name field: a random combination of characters/figures will do. This way your identity remains protected.

If your first language is Dutch, you can use this hyperlink.
http://www.thesistools.com/?qid=35186&ln=ned
You are NOT obliged to fill in your email address in the first name field: a random combination of characters/figures will do. This way your identity remains protected.

With kind regards,
Joost van de Waal

Masters Student
Business Administration
University of Twente

Dutch Invitation (PMI version)

This invitation was used for promoting the survey at the Dutch PMI Web site and their newsletter. The hyperlink opened a new window in which the Dutch survey version could be started.

Onderzoek projectmanagement software
Hoe tevreden bent u met de projectmanagement methodiek en ondersteunende software binnen uw bedrijf? In het kader van zijn afstuderen aan de Universiteit Twente, vraagt Joost van de Waal u mee te werken aan zijn onderzoek naar het succes van projectmanagement software en bijbehorende methodieken. Het invullen van de online enquête kost slechts 5 minuten van uw tijd (20 meerkeuzevragen). Als deelnemer aan de enquête ontvangt u de resultaten van het onderzoek per e mail (indien gewenst).

Figure 97 Invitation Web survey on PMI Web site

Dutch Invitation (first e-mail version)

This invitation was initially used for promoting the survey by e mail. The hyperlink opened a new window in which the survey could be started in Dutch.

Geachte heer/mevrouw, by the e-mail invitations here a personal name was placed.

Hoe tevreden bent u met de projectmanagement methodiek en ondersteunende software binnen uw bedrijf? Uit een rapport van Ernst & Young (juni 2006) blijkt dat implementaties van projectmanagement software verrassend vaak falen.

In het kader van mijn afstuderen aan de Universiteit Twente doe ik onderzoek naar het succes van projectmanagement software en bijbehorende methodieken. Mijn vraag aan u is of u mee wilt werken aan dit onderzoek? Het invullen van de online enquête kost u slechts 5 minuten tijd (20 meerkeuzevragen).

Waarom zou u meewerken aan een zoveelste enquête?

Als deelnemer aan de enquête ontvangt u de resultaten van het onderzoek per email (indien gewenst). Deze resultaten geven u een duidelijk beeld van de op dit moment meest gehanteerde projectmanagement software en methodieken. Daarnaast kunt u in één oogopslag zien onder welke omstandigheden de verschillende typen software het beste presteren.

Deze link brengt u naar de enquête:
http://www.thesistools.com/?qid=35164&ln=ned
U hoeft GEEN emailadres in te vullen in het eerste antwoordveld, een willekeurige combinatie van letters/cijfers volstaat. Zo blijft uw anonimiteit gewaarborgd.

Met vriendelijke groet.

Joost van de Waal
Student Bedrijfskunde
Universiteit Twente

Dutch Invitation (second version)

After a few weeks the survey could be accessed online, an altered Dutch invitation version was written. It revealed some early results that might persuade extra participants to start the survey. This invitation was, besides by e-mail, also used for promoting the survey at the Dutch Startpagina Web site. The hyperlink opened a new window in which the Dutch version of the survey could be started.

Geachte heer/mevrouw, by the e-mail invitations here a personal name was placed.

Hoe tevreden bent u met de projectmanagement methode en ondersteunende software binnen uw organisatie? Uit een rapport van Ernst & Young (juni 2006) blijkt dat implementaties van projectmanagement software verrassend vaak falen.

In het kader van mijn afstuderen aan de Universiteit Twente doe ik een onderzoek naar het succes van projectmanagement software en methoden.

Uit de onderzoeksresultaten die ik tot nu toe heb ontvangen blijkt dat er op dit moment zeer veel aanbieders van projectmanagement software zijn. Ook blijkt dat MS Project nog steeds het meest gebruikt wordt. Het ziet er echter naar uit dat deze software in veel condities niet als succesvol beschouwd wordt.

Mijn vraag aan u is of u mee wilt werken aan dit onderzoek? Het invullen van de online enquête kost u slechts 5 minuten tijd (20 meerkeuzevragen).

Waarom zou u meewerken aan een zoveelste enquête?

Als deelnemer aan deze enquête ontvangt u de resultaten van het onderzoek per email (indien gewenst). Deze resultaten geven u een duidelijk beeld van de op dit moment meest gehanteerde projectmanagement software en methodieken. Daarnaast kunt u in één oogopslag zien onder welke omstandigheden de verschillende typen software het beste presteren.

Deze link brengt u naar de enquête:
http://www.thesistools.com/?qid=35470&ln=ned
U hoeft GEEN emailadres in te vullen in het eerste antwoordveld, een willekeurige combinatie van letters/cijfers volstaat. Zo blijft uw anonimiteit gewaarborgd.

Met vriendelijke groet,

Joost van de Waal
Student Bedrijfskunde
Universiteit Twente

Request for Re-participating

A request for completing the survey after an error was found was sent to 15 participants who only partially completed the survey. This was caused by a broken question routing.

Geachte heer/mevrouw, a personal name was placed here

Uit enkele opmerkingen over mijn enquête over projectmanagement software kreeg ik de indruk dat er iets niet in orde was met de routing van de enquête. Dit vermoeden bleek waar te zijn.

Gelukkig valt de schade mee, waarschijnlijk hebben 15 van de 135 mensen hierdoor mogelijk niet alle vragen gezien. U lijkt tot deze groep te horen.

Ik heb de routing inmiddels gecorrigeerd en wanneer u nog eens bereid zou zijn om hem in te vullen dan zou ik dat zeer appreciëren. U zult zien dat er nu meer vragen over de software gesteld worden.

Directe link naar enquête:
http://www.thesistools.com/?qid=35208&ln=ned

Mocht u overigens nog mensen kennen, die ook op project basis werken en bereid zijn een enquête in te vullen, stuurt u deze link dan gerust door.

Mijn welgemeende excuses voor het ongemak.

Met vriendelijk groet,
Joost van de Waal

Commentary on Survey

Quite a number of respondents commented on the survey. They made their remarks, suggestions and questions either by e-mail, by messages on forum Web sites and by the commentary field in the survey. A selection of these comments is listed below. The names were made fictitious due to the promised anonymity and privacy protection.

"Beste Joost
Natuurlijk werk ik mee aan het onderzoek! Niet alleen omdat de resultaten me interesseren, maar ook omdat ik studenten altijd een handje wil helpen. Wat me wél intrigeert, is hoe je aan mijn gegevens bent gekomen. Wil je me daarover bellen? Kunnen we meteen even wat verder praten. Bedankt!
Met vriendelijke groet
drs. K. Bloem"

"Understand that MS Project is little more than a scheduling tool. Resource management handled via custom spreadsheet. All other tools utilized are non-integrated from PM perspective."

"Ik heb Prince2 gedaan en werk projectmatig maar weet pas sinds gisteren bij toeval af van deze tool. Zelf gebruikte ik meestal MS Projects."

"Volgens mij vergeet je een hele open-source wereld, waar erg veel aardige tools, maar ook aanpakken/processen uit komen t.b.v. software ontwikkeling."

"Belangrijke opmerking over het onderzoek: je meet niet wat je wilt meten! Veel projectmanagement tools zijn uitstekend, onder voorwaarde dat mensen ook verstand hebben van het plannen van een project. Dit komt veel meer neer op requirements valideren, WBS"

"AtTask software, sometimes called @task is the best. It has just recently come out with a new capacity planner, and really helps our company save money and reach goals."

"Eigen methode sterk gebaseerd op PMBOK en PRINCE2. Tools hoofdzakelijk nog MS Excel, met MS Project voor de grotere projecten."

"Wat mij opvalt in de enquête zijn het ontbreken van vragen omtrent projectomvang, bevindingen van eventueel gebruikte tools, agile/SCRUM aanpak t.a.v. project management. Verder mis ik vragen t.a.v. het gebruik van specifieke methoden binnen de planning."

"What a nice looking and interesting survey. Good luck with writing your thesis!"

"De software is binnen onze organisatie nog in een ontwikkelingsstadium. Er komen regelmatig updates, waardoor het programma zich verder verbetert."

"De enquête ziet er erg strak uit en is zeker niet te lang zoals veel enquêtes tegenwoordig vaak zijn! Ik ben zeer benieuwd naar de resultaten."

"De organisatie is nu beginnende met het omarmen en gebruiken van Prince 2. De eerste projecten worden nu met MS Project gedaan. Resultaten zien er gunstig uit, e.e.a. behoeft nog wel veel meer inbedding en gebruik door de PL's"

"I am interested in knowing what other orgs use for small and med projects, beside Microsoft Project."

"Meeste projectmanagementsoftware leidt niet tot overzichtelijk plannen en organiseren. Te ingewikkeld behalve MicroSoft Project. Mijn ervaring vooral visuele communiceren via planbord e.d."

"Ik ben een ZZP-er en werk bij grote opdrachtgevers met meer dan 1000 werknemers. Zelden is er meer voorhanden dan MS Project. Zelf prefereer ik Open Workbench omdat de resource scheduling goed werkt."

"Ik woon in Spanje en werk(te) voor een projectontwikkelaar. Simpel, geen overhead en met nul middelen alles uitbesteden. Was niet meer nodig dan een Excel sheet."

"Projectmanagers software is slechts een ondersteunend middel. projectmanagement is vooral mensenwerk, goed met klanten om kunnen gaan en goed kunnen communiceren. Een goede projectmanager kan zelfs met Excel een project goed sturen."

In de enquête wordt het gebruik van software vergeleken met het hanteren van een methode. Dit klopt niet. Een moderne methode als Prince 2 kan met een reeks verschillende tools ondersteund worden.

"Dear Joost

I've just filled in your questionnaire. really to see what questions you would ask. We develop, implement and maintain the 4c project portfolio management software, which we also use to help us manage our own projects.

I'd like to share some of my thoughts and experiences with you - you might like to consider some of these points.

We generally work with medium-sized organizations and, in our experience: the successful implementations are those where the company has a clear methodology and set of project management processes already in place.

Less successful implementations occur where senior management think that the software is some sort of "golden bullet" that will solve their business process issues, rather than recognizing that it is merely a tool to support the processes. Conversely, where senior management do not actively support and promote the use of the tool, there is a risk that there is a low return on the investment because the software is used incorrectly, inefficiently, or eventually not at all.

In that sense, therefore, it almost doesn't matter which software is chosen, providing that its facilities fit the business requirements. It is the way in which it is implemented that is likely to influence success.

The vendor should clearly understand the business needs and the processes the tool will support, and design the training around the needs of the users and their roles in the processes.

Senior users should be involved in the training, to explain the processes and support other staff in effective use of the tool, and senior management should be seen to sponsor use of the software at all levels.

I hope this is helpful, good luck with your thesis!

Linda Clarkson, Director
Oak Systems Ltd.
London, Berkshire, England"

"Beste Joost,
Ik vraag mezelf af hoe je aan mijn gegevens bent gekomen. Ik heb je enquete ingevuld en wens je veel succes met je afstuderen.
Met vriendelijke groeten.
Johan van Haven"

"Joost,
I am working at an engineering company. While we are using MS Project for many years, I was never totally convinced
The software is getting more logical, but it still lacks an intuitive way of working. Currently I want to experiment with other tool. that's why I'm interested in your results. Particularly those of the smaller companies.
Regards,
Richard Averley"

"Hi Joost,
Dank voor je uitnodiging. Volgens mij doe je een zeer interessant onderzoek! Ik zal zodadelijk de enquête invullen. Jouw observatie voor wat betreft MS Project deel ik wel. Eerlijk gezegd gebruik ik het de afgelopen jaren eigenlijk helemaal niet meer...
Ik ken ook nog wel wat andere projectleiders in den lande. Zal ik die ook op de hoogte stellen van jouw enquête?
Overigens ben ik werkzaam op de UT als projectleider bij ITBE en straks het Onderwijsservicecentrum, voor email zie cc.
Mag ik vragen bij welke vakgroep (prof) je je onderzoek uitvoert? En ik ben zeker geïnteresseerd in je resultaten. Wanneer zijn die te verwachten?
Groet,
Gerrit Boom"

III Standard PM Methods

This 3rd appendix gives an overview and a brief description of the most used standard PM methods that had came across during the employing the survey.

PRINCE2

Projects in Controlled Environments (**PRINCE**) is a PM method that covers the organization, management and control of projects. According to PRINCE a project has a clear beginning, middle and end, a clear organizational structure and defined objectives. You can use a managing method like PRINCE to ensure that a project is successful, which means that finishes on time, within budget and provides the customer with what they have asked for (OGC, 2005).

PRINCE was developed by the CCTA, which is now part of the Office of Government Commerce (OGC). In1989 **PRINCE** was developed as a UK Government standard for IT PM. Since its introduction, PRINCE has become widely used in both the public and private sectors and is at this time the de facto standard for PM in the UK (and also in the Netherlands if the results of the thesis are representative).

Although PRINCE was originally developed for the needs of **IT** projects, the method has also been used on many non IT projects. The most recent version of the method, PRINCE2, is designed to incorporate the requirements of existing users and to enhance the method towards a generic, best practice approach for the management of all types of projects.

PRINCE2 is a process based approach for PM providing an easily to customize and scalable method for the management of all types of projects. Each process is defined with its key inputs and outputs. PRINCE2 outlines eight processes that are required to successfully carry out a project (Figure 98). The method describes how a project is divided into manageable stages enabling client control of resources and regular progress monitoring throughout the project. The various roles and responsibilities for managing a project are fully described by the method and are adaptable to suit the size and complexity of the project, and the skills of the organization.

One of the most important advantages of PRINCE2 is that it embodies proven and established best practice in PM. It is widely recognized and understood, and so provides a common language for all participants in the project. In addition PRINCE2 is very useful for educative use.

Figure 98 PRINCE2 process model (Source: OGC, 2005)

PMBOK

The Project Management Body of Knowledge (PMBOK) guide provides an overview of best practices in PM. The PM practices described are not industry specific but are generic and designed to be adapted to go with any type or size of project.

PMBOK was created by the Project Management Institute (PMI) in 1987. While PMBOK is generally well accepted worldwide, it is by far the leading approach in North America.

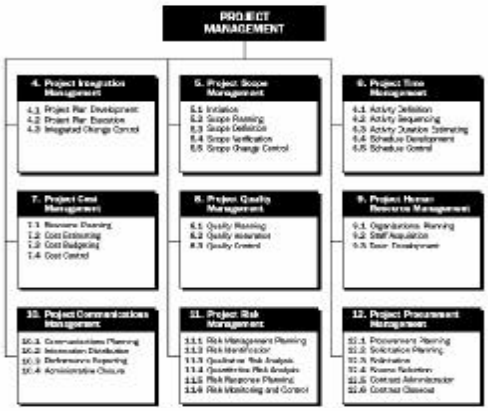


Figure 99 Overview PMBOK knowledge areas (Source: PMI, 2000)

Figure 100 PMBOK process groups of the Scope Management area (Source: PMI, 2000)

PMBOK is defined by a PM framework, PM processes and PM knowledge areas (PMI, 2004). The PMBOK PM framework provides a basic overview and structure for understanding and implementing PM. This framework describes how the five PM process groups and their requisite PM processes provide the basis for sound PM practice.

The PMBOK organizes the 44 PM processes into 9 knowledge areas (Figure 99). These are integration, scope, time, cost, quality, human resource, communication, risk and procurement management. Each of these 9 areas was briefly explained earlier (Section 2.3.4).

The 44 PM processes defined by PMBOK that describe all of the common processes that a project team would use to manage a project. The PMBOK PM processes are divided into five process groups (Figure 100). These are the initiating process group, the planning process group, the executing process group, the monitoring or controlling process group and the closing process group. These were also explained previously (Section 2.2.3).

CCPM

Critical Chain Project Management (CCPM) is a novel approach for managing projects. It was developed and publicized by Goldratt (1997) in his book Critical Chain. Goldratt is well known in the operations management community as the inventor of the Theory of Constraints (TOC). TOC is a tool for managing repetitive production systems based on the principle that every system has a constraint, and system performance can only be improved by enhancing the performance of the constraining resource. CCPM is an extension of TOC designed specifically for project environments.

The publication of Goldratt's book generated quite some disagreement in the PM community. The proponents of CCPM claim that it is a totally new, revolutionary way of thinking that can lead to better, even unprecedented, performance in terms of reducing delivery time and increasing the ability to meet schedule and budget commitments. Others argue that the principles behind CCPM have been known to and applied by experienced project managers for decades, and that CCPM exclusivity is in the terminology rather than in substance.

While according to Goldratt the Critical Path Method (Section 2.3.7) focuses on getting projects done at minimal cost, the Critical Chain Project Management (CCPM) method focuses on getting the job done as quickly as possible. CCPM focuses first on getting jobs done on time, and then on budget and quality.

In addition, working with the CCPM method requires the use of specialized software currently offered by a small number of vendors, not necessarily the market leaders. As a result, any organization that is considering the adoption of CCPM as a way for improving project performance faces significant costs, both economically and culturally.

Scrum

The Scrum approach was first referred to by Takeuchi and Nonaka (1986). The term 'Scrum' was derived from rugby. It refers to a tight formation of forwards, who bind together in specific positions when a scrum down is called. Scrum was formalized in the mid 90s as an 'agile' method for PM in software development projects, where requirements and priorities change rapidly and regularly. Though Scrum can be applied anywhere there is a small team of people working together to achieve a common goal.

A key principle of Scrum is its empirical approach, accepting that the problem cannot be fully understood or defined. Therefore Scrum is focusing on maximizing the team's ability to respond in an agile way to emerging challenges. Consequently there are no specific prescribed guidelines or control processes for Scrum.

Instead Scrum uses various concepts (Figure 101). Some of them will briefly be explained here. The 'Sprint', this is a period of 30 days or less where a set of work will be performed to create a deliverable. The 'Backlog' this is all work that has to be performed in the foreseeable future. Then the 'Sprint Backlog', this consequently is the work that should be done during the current sprint. The 'Product Backlog', which is the work that should be done for the whole product as it is desired by the customer. And finally the 'Scrum' stands for a daily meeting at which progress and obstacles to progress are reviewed.

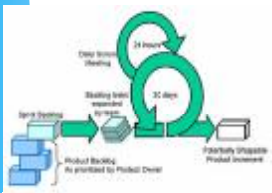


Figure 101 Scrum concept scheme (Source: Schwaber, 2007)

According to the inventors of Scrum traditional development methods are designed only to respond to the unpredictability of the external and development environments at the start of an enhancement cycle. Nevertheless such newer approaches are still limited in their ability to respond to changing requirements once the project has begun.

The Scrum method, on the other hand, is designed to be relatively flexible throughout. It provides several control mechanisms for planning a product release combined with various managing variables as the project progresses. This enables organizations to change the project and deliverables at any point in time, delivering the most appropriate release.

DSDM

Dynamic Systems Development Method (DSDM) is a method that was designed to develop information systems. It was developed in 1993 and it was intended to be different from the classical software development methods. Where each design or build step follows a preceding step, until a project finishes. It was designed to deliver products in an iterative way (DSDM.org).

It's based on three main iterations (Figure 102). These are the functional model iteration, the design and build iteration and the implementation iteration. Before the iterations can start, the business, the client organization and the feasibility of a project have to be studied. At the end of all iterations, but as well within each single iterative process, specific products are delivered to the client organization.

Figure 102: DSDM framework (source: DSDM.org)

Important advantages of this framework are, according to proponents, the flexibility of the framework, as products can be shaped and reshaped until they are right for the client. According to DSDM the products a project delivers are only useful to an organization, when a client is indeed able to use the product. In the framework the communication with a client and feedback on the basis of sub-products is considered important. But this framework is also a method which makes the whole software development process easy to follow for the client or the contractor.

IPMA Competence Baseline

The International Project Management Association Competence Baseline (ICB) is the basis for the IPMA certification system which includes four different levels. Each level shows the core and additional elements of the knowledge and experience, as well as the aspects of the personal behavior and general impression for the certification of PM competence (Figure 103).

ICB is a standard method that could be very useful to practitioners and stakeholders. It acts out the knowledge and experience expected from the managers of projects, programmes and project portfolios.

The ICB contains basic terms, tasks, practices, skills, functions, management processes, methods, techniques and tools that are used in good PM practice and theory, as well as specialist knowledge and experience, where appropriate, of innovative and advanced practices used in more limited situations.

The ICB offers access to the technical, behavioral and contextual competence elements of PM. As an evolving profession, it is critical that PM practitioners have access to up to date information. The ICB content is based on the contributions by IPMA's members.

Level		Capabilities	Certification Process				Title	Validity
				Stage 1	Stage 2	Stage 3		
A	Programme or Projects Director	Competence = knowledge + experience + personal attitude	CPD	• Application • CV • Self assessment • References • Project list	Optional E.g. Workshop or seminar	Project Report Inter-view	Certificated Project Director	3-5 years
B	Project Manager		CPM				Certificated Project Manager	
C	Project Management Professional		PMP			Exam	Registered Project Management Professional	Time limited
D	Project Management Practitioner	Knowledge	PMF		Exam		Project Management Fachmann/ Professional	Not time limited

Figure 103: IPMA Competence Baseline and its levels (source: IPMA.ch)

MSP

Managing Successful Programmes (MSP) was developed by the Office of Government Commerce (OGC), an independent Office of the UK Treasury, and supported by a full range of commercial partners. It was first released in 1999, and in 2007 a third edition was released to reflect the growing knowledge of programme management. MSP is the UK Government best practice standard for effective programme management, and is a globally recognized qualification.

A programme is made up of a number of projects that have been identified by an organization. Together these projects will deliver a defined objective, or set of objectives, for the organization. A programme can only succeed if the projects within the programme are completed. Therefore, without programme management the projects would be uncoordinated and not incorporated into a final goal.

MSP has a standard and consistent approach to programme management. It provides a framework (Figure 104) for practitioners to direct the change process while ensuring the focus is maintained on the business objectives

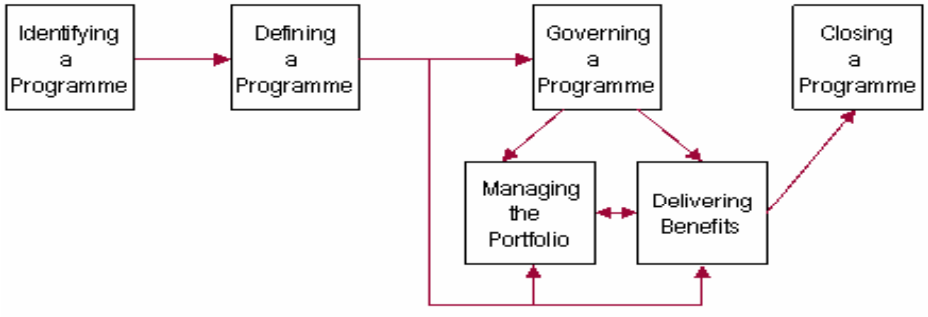


Figure 104 - MSP Framework (source: OGC, 2007)

The MSP programme management method gives added value to any organization that needs to manage and control a number of projects, by providing a framework for practitioners to work with that has been underpinned by current research. In this way there is a close link between MSP and OGC's PRINCE2. Therefore it was decided to admit the MSP to the data as standard PM method.

RUP

The Rational Unified Process (RUP) is a software design method created by the Rational Software Company. This was acquired by IBM in 2006. RUP is a thick method. The whole software design process is described with high detail. Thus RUP is particularly applicable on larger software projects. Though, the RUP method is general enough to be used without necessary training. This makes it easy to adapt the method to the special needs of a single project or company.

Figure 105 - The iterative RUP approach to software development (Source: RUP)

In RUP, an iterative approach is used which looks similar to that of DSDM. A by RUP developed software product is designed and built in a succession of incremental iterations. Every iterative cycle includes some or most of the development disciplines (requirements, analysis, design, implementation, testing, etc). Figure 105 shows an iteration of a RUP project in a graphical way.

IV PM Software Vendors

This 4th appendix shows fragments of texts from Web pages of PM software vendors. This list of vendors and text fragments is restricted to those that market method specific PM software. The text fragments are the result of the content analysis of all the Web sites of the PM software vendors that were encountered by the survey. All the vendors' Web sites were scanned on text fragments which could be interpreted that their software is developed to specifically support certain standard PM methods.

In the 'References' an exhaustive list of all encountered PM software vendors (including some software engineering companies) and their Web sites can be found.

BugBox, by IT Governance
Method(s): PRINCE2
"PRINCE2 software for project teams. Takes the pain out of PRINCE2."

cc Mpulse, by Spherical Angle
Method(s): CCPM
"cc-MPulse is a multi-project CCPM add-in module for Microsoft® Project that incorporates all the features of cc Pulse and allows project scheduling across an entire enterprise, based on one or more designated drum resources (pacesetter resources). This multi project scheduling step is crucial to the complete implementation of the Critical Chain Multi Project Management Method and the exploitation of the full set of benefits afforded by CCPM."

i-method, by Interactive methodologies
Method(s): PRINCE2
"i-method has been developed to bridge the gap between PRINCE2™ theory and its application, providing staff with document templates, automatic reporting, a central data repository, automatic configuration management and much, much more. If you are looking for PRINCE2™ compliance, this tool is the answer."

Hydra, by Project Management Group (PMG)
Method(s): PRINCE2, MSP
"Hydra Framework is the most detailed process based methodology for programme management. It supports both Prince2 and the OGC's Managing Successful Programmes (MSP) best practice but goes much further. Hydra Framework is structured in five layers to provide appropriate access to the programme management community dependant on need and role. It also contains Hypertext links to documents, templates and forms in Hydra Collaborator or other applications used for source documents."

MPMM, by Method123
Method(s): PMBOK, PRINCE2
"It's different because it's based on the worldwide standards for project management: PMBOK® and Prince2®."

P2.net, by Concerto Support Services
Method(s): PRINCE2
"Although P2.net can be configured to support any methodology, it contains many of the central PRINCE2™ features and supports the PRINCE2™ environment with central workflow facility, guidance and standard features such as PID, Lessons Learned Log, Tolerences, Risk Log and more."

Principal Toolbox, by Fortes Solutions
Method(s): PRINCE2, MSP
"The Principal Toolbox supports the management of PRINCE2™ projects and MSP™ (Managing Successful Programmes)."

PROJECT in a box, by Praxis Solutions
Method(s): PRINCE2
"PROJECT in a box are the only software providers to licence and provide Authentic PRINCE2™ materials in their software to support users navigation and understanding of the methodology."

PROJECT Insight, by Metafuse
Method(s): PMBOK
"Project Insight is dedicated to developing and providing Web based project management software and services according to the highest standards in the industry. We follow the Project Management Institute's (PMI) standards and our software is PMBOK compliant (Project Management Book of Knowledge)."

Project InVision, by Project InVision International (PII)
Method(s): PMBOK
"Project InVision PPM includes a complete project management methodology that addresses all of the core processes in the Project Management Institute's (PMI) industry standard Guide to the Project Management Body of Knowledge (PMBOK® Guide)."

ProjectProgress, by Project Progress Limited
Method(s). PRINCE2
"ProjectProgress is the leading PRINCE2™ Web based project management software. Our mission is to unite project teams and management teams in a collaborative space providing solutions that help organizations operate PRINCE2™ more efficiently and productively."

Share Lock, by DataLeaf ICT
Method(s): PRINCE2
"Prince2 ondersteuning door software tools."

Suite Cardinis, by Cardinis Solutions
Method(s): PMBOK. PRINCE2
"Since its birth the Suite CARDINIS has been supporting international standards (PMI, PRINCE II)."

VersionOne, by VersionOne
Method(s): Scrum, XP, DSDM, Agile UP
"Deployable in minutes, VersionOne enables development teams to accelerate the rollout of today's leading agile methodologies across multiple projects, releases, teams, and locations. Configurable, methodology-specific templates for Scrum, Extreme Programming (XP), DSDM, and Agile UP accelerate internal deployment and can be customized for teams utilizing hybrid methodologies."

V Additional Explanations

In this 5th appendix the extensive argumentation of the used research method and a detailed scheme of the report structure with its explanation are enclosed. These were trimmed down or left out completely of the thesis' main text. Hence they were considered as less relevant for the average reader of this thesis and because of the space limitations.

Research Method

In this section will be discussed what kind of method would be most appropriate for conducting this research.

Qualitative versus Quantitative Data

The first decision that had to be made was about the way of doing the research. Which method would be the most appropriate for solving the central problem, the qualitative or quantitative method (or even a combination of both)? According to Creswell (1994) it depends on what the researchers are looking for and how much time and resources the researchers have available.

Holme and Solvang (1991) claim that qualitative research is characterized by the proximity the researchers have to the respondents. In qualitative research, the use of small groups normally not larger than 30 respondents are used (Cantzler, 1992). Qualitative research is often built upon interviews and open questions. Due to the way data collection is done, the answers can vary and it also requires time and money to collect data this way (Yauch, 2003).

Babbie (2001) characterizes quantitative research as a method where a large amount of respondents can be researched and where the data collection is many times done through questionnaires and statistical methods can be applied to the collected data.

Based on the fact that most other available reports about project management (e.g. White & Fortune, 2002; KPMG, 2005; PSO Partners, 2005; Ernst & Young, 2006; Vrije Universiteit Amsterdam et al., 2007) are based on quantitative data it was decided to as well use a quantitative research method for this study. A quantitative method would probably ease comparisons with these other studies and this could increase the external validity of this study. Furthermore, a quantitative study is a good way to minimize the subjectivity of the researcher. With qualitative methods the chance of the researcher becoming prejudiced by the interests of the organization that facilitated the research is bigger (Miles, 1979).

Case Studies versus Large Sample Studies

The second decision that had to be made about the way of doing the research was about the number of respondents. Will the problem be investigated with a case study or a large sample study? At first, the idea was to do a cross case study. Within two or three organizations with different PM software, various aspects of the software could be analyzed. This way important critical factors success factors could be listed and ranked by importance. After reading a number of articles about case studies the advantages and disadvantages of these studies became clear.

Miles (1979) wrote a very critical article about qualitative research and case studies. Although Miles self advocates quantitative research, he starts with summarizing the advantages of qualitative data. According to Miles qualitative data is attractive for many reasons; it is rich, full, earthy, holistic and 'real'. As a result the face validity seems sound. Qualitative data maintains a chronological flow where that is important and suffers minimally from retrospective distortion. Qualitative data, in principle, offers a far more precise way to assess causality in organizational affairs than methods like cross-sectional correlations. After all, intensive longitudinal fieldwork studies can contain dozens of 'waves' of data collections, not just one or a few. Besides these numerous advantages of case studies there are also several disadvantages.

Yin (1981), who wrote many articles about case studies and can be seen as an advocate of case studies, confirmed some main disadvantages. First, respondents often are objective to the research results and force researchers to re-write history in order to appear more favorably in

the case study. Further the typical case study report is a lengthy narrative that follows no predictable structure and is hard to write and hard to read. Another disadvantage can be the limitations of numbers, even though case studies also can be quantitative; those numbers remain very context specific, which makes case studies hard to generalize.

Taking all these pros and cons into account it was decided to do a large sample study. If the study would be conducted in a case study way, within a limited number of organizations and with limited numbers of data to be statistical significant, the results are most likely less attractive to be published. While one of the main objectives of this research to publish the results (Section 1.3.2).

Longitudinal Studies versus Cross sectional Studies

The final decision that had to be made about the way of doing the research was about the time dimension of the research. Should it become a longitudinal study or a cross-sectional study? Cross sectional studies involve observations of a sample, or cross section, of a population in one point of time. Longitudinal studies (e.g. trend studies, cohort studies and panel studies) are designed to permit observations over a period in time. The main advantages of cross sectional research are that it can be conducted relative swift and costs less than longitudinal studies (Holton III, 2005). In addition cross sectional research doesn't have problems like history, maturity, mortality (Campbell & Stanley, 1963), which are related to the time dimension and cohort-effects, which are influences of sample members on each other (Zeger & Liang, 1992).

Naturally cross sectional research has some weaknesses too. The main inherent problem is one can do no hard judgments concerning a causal relation between presumed independent and dependent variables (Maris, 2006). For a relation between variables to be causal three criteria have to be satisfied (Lazarsfeld, 1959). The first requirement is there should be a correlation between the variables. The second requirement is that the causes precede the effect. This requirement can't be proved with a cross sectional study, for the reason that a cross-sectional study only measures the variables at one point in time. At best this requirement can be made reasonable. The third requirement is that the effect cannot be explained in terms of a third variable. A possible third variable can only truly be excluded in experimental laboratories studies. In observations of the 'real' world one can only try to exclude as many as possible other variables with elaborations. Although cross-sectional research consequently isn't suitable for explanatory research, it can be used for studying correlations.

Due to the cost and time limitations, as explained in the Section 'scope of the thesis' (1.4.2), it was decided to do a one time cross sectional study. Nevertheless it was decided to keep the option open to contact the respondents -if necessary- afterwards.

Structure of the Report

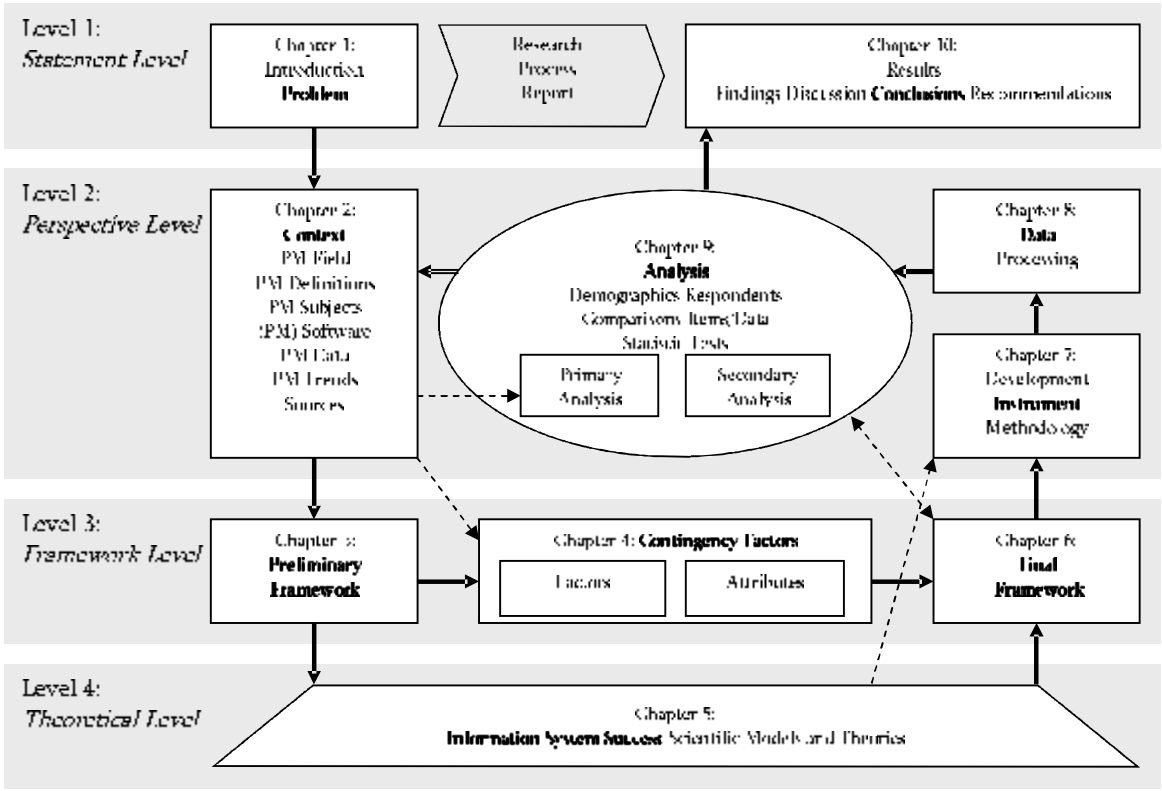


Figure 98 Theoretical scale scheme

Explanation of the Scheme

The solid arrows follow the main reading sequence of the chapters. Chapter 4 and 5 can be read simultaneously. The central point of the scheme is Chapter 9. In this chapter the data of this research is examined with statistic tests and compared with existing data.

The double lined arrow between Chapters 9 and 2 represents the loop in the research process. Although the solid lines show the main linear-analytic structure in which the research could be arranged, the actual research process involved numerous iterations. During the research many new sources of information, findings and perspectives led to small and large adjustments in the research progression.

The dotted arrows represent relations between several chapters that exist autonomously irrespective the reading sequence. For instance the arrow between Chapters 2 and 9 stands for the comparisons between other existing data of PM and the data of this study. The arrow between Chapters 2 and 4 symbolizes the assembly of the attributes of the contingencies within the context of PM. The dotted arrow between Chapters 5 and 7 embodies the building of the instrument items with the aid of established theories and models. Finally the dotted arrow between Chapters 6 and 9 symbolizes a possible reciprocal influence. The framework powers the variable data analysis and in its turn the data analysis will possibly lead to adjustments of the framework.

The scheme covers 4 different levels. These are displayed on the left side. Level 1 is statement level. It starts with the problem description. The level proceeds with reporting the research process and ends with answering the problem by stating the conclusions. Level 2 is the perspective level. This level explores, observes and examines the problem within the PM practice. Level 3 is the framework level. In this level the relations between the factors and later on the attributes of the variables are assessed. The final level, level 4, is the theoretical level. In this level the information system success research is reviewed.

VI Additional Charts and Tables

This 6th appendix includes all the additional charts and tables that were built with help of the data. All these charts and tables were made in SPSS (version 14 and 15). The order in which they are displayed corresponds with the sequence of the sections belonging to the 'Data Analysis', chapter (9).

Sample Frequencies

Respondent Demographics

				Count	Column N %
Survey Language	Dutch	Respondent Source	PMI NL	82	35,1%
			Random Invited Project Managers	11	4,7%
			PM Acquaintances	23	9,8%
			PM Startpagina	17	7,3%
			total	163	69,7%
	English	Respondent Source	All PM Forum	42	17,9%
			Ganthead PM Forum	29	12,4%
			total	71	30,3%

Table 6 Respondent's language * source crosstabulation

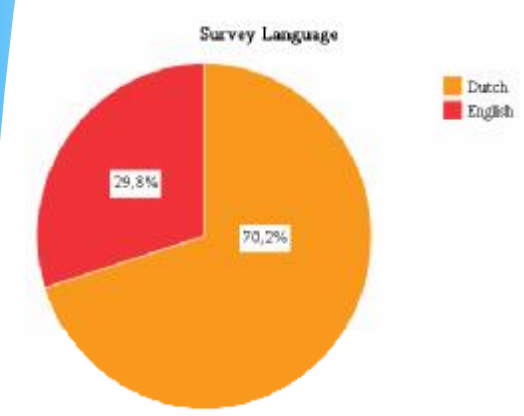


Figure 105 Respondent's Language Frequencies

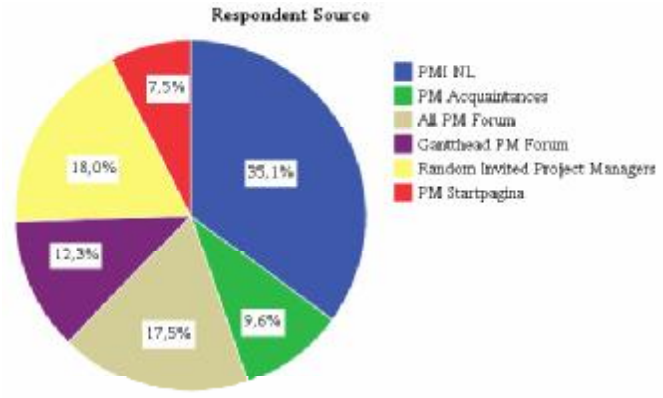


Figure 106 Respondent's source frequencies

PM Organization Frequ

		Count	Column N %
Number of employees	0 - 50	47	20,2%
	50 - 100	33	14,2%
	100 - 250	18	7,7%
	250 - 500	20	8,6%
	500 - 1.000	27	11,6%
	1.000 - 2.500	36	15,5%
	2.500 - 10.000	28	12,0%
	> 10.000	25	10,7%
	total	233	100,0%

Table 7 Organizational size frequencies

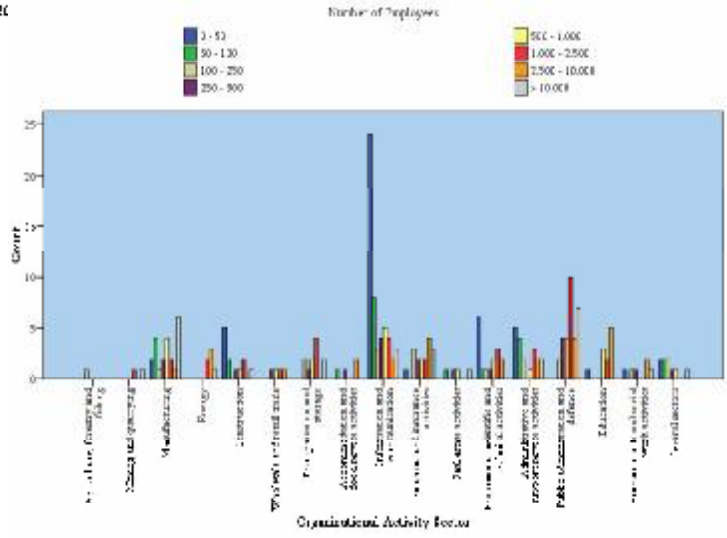


Figure 107 Distribution of organizational sectors and size

Organizational Activity Sector * Number of Employees Crosstabulation

			Number of Employees								
			1 - 50	51 - 100	101 - 250	251 - 500	501 - 1000	1001 - 2500	2501 - 10000	> 10000	Total
Organizational Activity Sector	Agriculture, forestry and fishing	Count	0	0	1	0	0	0	0	0	1
		% within Number of Employees	,0%	,0%	5,6%	,0%	,0%	,0%	,0%	,0%	,4%
	Mining and quarrying	Count	0	0	0	0	0	1	0	1	2
		% within Number of Employees	,0%	,0%	,0%	,0%	,0%	4,8%	,0%	3,4%	,8%
	Manufacturing	Count	2	1	1	2	1	2	1	6	22
		% within Number of Employees	4,2%	12,5%	5,6%	10,0%	11,1%	5,6%	3,6%	20,7%	9,2%
	Energy	Count	0	0	0	0	0	2	5	1	10
		% within Number of Employees	,0%	,0%	,0%	,0%	,0%	9,5%	17,9%	3,4%	4,2%
	Construction	Count	5	2	0	[illegible]	[illegible]	2	0	[illegible]	12
		% within Number of Employees	10,4%	8,7%	,0%	5,0%	3,7%	9,5%	,0%	3,4%	5,0%
	Wholesale and retail trade	Count	0	0	0	1	1	1	1	0	4
		% within Number of Employees	,0%	,0%	,0%	5,0%	3,7%	4,8%	3,6%	,0%	1,7%
	Transportation and storage	Count	0	0	2	[illegible]	2	4	0	2	11
		% within Number of Employees	,0%	,0%	11,1%	5,0%	7,4%	19,0%	,0%	6,9%	4,6%
	Accommodation and food service activities	Count	0	1	0	1	0	0	2	0	4
		% within Number of Employees	,0%	4,3%	,0%	5,0%	,0%	,0%	7,1%	,0%	1,7%
	Information and communication	Count	24	8	2	4	5	1	2	5	51
		% within Number of Employees	50,0%	34,8%	11,1%	20,0%	18,5%	4,8%	7,1%	17,2%	21,3%
	Financial and insurance activities	Count	[illegible]	0	2	2	2	1	4	5	17
		% within Number of Employees	4,2%	,0%	11,1%	10,0%	7,4%	5,6%	14,3%	17,2%	7,1%
	Real estate activities	Count	0	1	0	1	1	0	0	1	4
		% within Number of Employees	,0%	4,3%	,0%	5,0%	3,7%	,0%	,0%	3,4%	1,7%
	Professional, scientific and technical activities	Count	6	1	1	[illegible]	2	4	2	0	16
		% within Number of Employees	12,5%	4,3%	5,6%	5,0%	7,4%	8,3%	7,1%	,0%	7,0%
	Administrative and support service activities	Count	8	3	2	0	1	4	2	2	19
		% within Number of Employees	17,0%	13,0%	11,1%	,0%	3,7%	9,5%	7,1%	6,9%	8,3%
	Public administration and defence	Count	0	0	2	4	4	10	4	7	31
		% within Number of Employees	,0%	,0%	11,1%	20,0%	14,8%	47,6%	14,3%	24,1%	13,0%
	Education	Count	2	0	0	0	3	1	5	0	11
		% within Number of Employees	4,2%	,0%	,0%	,0%	11,1%	4,8%	17,9%	,0%	4,6%
	Human health and social work activities	Count	[illegible]	0	1	[illegible]	0	0	2	[illegible]	[illegible]
		% within Number of Employees	4,2%	,0%	5,6%	5,0%	,0%	,0%	7,1%	3,4%	4,2%
	Other service activities	Count	2	2	2	[illegible]	[illegible]	0	0	[illegible]	[illegible]
		% within Number of Employees	4,2%	8,7%	11,1%	5,0%	3,7%	,0%	,0%	3,4%	3,8%
Total		Count	48	23	18	20	27	21	28	29	238
		% within Number of Employees	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 8: Cross-tabulation of organizational sectors and size

PM Method Frequencies

		Count	Column N %
Most Used PM Method	No PM method	[illegible]	[illegible]
	Home-grown PM method	[illegible]	[illegible]
	PRINCE2	[illegible]	[illegible]
	PMBOK	[illegible]	[illegible]
	[illegible]	4	1,8%
	[illegible]	4	1,8%
	[illegible]	2	,9%
	IPMA	2	,9%
	MSP	2	,9%
	RUP	2	,9%
	[illegible]		,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	XP	1	,4%
	Total	[illegible]	100,0%

Table 10: PM Method Frequencies

		Count	Column N %
Does Top Management Want to Introduce PM Method	No	14	33.3%
	Yes, PRINCE2	11	26.2%
	Yes, but has not determined which one	5	11.9%
	Yes, PMBOK	2	4,8%
	Yes, MSP	1	2.4%
	Respondent has no idea	9	21,4%
	Total	42	100.0%

Table 9: Attitude top management to change PM Method

	Top Management Attitude towards Most Used PM Method			
	No	Yes	Don't know	Total
Count	13	136	37	186
Row N %	7,0%	73,1%	19,9%	100,0%

Table 11: Top management attitude towards PM Method

		Count	Column N %
Top Management with Negative Attitude toward Current PM Method	Doesn't see value of PM method	4	30,8%
	Is still in search of a (more) suitable PM method	3	23.1%
	Prefers PRINCE2	3	23,1%
	Prefers a home-grown PM method	2	15.4%
	Prefers PMBOK	1	7,7%
	Total	13	100.0%

Table 12: Top management preference

		Count	Column N %
Actual Usage Most Used PM Method	0 - 25 %	48	25.8%
	25 - 50 %	59	31.7%
	50 - 75 %	46	24,7%
	75 - 100 %	33	17.7%
	Total	186	100,0%

Table 13: Use PM Method Frequencies

	Importance of Most Used PM Method								
	Strongly decreasing	Decreasing	Slightly decreasing	Constant	Slightly increasing	Increasing	Strongly increasing	No idea	Total
Count	1	11	15	39	64	37	17	2	186
Row N %	,5%	5,9%	8,1%	21.0%	34.4%	19,9%	9,1%	1,1%	100,0%
Row cluster %		14,5%		21.0%		63.4%		1,1%	100,0%

Table 14: Importance PM Method Frequencies

	Attitude of Respondent toward Most Used PM Method								
	Very negative	Negative	Little negative	Neutral	Little positive	Positive	Very positive	No opinion	Total
Count	1	3	6	18	66	61	25	6	186
Row N %	,5%	1,6%	3,2%	9,7%	35,5%	32,8%	13,4%	3,2%	100,0%
Row cluster %		5,4%		9,7%		81,7%		3,2%	100,0%

Table 15: Attitude Respondent PM Method Frequencies

PM Software Frequencies

		Count	Column N %
Reason Absence PM Software	Project organization too small	14	38,9%
	No commitment top management	7	19,4%
	Previous bad experience	5	13,9%
	PM processes are immature	3	8,3%
	Organization selection process	3	8,3%
	Unfamiliar with PM software	2	5,6%
	No idea	2	5,6%
	Total	36	100,0%

Table 16 Reason absence PM Software

		Count	Column N %
PM Software (packages / vendors)	Microsoft Project	69	30,3%
	None	40	17,5%
	Tools based on Microsoft Access, Excel, SharePoint	12	5,3%
	[illegible]	8	3,5%
	PROJECT [illegible]	7	3,1%
	Primavera	7	3,1%
	Planning (in-house)	5	2,2%
	[illegible]	5	2,2%
	PROJECT [illegible]	4	1,8%
	Project Progress	4	1,8%
	Bugtrax	4	1,8%
	Project InVision	3	1,3%
	[illegible]	3	1,3%
	Principal Toolbox [illegible]	3	1,3%
	Artemis	3	1,3%
	Changepoint (Compuware)	2	,9%
	[illegible]	2	,9%
	[illegible]	2	,9%
	[illegible]	2	,9%
	[illegible]	2	,9%
	[illegible]	2	,9%
	Plan	2	,9%
	OmniPlan	2	,9%
	Projectplace	2	,9%
	OpenProj [illegible]	2	,9%
	Version One	[illegible]	,4%
	[illegible]	[illegible]	,4%
	Mindmanager	[illegible]	,4%
	[illegible]	[illegible]	,4%
	Version One	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	Open Workbench	[illegible]	,4%
	[illegible]	1	,4%
	PLS	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	[illegible]	,4%
	Project Managers [illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	[illegible]	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	[illegible]	1	,4%
	Total	228	100,0%

Table 17 PM Software (Providers)

	Top Management Commitment toward PM Software								
	Very uncommitted	Uncommitted	Little uncommitted	Neutral	Little committed	Committed	Very committed	No idea	Total
Count	14	39	13	26	34	36	14	16	192
Row N %	7,3%	20,3%	6,8%	13,5%	17,7%	18,8%	7,3%	8,3%	100,0%
Row Cluster %		34,4%		13,5%		43,8%		8,3%	100,0%

Table 18 Top management commitment PM Software

Cluster Frequencies

PM Method Clusters Frequencies

			Most Used PM Method (none vs home-grown vs standard)			
			None	Home-grown	Standard	Total
Most Used PM Method (none-formal vs formal)	None-formal	Count	12			12
		Row N %	100,0%			18,1%
	Formal	Count		73	113	186
		Row N %		39,2%	60,8%	81,6%
	Total	Count	42	73	113	228
		Row N %	18,1%	32,0%	49,6%	100,0%

Table 20 PM Method clusters by formality and use

		Count	Column N %
Standard PM Methods	PRINCE2	71	62,8%
	PMBOK	24	21,2%
	SCRUM	3	2,7%
	CCPM	3	2,7%
	IPMA	2	1,8%
	DSDM	2	1,8%
	RUP	2	1,8%
	MSP	2	1,8%
	PRINCE	1	,9%
	EVO	1	,9%
	XP	1	,9%
	APQP	1	,9%
	Total	113	100,0%

Table 21 Standard PM Methods frequencies

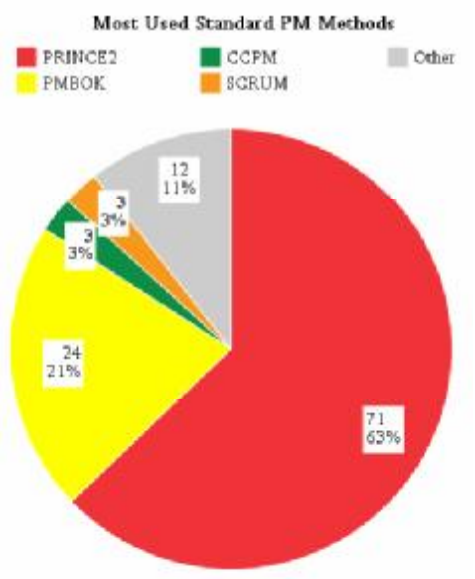


Figure 112 Standard PM Methods pie chart

PM Software Clusters Frequencies

		Count	Column N %
Type of PM Software (custom-built vs generic vs method-specific)	Custom-built	17	8,9%
	Generic	132	68,8%
	Method-specific	43	22,4%
	Total	192	100,0%

Table 22 PM Software clusters frequencies

		Count	Column N %
Custom-built PM Software (packages / vendors)	Centrit	3	17,6%
	Custom built (Excel)	2	11,8%
	Ekam	2	11,8%
	EMO Tool (EDS)	1	5,9%
	Mentormate	1	5,9%
	Pontis	1	5,9%
	i-PLAN LPI	1	5,9%
	Easy	1	5,9%
	VAIL (Magenta Solution	1	5,9%
	Ihsan IT	1	5,9%
	One Box	1	5,9%
	PTS	1	5,9%
	Lotus	1	5,9%
	Total	17	100,0%

Table 23 Custom-built PM Software frequencies

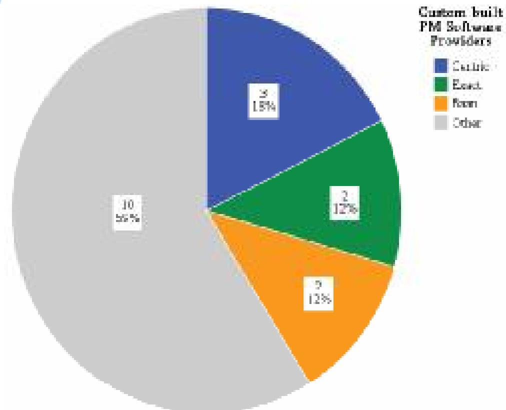


Figure 111 Custom built PM Software vendors pie chart

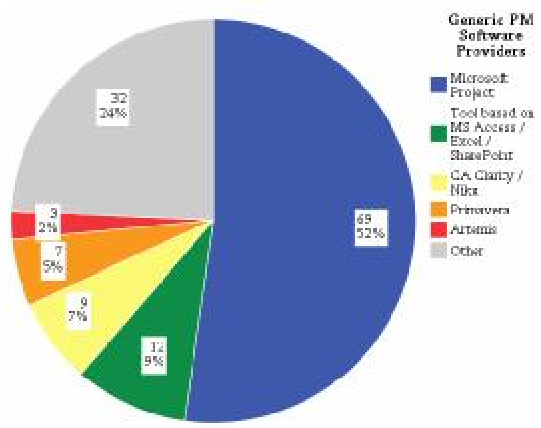


Figure 112 Generic PM Software provider pie chart

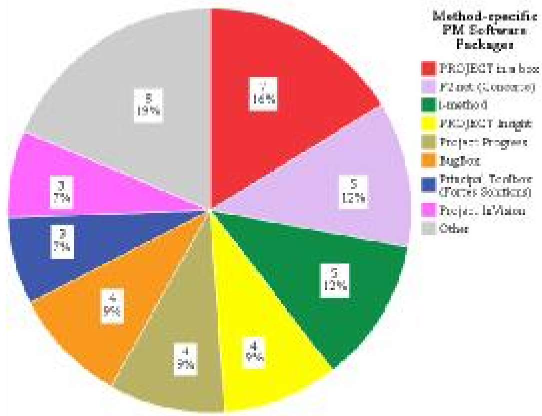
		Count	Column N %
Generic PM Software (packages / vendors)	Microsoft Project	69	52.3%
	Tool based on Microsoft Access / Excel / SharePoint	12	9.1%
	CA Clarity / Niku	9	6.8%
	Primavera	7	5.3%
	Artemis	3	2.3%
	Changepoint (Compuware)	2	1.5%
	@task	2	1.5%
	4c (4C Systems)	2	1.5%
	PeopleSoft ESA (Oracle)	2	1.5%
	OmniPlan	2	1.5%
	Projectplace	2	1.5%
	Open Plan (Deltek)	2	1.5%
	e-Synergy (Exact)	1	.8%
	Time Control (HMS Software)	1	.8%
	AMS Realtime Projects	1	.8%
	Powerproject (Asta)	1	.8%
	Open Workbench	1	.8%
	GanttProject	1	.8%
	dotProject	1	.8%
	[illegible]	1	.8%
	Easy Projects (Logic Software)	1	.8%
	Project Managers Jetpack ([illegible])	1	.8%
	EPM ([illegible])	1	.8%
	Maconomy Resource Planning	1	.8%
	PSNext (Sciforma)	1	.8%
	[illegible] Project	1	.8%
	xRPM / cPD (SAP)	1	.8%
	Planview	1	.8%
	OPX2 (Planisware)	1	.8%
	[illegible]	1	.8%
	Total	132	100.0%

Table 24 Generic PM Software provider frequencies

		Count	Column N %
Method-specific PM Software (packages / vendors)	PROJECT in a box	7	16.3%
	P2.net (Concerto)	5	11.6%
	i-method	5	11.6%
	PROJECT Insight	4	9.3%
	Project Progress	4	9.3%
	BugBox	4	9.3%
	Project InVision	3	7.0%
	Principal Toolbox (Fortes Solutions)	3	7.0%
	ShareLook ([illegible])	2	4.7%
	VersionOne	1	2.3%
	[illegible]	1	2.3%
	Cardinis Suite	1	2.3%
	Hydra (Project Management Group)	1	2.3%
	MPMM (Method 123)	1	2.3%
	[illegible] (Spherical Angle)	1	2.3%
	Total	43	100.0%

Table 25 Method-specific PM Software provider frequencies

Figure 113 Method-specific PM Software provider pie chart



Comparisons Frequencies

Survey of White and Fortune, 2002

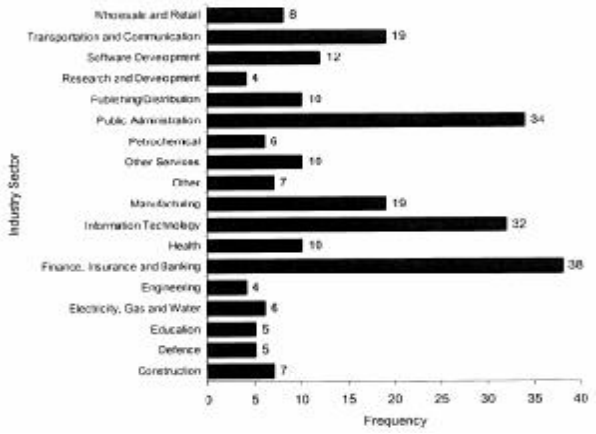


Figure 114: Industry sector frequencies (Source: White & Fortune, 2002)

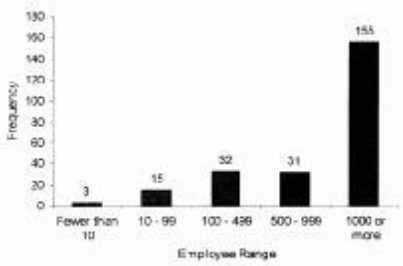


Figure 115: Employee range (Source: White & Fortune, 2002)

Project management method/methodology/tool/technique	Count of frequency of use	Total used	Mean	Mode	Range
Project management methods/methodologies		206	0.87	1	3
Projects in controlled environments (PRINCE)	23				
Projects in controlled environments 2 (PRINCE2)	14				
Structured systems analysis and design methodology (SSADM)	17				
The European risk management methodology (RISKMAN)	1				
The RIBA plan of work	2				
Other project management methods/methodologies[a]	16				
In house project management methods	128				
In house similar to PRINCE	5				
Project management tools		617	2.61	1	7
Critical path method (CPM)	70				
Work breakdown structure (WBS)	75				
Cash flow analysis (CFA)	43				
Gantt bar charts	152				
Graphical evaluation and review technique (GERT)	4				
Programme evaluation and review technique (PERT)	24				
Strengths weaknesses, opportunities and threats (SWOT)	41				
Other project management tools[b]	21				
Project management software	182				
In house project management tools	5				

Table 28: PM Methods, Tools and Techniques (Source: White & Fortune, 2002)

Survey of PSO PRO Consultants, 2005

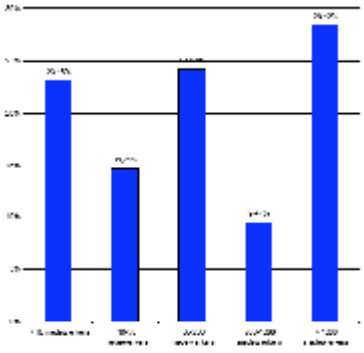


Figure 117: Employee range (Source: PRO, 2005)

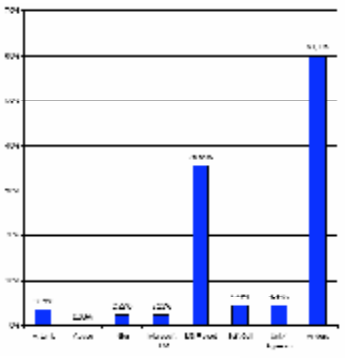
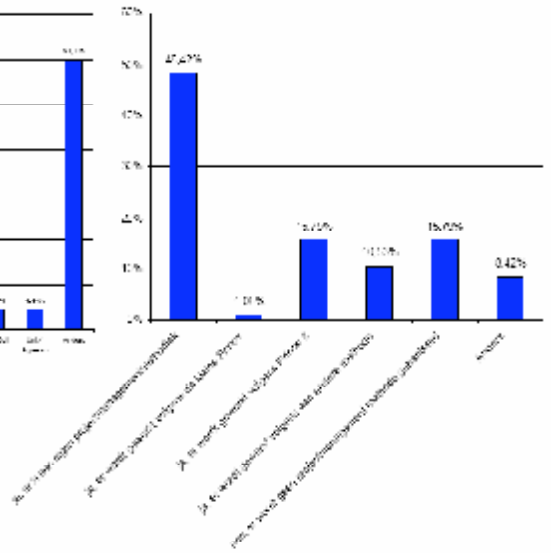


Figure 116: PM Software procedure (Source: PRO, 2005)

Figure 118: PM Methods (Source: PRO, 2005)



Survey of KPMG, 2005

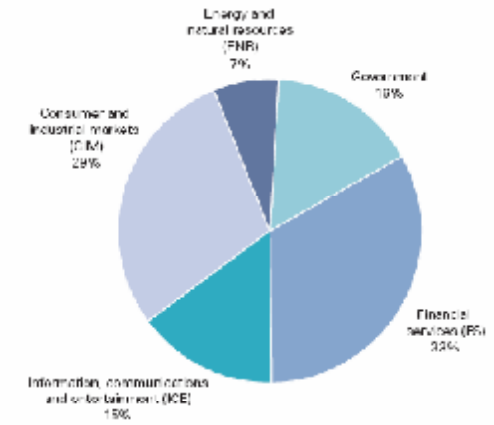


Figure 119: Industry sectors (Source: KPMG, 2005)

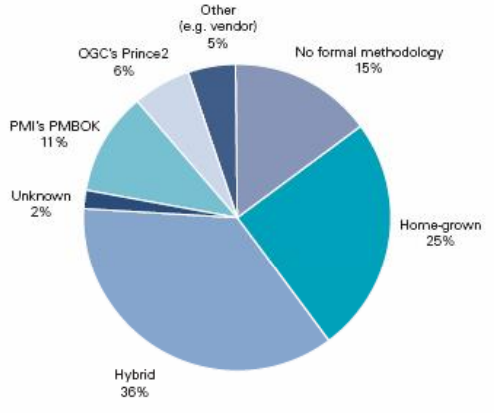


Figure 120: PM Methods (Source: KPMG, 2005)

PM Survey 2006/2007

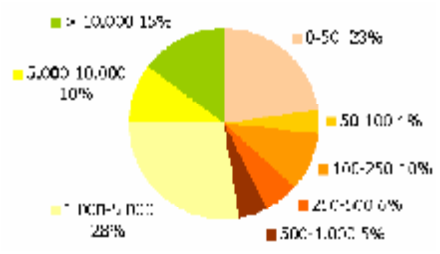


Figure 121: Employee range (Source: PM Survey, 2007)

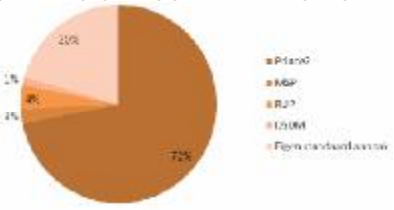


Figure 122: PM Method (Source: PM Survey, 2007)

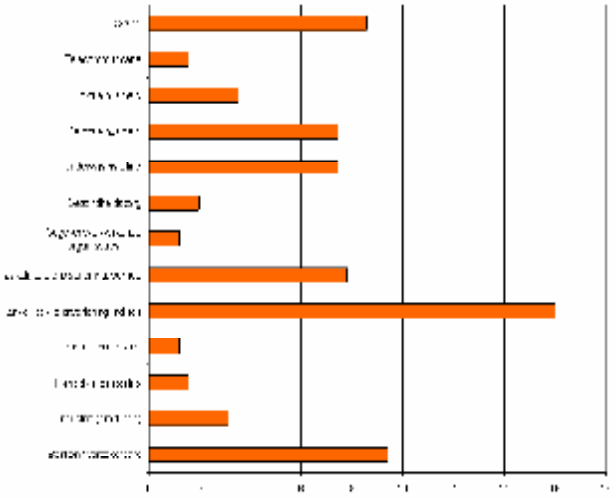


Figure 123: Activity sector (Source: PM Survey, 2007)

Attribute Frequencies

Frequencies of 10 Main Items

	Main Item 1 - Reliability of PM Software								
	Very bad	Bad	Below average	Average	Above average	Good	Very good	No idea	Total
Count	1	19	26	53	52	25	14	1	192
Row N %	,5%	9,9%	13,5%	27,6%	27,1%	13,0%	7,3%	,5%	100,0%
Table N %		23,9%		27,6%		47,9%		,5%	100,0%

Table 21: Reliability of PM Software

	Main Item 2 - Ease of Use of PM Software								
	Very bad	Bad	Below average	Average	Above average	Good	Very good	No idea	Total
Count	2	16	41	49	52	24	9	1	192
Row N %	1,0%	8,3%	20,8%	25,5%	27,1%	12,0%	4,7%	,5%	100,0%
Table N %		30,2%		25,5%		44,3%		,5%	100,0%

Table 22: Ease of use of PM Software

Main Item 3 - Usefulness of Features and Functions of PM Software

	Very bad	Bad	Below average	Average	Above average	Good	Very good	No idea	Total
Count	4	9	46	47	62	27	8	1	192
Row N %	2,1%	4,7%	24,0%	24,5%	32,3%	14,1%	4,2%	,5%	100,0%
Table N %		30,7%		24,5%		45,5%		5%	100,0%

Table 18 - Usefulness of features and functions of PM Software

Main Item 4 - Overall Satisfaction with PM Software

	Very dissatisfied	Dissatisfied	Little dissatisfied	Neutral	Little satisfied	Satisfied	Very satisfied	No idea	Total
Count	4	18	26	33	39	21	7	3	192
Row N %	2,1%	9,4%	13,5%	17,2%	20,3%	10,9%	3,6%	1,6%	100,0%
Table N %		47,9%		17,2%		34,9%		5,2%	100,0%

Table 19 - Overall Satisfaction with PM Software

Main Item 5 - Efficiency by PM Software

	Very negative	Negative	Little negative	Neutral	Little positive	Positive	Very positive	No opinion	Total
Count	11	6	34	53	64	24	9	3	192
Row N %	5,7%	3,1%	17,7%	27,6%	33,3%	12,5%	4,7%	1,6%	100,0%
Table N %		26,6%		27,6%		70,8%		1,6%	100,0%

Table 20 - Efficiency by PM Software

Main Item 6 - Effectiveness by PM Software

	Very negative	Negative	Little negative	Neutral	Little positive	Positive	Very positive	No opinion	Total
Count	1	11	30	53	63	17	9	3	192
Row N %	,5%	5,7%	15,6%	27,6%	32,8%	8,9%	4,7%	1,6%	100,0%
Table N %		23,4%		27,6%		67,2%		1,6%	100,0%

Table 21 - Effectiveness by PM Software

Main Item 7 - Costs of PM Software

	Much worse than expected	Worse than expected	Little worse than expected	As expected	Little better than expected	Better than expected	Much better than expected	No idea	Total
Count	4	20	28	78	24	17	9	49	192
Row N %	1,6%	10,4%	9,4%	40,6%	12,5%	8,9%	4,7%	25,5%	100,0%
Table N %		21,4%		40,6%		22,9%		25,5%	100,0%

Table 22 - Costs of PM Software

Main Item 8 - Implementation Time of PM Software

	Much worse than expected	Worse than expected	Little worse than expected	As expected	Little better than expected	Better than expected	Much better than expected	No idea	Total
Count	7	24	27	79	43	17	7	44	192
Row N %	,5%	12,5%	14,1%	41,1%	22,4%	8,9%	3,6%	22,9%	100,0%
Table N %		26,6%		41,1%		35,2%		22,9%	100,0%

Table 23 - Implementation time of PM Software

Main Item 9 - PM Process support by PM Software

	Much worse than expected	Worse than expected	Little worse than expected	As expected	Little better than expected	Better than expected	Much better than expected	No idea	Total
Count	2	20	39	43	43	18	9	9	192
Row N %	1,0%	10,4%	20,3%	24,0%	22,4%	9,4%	4,7%	4,7%	100,0%
Table N %		30,7%		24,0%		36,4%		4,7%	100,0%

Table 24 - Process support by PM Software

Main Item 10 - Organizational Development by PM Software

	Much worse than expected	Worse than expected	Little worse than expected	As expected	Little better than expected	Better than expected	Much better than expected	No idea	Total
Count	8	26	57	42	24	9	9	27	192
Row N %	4,2%	13,5%	29,7%	21,9%	12,5%	4,7%	3,6%	14,1%	100,0%
Table N %		47,4%		21,9%		18,8%		14,1%	100,0%

Table 25 - Organizational development by PM Software

Frequencies of 3 Supplementary Items

	Conditions of Use of PM Software			
	Obligatory	Voluntary	Other[a]	Total
Count	81	106	5	192
Row N %	42,2%	55,2%	2,6%	100,0%

a. e.g. combinations of obligatory and voluntary

Table 5.66 Conditions of use PM software

		Count	Column N %
Perceived Use of PM software	10%	18	9,4%
	20%	20	10,4%
	30%	25	13,0%
	40%	15	7,8%
	50%	14	7,3%
	60%	23	12,0%
	70%	29	15,1%
	80%	21	10,9%
	90%	16	8,3%
	100%	8	4,2%
	No idea	3	1,6%
	Total	192	100,0%

Table 5.67 Perceived use of PM Software frequencies

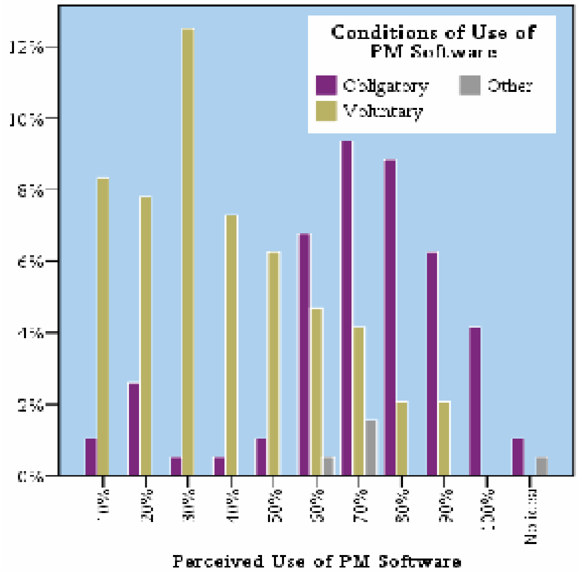


Figure 12 Perceived use by conditions of use frequencies

	Attitude of Respondents toward Using PM Software								
	Very unwilling	Unwilling	Little unwilling	Neutral	Little willing	Willing	Very willing	No idea	Total
Count	1	16	29	42	53	39	8	4	192
Row N %	,5%	8,3%	15,1%	21,9%	27,6%	20,3%	4,2%	2,1%	100,0%
Table N %	,5%	8,3%	15,1%	21,9%	27,6%	20,3%	4,2%	2,1%	100,0%

Table 5.69 Attitude responses PM Software

Descriptive Statistics of Main and Supplementary Items

Statistics

	N		Mean	Median	Mode	Std. Deviation	Minimum	Maximum
	Valid	Missing[b]						
Main Item 01 - Reliability of PM Software	191	37	4,40	4,41[a]	[illegible]	1,19	1	7
Main Item 02 - Ease of Use of PM Software	191	37	4,25	4,29[a]	5	1,32	1	7
Main Item 03 - Usefulness of Functions and Features of PM Software	191	37	4,32	4,37[a]	[illegible]	1,32	1	7
Main Item 04 - Satisfaction of PM Software	187	41	3,92	3,71[a]	5	1,45	1	7
Main Item 05 - Efficiency by PM Software	189	39	4,47	4,55[a]	[illegible]	1,17	2	7
Main Item 06 - Effectiveness by PM Software	189	39	4,21	4,22[a]	4	1,19	1	7
Main Item 07 - Costs of PM Software	143	85	4,03	4,04[a]	4	1,40	1	7
Main Item 08 - Implementation Time of PM Software	159	69	3,99	3,98[a]	4	1,30	1	7
Main Item 09 - PM Process Support by PM Software	183	45	3,92	3,94[a]	4	1,41	1	7
Main Item 10 - Organisational Development by PM Software	171	57	3,57	3,59[a]	3	1,35	1	7
Suppl. Item 01 - Conditions of Use of PM Software	187	41	1,57	1,57[a]	2	,55	1	3
Suppl. Item 02 - Perceived Use of PM Software	181	47	5,06	5,03[a]	7	2,55	1	9
Suppl. Item 03 - Attitude of Respondent toward PM Software	188	40	4,49	4,47[a]	[illegible]	1,35	1	7

a. Calculated from grouped data.

b. Every item is missing at least 36, since this many respondents did not report any PM software

Table 5.70 Descriptive statistics of main and supplementary items

Frequencies of Construct

			Count	Column N %	Cluster N %
Mean Item Score Ranges	1-2	Unsuccessful	1	,5%	
	2-3	Unsuccessful	14	7,3%	
	3-4	Unsuccessful	75	39,1%	46,9%
	4-5	Successful	76	39,6%	
	5-6	Successful	17	8,9%	
	6-7	Successful	9	4,7%	53,1%
	Total		192	100,0%	100,0%

Table 40: Mean item score ranges

Test Variable Frequencies

	Test Variable (Overall Successfulness of PM Software According to Respondent)								
	Very unsuccessful	Unsuccessful	Little unsuccessful	Neutral	Little successful	Successful	Very successful	No idea	Total
Count	2	25	40	42	35	28	7	12	192
Row N %	1,0%	[illegible]	20,8%	21,9%	18,2%	14,6%	3,6%	6,3%	100,0%
Table N %		35,4%		21,9%		36,4%		6,3%	100,0%

Table 41: Test variable frequencies

	Constructed Variable (Recoded in Categories)								
	Very unsuccessful	Unsuccessful	Little Unsuccessful	Neutral	Successful	Very successful	Very successful	No idea	Total
Count	0	7	53	72	9	47	4	0	192
Row N %	,0%	3,6%	27,6%	37,5%	4,7%	24,5%	2,1%	,0%	100,0%
Table N %		31,3%		37,5%		31,3%		,0%	100,0%

Table 42: Constructed variable (recoded in categories) frequencies

Variances between Test Variable and Constructed Variable

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Equal Course	133	58,2	69,3	69,3
	Opposing Course	5	2,2	2,6	71,9
	N/A [a]	54	23,7	28,1	100,0
	Total	192	84,2	100,0	
Missing	System	36	15,9		
Total		228	100,0		

a. In these cases it is [illegible] value is 'No idea' or 'Neutral'

Table 43: Variances between test and constructed variable

Associative Items

PM Organization Correlations

Correlations

		Respondent Source	Survey Language	Organizational Size	Organizational Activity Sector	Willing to Cooperate
Respondent Source	Pearson Correlation	1	,651**	-,081	-,040	,010
	Sig. (2-tailed)		,000	,222	,552	,877
	N	228	228	228	228	228
Survey Language	Pearson Correlation	,651**	1	,101	-,025	-,011
	Sig. (2-tailed)	,000		,128	,712	,869
	N	228	228	228	228	228
Number of Employe	Pearson Correlation	-,081	,101	1	,022	-,006
	Sig. (2-tailed)	,222	,128		,739	,931
	N	228	228	228	228	228
Organizational Activity Sector	Pearson Correlation	-,040	-,025	,022	1	,015
	Sig. (2-tailed)	,552	,712	,739		,501
	N	228	228	228	228	228
Willing to Cooperate	Pearson Correlation	,010	-,011	-,006	,045	1
	Sig. (2-tailed)	,877	,869	,931	,501	
	N	228	228	228	228	228

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4a: PM Organization correlations

PM Method Correlations

Correlations

		Most Used PM Method (frame-growers vs standard)	Attitude of the Management toward Most Used PM Method	Attitude Respondent toward Most Used PM Method	Perceived Use Most Used PM Method	Importance of Most Used PM Method
Most Used PM Method (frame-growers vs standard)	Pearson Correlation	1	,011	,017	,159*	,150*
	Sig. (2-tailed)		,876	,808	,209	,294
	N	186	145	182	186	170
Attitude of the Management toward Most Used PM Method	Pearson Correlation	,011	1	,110*	,284	,227**
	Sig. (2-tailed)	,876		,276	,389	,287
	N	145	145	144	149	148
Attitude of Respondent toward Most Used PM Method	Pearson Correlation	,017	,122*	1	,159*	,186*
	Sig. (2-tailed)	,808	,276		,209	,281
	N	182	144	182	184	168
Perceived Use Most Used PM Method	Pearson Correlation	,159*	,088	,159*	1	,196*
	Sig. (2-tailed)	,089	,288	,088		,209
	N	186	149	182	186	170
Importance of Most Used PM Method	Pearson Correlation	,150*	,227**	,186*	,196*	1
	Sig. (2-tailed)	,294	,287	,281	,209	
	N	170	148	168	170	170

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4b: PM Method correlations

PM Software Correlations

Correlations

		Type of PM Software (custom-built vs generic vs method-specific)	Attitude of Top Management toward PM Software	Attitude of Respondent toward PM Software	Condition of Use of PM Software	Perceived Use of PM Software
Type of PM Software (custom-built vs generic vs method-specific)	Pearson Correlation	1	,030	,160*	,158*	,056
	Sig. (2-tailed)		,699	,033	,035	,444
	N	193	176	168	167	189
Attitude of Top Management toward PM Software	Pearson Correlation	,030	1	,423**	,327**	,459**
	Sig. (2-tailed)	,699		,000	,000	,000
	N	176	176	173	171	174
Attitude of Respondent toward PM Software	Pearson Correlation	,160*	,423**	1	,227**	,380**
	Sig. (2-tailed)	,033	,000		,003	,000
	N	168	173	168	165	166
Condition of Use of PM Software	Pearson Correlation	,158*	,327**	,227**	1	,581**
	Sig. (2-tailed)	,029	,000	,003		,000
	N	167	171	165	167	165
Perceived Use of PM Software	Pearson Correlation	,056	,459**	,380**	,581**	1
	Sig. (2-tailed)	,444	,000	,000	,000	
	N	189	174	166	165	189

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 46. PM Software correlations

PM Software Success Correlations

Correlations

		Constructed Variable PM Software Success	Attitude of Top Management toward PM Software	Attitude of Respondent toward Using PM Software	Condition of Use of PM Software	Perceived Use of PM Software
Constructed Variable PM Software Success	Pearson Correlation	1	,444**	,468**	,165*	,274**
	Sig. (2-tailed)		,000	,000	,026	,000
	N	193	176	168	167	189
Attitude of Top Management toward PM Software	Pearson Correlation	,444**	1	,423**	,327**	,459**
	Sig. (2-tailed)	,000		,000	,000	,000
	N	176	176	173	171	174
Attitude of Respondent toward Using PM Software	Pearson Correlation	,468**	,423**	1	,227**	,380**
	Sig. (2-tailed)	,000	,000		,003	,000
	N	168	173	168	165	166
Condition of Use of PM Software	Pearson Correlation	,165*	,327**	,227**	1	,581**
	Sig. (2-tailed)	,026	,000	,003		,000
	N	167	171	165	167	165
Perceived Use of PM Software	Pearson Correlation	,274**	,459**	,380**	,581**	1
	Sig. (2-tailed)	,000	,000	,000	,000	
	N	189	174	166	165	189

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 47. PM Software Success correlations

Administering TAM

Correlations

			Perceived Usefulness	Perceived Ease of Use	Attitude toward Using	Use
Kendall's tau_b	Perceived Usefulness	Correlation Coefficient	1.000	.289**	.238**	.176*
		Sig. (2-tailed)	.	.000	.000	.012
		N	191	191	187	164
	Perceived Ease of Use	Correlation Coefficient	.289**	1.000	.212**	.099
		Sig. (2-tailed)	.000	.	.000	.078
		N	191	191	187	164
	Attitude toward Using	Correlation Coefficient	.238**	.212**	1.000	.316**
		Sig. (2-tailed)	.000	.000	.	.000
		N	187	187	188	162
	Use	Correlation Coefficient	.176*	.099	.316**	1.000
		Sig. (2-tailed)	.012	.078	.000	.
		N	164	164	162	165

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 49 - TAM element correlations irrespective condition

Correlations

			Perceived Usefulness	Perceived Ease of Use	Attitude toward Using	Use
Kendall's tau_b	Perceived Usefulness	Correlation Coefficient	1.000	.283**	.152*	.111
		Sig. (2-tailed)	.	.001	.028	.079
		N	105	105	103	97
	Perceived Ease of Use	Correlation Coefficient	.283**	1.000	.283**	.182*
		Sig. (2-tailed)	.001	.	.001	.021
		N	105	105	103	97
	Attitude toward Using	Correlation Coefficient	.152*	.283**	1.000	.218*
		Sig. (2-tailed)	.028	.001	.	.011
		N	103	103	104	96
	Use	Correlation Coefficient	.111	.200**	.272**	1.000
		Sig. (2-tailed)	.278	.021	.001	.
		N	97	97	96	99

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 50 - TAM element correlations in obligatory condition

Correlations

			Perceived Usefulness	Perceived Ease of Use	Attitude toward Using	Use
Kendall's tau_b	Perceived Usefulness	Correlation Coefficient	1.000	.238**	.252**	.014
		Sig. (2-tailed)	.	.025	.006	.910
		N	87	87	84	66
	Perceived Ease of Use	Correlation Coefficient	.238**	1.000	.211*	-.024
		Sig. (2-tailed)	.025	.	.021	.774
		N	87	87	84	66
	Attitude toward Using	Correlation Coefficient	.252**	.211*	1.000	.215*
		Sig. (2-tailed)	.006	.011	.	.029
		N	84	84	84	66
	Use	Correlation Coefficient	.014	-.024	.216*	1.000
		Sig. (2-tailed)	.910	.774	.025	.
		N	66	66	64	66

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 51 - TAM element correlations in obligatory condition

Administering TTF Model

Correlations

			Task Technology Fit[a]	Belief[b]	Utilization (Use)	Performance Impact[c]
Kendall's tau_b	Task Technology Fit	Correlation Coefficient	1.000	.078*	.107*	.210**
		Sig. (2-tailed)	.	.023	.024	.000
		N	189	181	159	181
	Attitude towards Using	Correlation Coefficient	.258**	1.000	.319**	.278**
		Sig. (2-tailed)	.000	.	.000	.000
		N	167	189	161	189
	Use	Correlation Coefficient	.107*	.097*	1.000	.016
		Sig. (2-tailed)	.024	.023	.	.827
		N	159	161	169	161
	Performance Impact	Correlation Coefficient	.467**	.278**	.016	1.000
		Sig. (2-tailed)	.000	.000	.827	.
		N	167	189	161	189

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. Represented by PM Process Support Item

b. Represented by Attitude Towards Using Item

c. Represented by equally weighted Utilization Items and Task Technology Fit Items

Table 50: TTF Model correlations

Evaluating Framework

			PM Software Success	
			Unsuccessful	Successful
			Count	Count
Organizational Sectors	Intangible asset	Agriculture, forestry and fishing	0	1
		Mining and quarrying	0	2
		Manufacturing	12	10
		Energy	2	3
		Construction	2	6
		Wholesale and retail trade	1	1
		Transportation and storage	2	3
		Accommodation and food service activities	0	3
		Total	22	29
	Intangible asset	Information and communication	11	29
		Financial and insurance activities	9	6
		Real estate activities	1	3
		Professional, scientific and technical activities	6	6
		Administrative and support service activities	0	2
		Several sectors	4	4
		Total	42	51
	Intangible asset	Public administration and defence	0	6
		Education	2	2
		Human health and social work activities	5	0
		Total	22	18

Table 51: Process organizational sectors

Correlations

		Organizational Success (tangible asset; intangible asset; intangible intellect)	Organizational Size (small; medium; large)	PM Method (none; home grown; standard)	PM Software (custom-built; generic; method specific)	PM Software Success (unsuccessful; successful)
Organizational Success (tangible asset; intangible asset; intangible intellect)	Pearson Correlation	1	,105	,094	,021	,063
	Sig. (2-tailed)		,107	,158	,387	,197
	N	228	228	228	192	192
Organizational Size (small; medium; large)	Pearson Correlation	,105	1	,206**	,115	,085
	Sig. (2-tailed)	,107		,002	,107	,220
	N	228	228	228	192	192
PM Method (none; home grown; standard)	Pearson Correlation	,094	,206**	1	,095	,159*
	Sig. (2-tailed)	,158	,002		,246	,028
	N	228	228	228	192	192
PM Software (custom-built; generic; method specific)	Pearson Correlation	,021	,115	,095	1	,061
	Sig. (2-tailed)	,387	,107	,236		,398
	N	192	192	192	192	192
PM Software Success (unsuccessful; successful)	Pearson Correlation	,063	,085	,159*	,061	1
	Sig. (2-tailed)	,197	,270	,028	,398	
	N	192	192	192	192	192

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 56. Final Framework correlations

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17,503[a]	4	,001
Likelihood Ratio	17,866	4	,001
Linear-by-Linear Association	9,486	1	,002
N of Valid Cases	228		

a. 2 cells (22,2%) have expected count less than 5. The minimum expected count is 11,37.

Table 57. Final Framework Chi-Square tests

PM Method (none; home-grown; standard) * Organizational Size (small; medium; large) Crosstabulation

			Organizational Size (small; medium; large)			
			0 - 100 Employees	100 - 1.000 Employees	> 1.000 Employees	Total
PM Method (none; home-grown; standard	None	Count	23	12	7	42
		% within Organizational Size (small; medium; large	32,9%	18,5%	7,5%	18,4%
	Home-grown	Count	18	19	36	73
		% within Organizational Size (small; medium; large	25,7%	29,2%	38,7%	32,0%
	Standard	Count	29	34	50	113
		% within Organizational Size (small; medium; large	41,4%	52,3%	53,8%	49,6%
Total		Count	70	65	93	228
		% within Organizational Size (small; medium; large	100,0%	100,0%	100,0%	100,0%

Table 58. Final Framework cross tabulation

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,178[a]	2	,075
Likelihood Ratio	5,203	2	,074
Linear-by-Linear Association	4,823	1	,028
N of Valid Cases	192		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 17,17.

Table 56: Chi-Square cross-tabulation

PM Software Success (unsuccessful; successful) * PM Method (none; home-grown; standard) Crosstabulation

			PM Method (none; home-grown; standard)			
			None	Home-grown	Standard	Total
PM Software Success (unsuccessful; successful)	Unsuccessful	Count	21	29	40	90
		% within PM Method (none; home-grown; standard)	63,6%	47,5%	40,8%	46,9%
	Successful	Count	12	32	58	102
		% within PM Method (none; home-grown; standard)	36,4%	52,5%	59,2%	53,1%
Total		Count	33	61	98	192
		% within PM Method (none; home-grown; standard)	100,0%	100,0%	100,0%	100,0%

Table 57: PM Method and PM Software Success cross-tabulation

Correlations within the PM Method Condition

		Organizational Scope (simple-craft; intangible-craft; intangible-intellect)	Organizational Size (small; medium; large)	PM Method (none; home-grown; standard)	PM Software (custom-built; generic method specific)	PM Software Success (unsuccessful; successful)
Organizational Scope (simple-craft; intangible-craft; intangible-intellect)	Pearson Correlation	1	,292	.	,171	-,060
	Sig. (2-tailed)		,062	.	,339	,711
	N	42	42	42	33	33
Organizational Size (small; medium; large)	Pearson Correlation	,292	1	.	,156	,257
	Sig. (2-tailed)	,062		.	,385	,148
	N	42	42	42	33	33
PM Method (none; home-grown; standard)	Pearson Correlation	.	.	.	.	.
	Sig. (2-tailed)	.	.	.	.	.
	N	42	42	42	33	33
PM Software (custom-built; generic method specific)	Pearson Correlation	,171	,156	.	1	,299
	Sig. (2-tailed)	,339	,385	.		,091
	N	33	33	33	33	33
PM Software Success (unsuccessful; successful)	Pearson Correlation	-,061	,261	.	,299	1
	Sig. (2-tailed)	,742	,138	.	,090	
	N	33	33	33	33	33

*. Cannot be computed because at least one of the variables is constant.

Table 58: Final framework correlations in no-method condition

Correlations within Home-grown PM Condition

		Organizational Sectors (tangible-oriented; intangible-oriented; intangible-intellect)	Organizational Size (small; medium; large)	PM Method (none; home-grown; standard)	PM Software (custom-built; generic-method-specific)	PM Software Success (unsuccessful; successful)
Organizational Sectors (tangible-oriented; intangible-oriented; intangible-intellect)	Pearson Correlation	1	-.136	.a	.038	-.269*
	Sig. (2-tailed)		.289	.	.771	.036
	N	71	71	71	61	51
Organizational Size (small; medium; large)	Pearson Correlation	.136	1	.a	.114	.084
	Sig. (2-tailed)	.289		.	.381	.720
	N	71	71	71	61	51
PM Method (none; home-grown; standard)	Pearson Correlation	.a	.a	.a	.a	.a
	Sig. (2-tailed)	.	.		.	.
	N	71	71	71	61	51
PM Software (custom-built; generic-method-specific)	Pearson Correlation	.038	.114	.a	1	.035
	Sig. (2-tailed)	.771	.381	.		.810
	N	61	61	61	61	51
PM Software Success (unsuccessful; successful)	Pearson Correlation	-.269*	-.082	.a	-.021	1
	Sig. (2-tailed)	.036	.526	.	.870	
	N	51	51	51	51	51

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

Table 59. Final framework correlations in home-grown method condition

Correlations within Standard PM Condition

		Organizational Sectors (tangible-oriented; intangible-oriented; intangible-intellect)	Organizational Size (small; medium; large)	PM Method (none; home-grown; standard)	PM Software (custom-built; generic-method-specific)	PM Software Success (unsuccessful; successful)
Organizational Sectors (tangible-oriented; intangible-oriented; intangible-intellect)	Pearson Correlation	1	.234*	.a	.029	.217
	Sig. (2-tailed)		.017	.	.789	.043
	N	113	113	113	98	90
Organizational Size (small; medium; large)	Pearson Correlation	.234*	1	.a	.027	.176
	Sig. (2-tailed)	.017		.	.787	.093
	N	113	113	113	98	90
PM Method (none; home-grown; standard)	Pearson Correlation	.a	.a	.a	.a	.a
	Sig. (2-tailed)	.	.		.	.
	N	113	113	113	98	90
PM Software (custom-built; generic-method-specific)	Pearson Correlation	.029	.027	.a	1	.211*
	Sig. (2-tailed)	.789	.787	.		.046
	N	98	98	98	98	90
PM Software Success (unsuccessful; successful)	Pearson Correlation	.217	.176	.a	.211*	1
	Sig. (2-tailed)	.043	.093	.	.046	
	N	90	90	90	90	90

*. Correlation is significant at the 0.05 level (2-tailed).

a. Cannot be computed because at least one of the variables is constant.

Table 60. Final framework correlations in standard method condition

PM Software Success (unsuccessful; successful) * PM Software (custom-built; generic method-specific) * PM Method (none; home-grown; standard) Crosstabulation

PM Method (none; home-grown; standard)				PM Software (custom-built; generic method-specific)			
				Custom-built	Generic	Method-specific	Total
None	PM Software Success (unsuccessful; successful)	Unsuccessful	Count	3	18	7	28
			% within PM Software (custom-built; generic method-specific)	33,3%	81,8%	77,8%	73,7%
		Successful	Count	2	4	2	10
			% within PM Software (custom-built; generic method-specific)	66,7%	18,2%	22,2%	26,3%
	Total		Count	9	22	9	38
			% within PM Software (custom-built; generic method-specific)	100,0%	100,0%	100,0%	100,0%
Home-grown	PM Software Success (unsuccessful; successful)	Unsuccessful	Count	6	21	4	31
			% within PM Software (custom-built; generic method-specific)	50,0%	65,6%	57,1%	62,0%
		Successful	Count	6	11	3	19
			% within PM Software (custom-built; generic method-specific)	50,0%	34,4%	42,9%	38,0%
	Total		Count	12	32	7	50
			% within PM Software (custom-built; generic method-specific)	100,0%	100,0%	100,0%	100,0%
Standard	PM Software Success (unsuccessful; successful)	Unsuccessful	Count	9	29	7	45
			% within PM Software (custom-built; generic method-specific)	69,2%	61,7%	25,9%	50,6%
		Successful	Count	4	18	20	44
			% within PM Software (custom-built; generic method-specific)	30,8%	38,3%	74,1%	49,4%
	Total		Count	13	47	27	89
			% within PM Software (custom-built; generic method-specific)	100,0%	100,0%	100,0%	100,0%

Table A1: PM Software * PM Method and PM Software Success cross tabulation

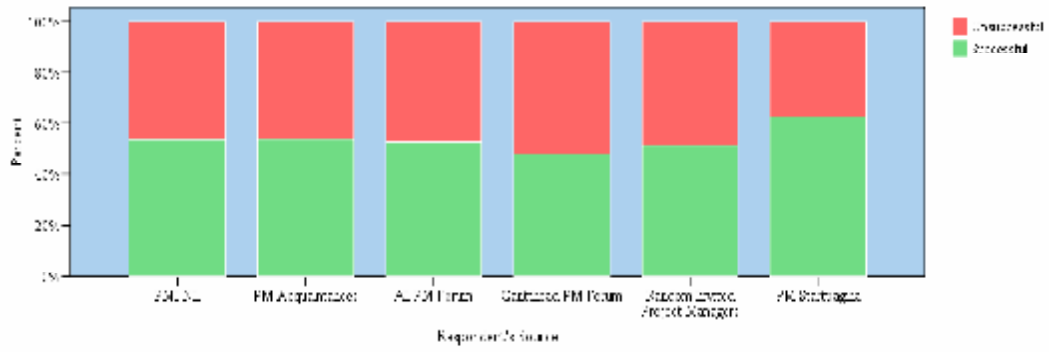


Figure 128: PM Software Success by respondent's source

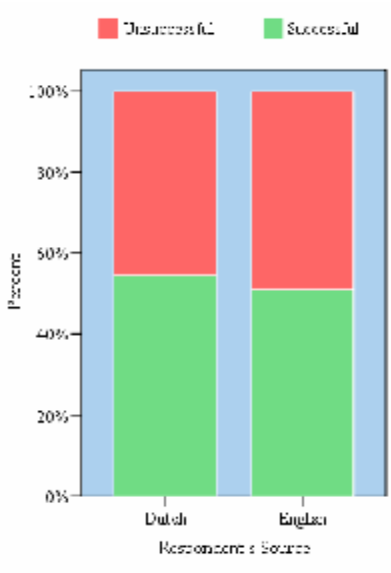


Figure 127: PM Software Success by language

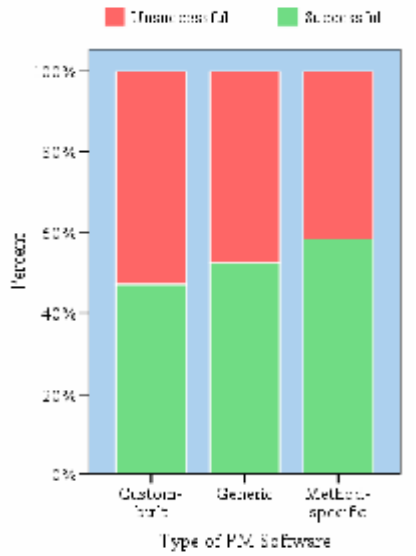


Figure 129: PM Software Success by PM Software

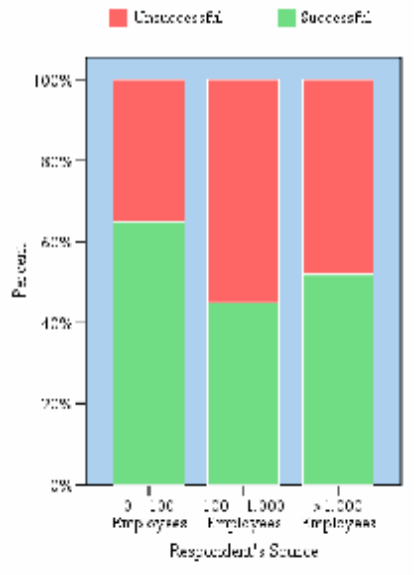


Figure 126: PM Software Success by organizational size

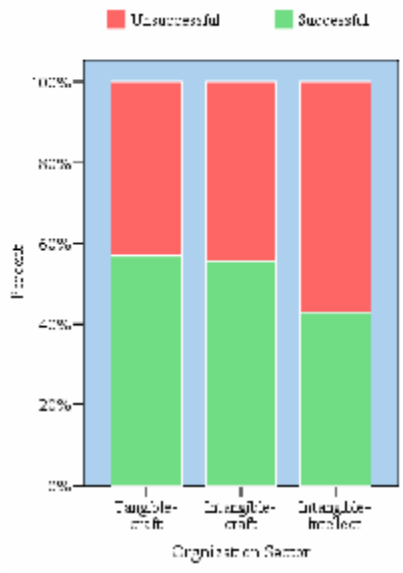


Figure 129: PM Software Success by organizational sector

VII Additional Figures

This 7th appendix includes figures several knowledge bodies, frameworks and theoretical models which were referred to in the main thesis text. These are the bodies of the PMBOK and P3M3. Also two Magic Quadrants (2006 and 2007) of Gartner are enclosed. Besides these figures this appendix contains various theoretical models, such as the Revisited D&M Model, the TRA Model, the TPB Model, the TAM2 and UTAUT Model.

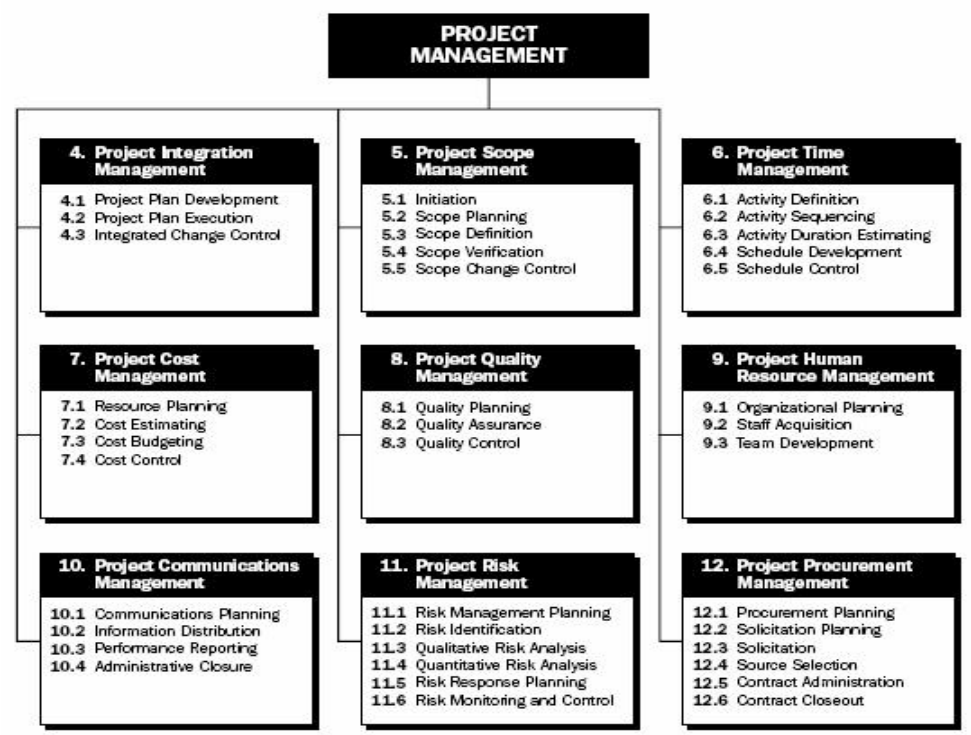


Figure VII: Overview of PM areas (alignment and PM processes (Source: PMBOK, 2000)

Maturity:	Project	Programme	Portfolio
Level 1 - *initial process*	Does the organisation recognise projects and run them differently from its ongoing business? (Projects may be run informally with no standard process or tracking system.)	Does the organisation recognise programmes and run them differently to projects? (Programmes may be run informally with no standard process or tracking system.)	Does the organisation's Board recognise programmes and projects and run an informal list of its investments in programmes and projects? (There may be no formal tracking and reporting process.)
Level 2 - *repeatable process*	Does the organisation ensure that each project is run with its own processes and procedures to a minimum specified standard? (There may be limited consistency or co-ordination between projects)	Does the organisation ensure that each programme is run with its own processes and procedures to a minimum specified standard? (There may be limited consistency or co-ordination between programmes)	Does the organisation ensure that each programme and/or project in its portfolio is run with its own processes and procedures to a minimum specified standard? (There may be limited consistency or co-ordination)
Level 3 - *defined process*	Does the organisation have its own centrally controlled project processes, and can individual projects flex within these processes to suit the particular project?	Does the organisation have its own centrally controlled programme processes and can individual programmes flex within these processes to suit the particular programme?	Does the organisation have its own centrally controlled programme and project processes and can individual programmes and projects flex within these processes to suit particular programmes and/or projects. And does the organisation have its own portfolio management process?

Figure VII: P3M3 Processes (Source: OGC, 2006)

Maturity:	Project	Programme	Portfolio
Level 4 - *managed process*	Does the organisation obtain and retain specific measurements on its project management performance and run a quality management organisation to better predict future performance?	Does the organisation obtain and retain specific measurements on its programme management performance and run a quality management organisation to better predict future programme outcomes?	Does the organisation obtain and retain specific management metrics on its whole portfolio of programmes and projects as a means of predicting future performance? Does the organisation assess its capacity to manage programmes and projects and prioritise them accordingly?
Level 5 - *optimised process*	Does the organisation run continuous process improvement with proactive problem and technology management for projects in order to improve its ability to depict performance over time and optimise processes?	Does the organisation run continuous process improvement with proactive problem and technology management for programmes in order to improve its ability to depict performance over time and optimise processes?	Does the organisation run continuous process improvement with proactive problem and technology management for the portfolio in order to improve its ability to depict performance over time and optimise processes?

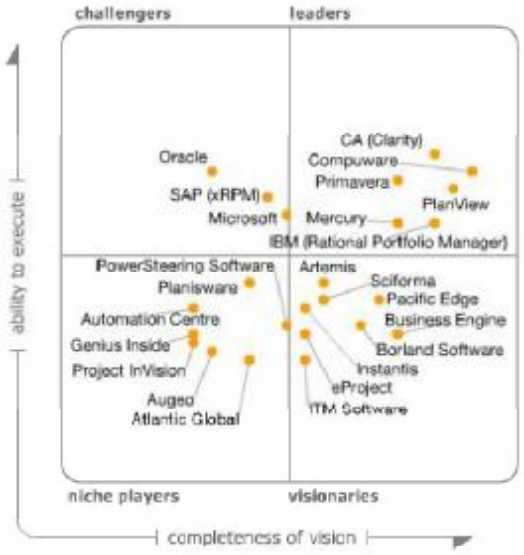
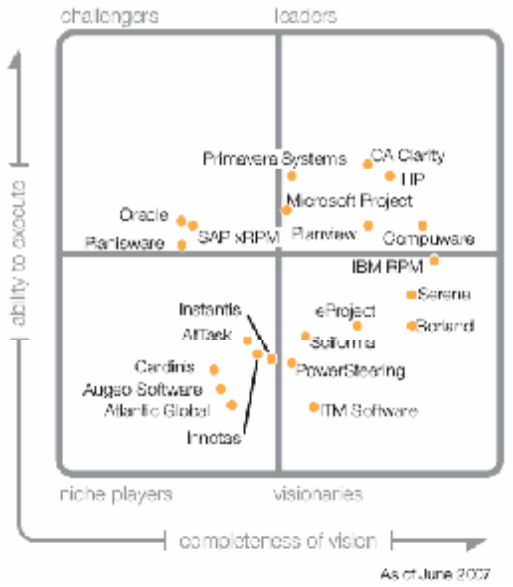


Figure 18: Magic Quadrant for PPM software 2006 (Source: Gartner, 2006)



As of June 2007

Figure 19: Magic Quadrant for PPM software 2007 (Source: Gartner, 2007)

Leaders

"Leaders in the IT PPM market are characterized by relative strengths in a majority of the completeness of vision criteria. Vision elements (of resource management and project communication/collaboration management) are realized via a well rounded ability to execute. For example, to help meet federal capital planning investment and control (CPIC) and corporate Sarbanes Oxley drivers, tools for integrated risk management (qualitative and quantitative) and project issue tracking are being introduced. Leaders typically have a relatively large and balanced PPM revenue stream, above average R&D commitment, a motivated direct sales force with an understanding of the (sometimes lengthy) PPM sales cycle, and a strong, incentive based plan and training for the PPM product. (Gartner, 2006:4)"

Challengers

"Challengers in the IT PPM market are characterized by high visibility from a balanced revenue stream that includes a direct PPM consulting service capability, and by strong sales and marketing. However, their vision is not fully realized. Vertical industry strategies may be limited by relatively little support for IT requirements such as IT or application development processes and roles, templates, and workflows with IT terms and procedures, and resource databases pre-configured to reflect IT skill sets. Business models may not be best suited to PPM. The vendor may play 'catch up' relative to innovators, or the vendor's product strategy may be based on an inappropriate or partial view of market needs. (Gartner, 2006:5)"

Visionaries

"Visionaries are characterized by a clear view of IT PPM requirements, but they have relatively less resources, skills or experience to help realize that vision. Vendors that exhibit business and technology innovation rate higher on the vision axis. For example, via architectural evolution (we expect that most PPM functions will be packaged as flexibly configurable, modular Web services within a few years). One recent innovation has been applying technology to 'expected utility analysis', which helps factor risk into project selection based on investment portfolio theories. Visionaries, however, may have shown some inconsistency between expressed plans or views and delivery, or inconsistency in supporting implementations. They may have had to cut R&D staff, suffered turnover in the sales force or marketing team, or were unable to provide support outside their immediate regions. (Gartner, 2006:5)"

Niche Players

"Niche Players in the IT PPM market are characterized by their focus on the needs of a specific market segment, whether by platform or region, or by vertical focus (IT may only be a secondary or tertiary target). A vendor's product strategy may be based on an inappropriate or partial view of market needs. Some ratings are reduced because of a lack of an adequate hosted or SaaS solution. Application portfolio management may be little supported if the product offering has difficulty with aggregate costing of such non-project service requests as minor software changes to accumulate costs for supporting named applications. (Gartner, 2006:5)"

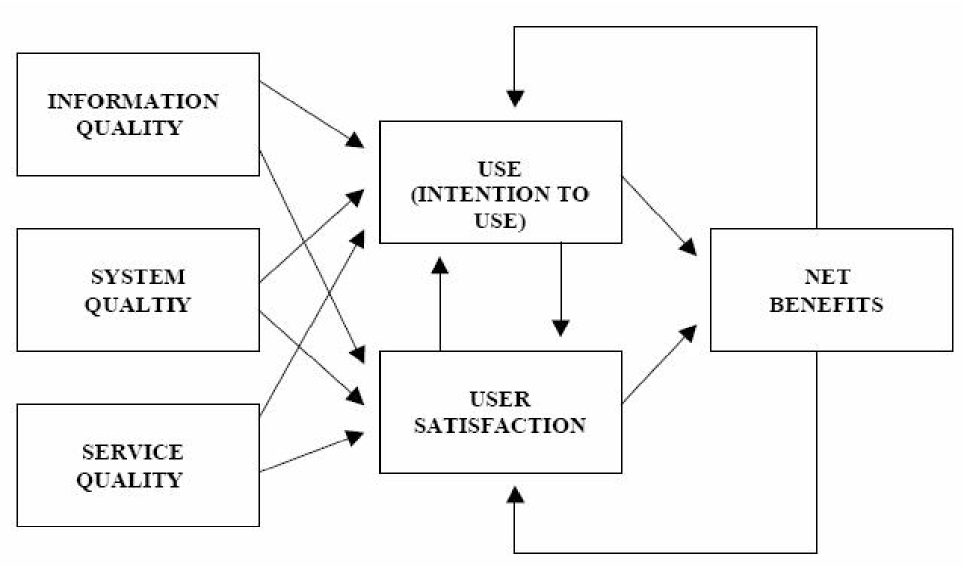


Figure 154: Updated D&M IS Success Model (Source: DeLone & McLean, 2003)

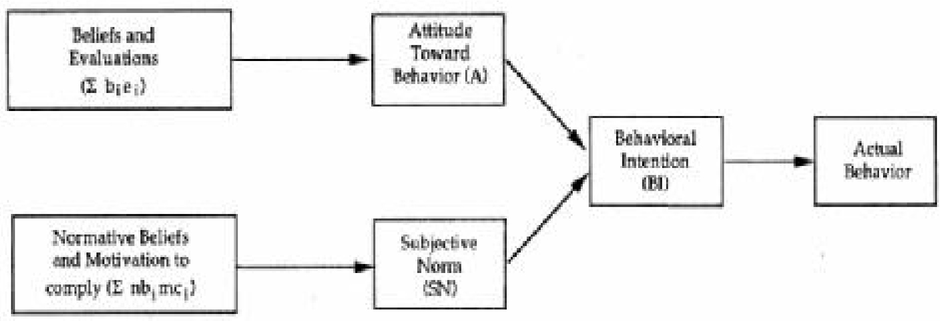


Figure 155: Theory of Reasoned Action (TRA) Model (Source: Ajzen & Fishbein, 1980)

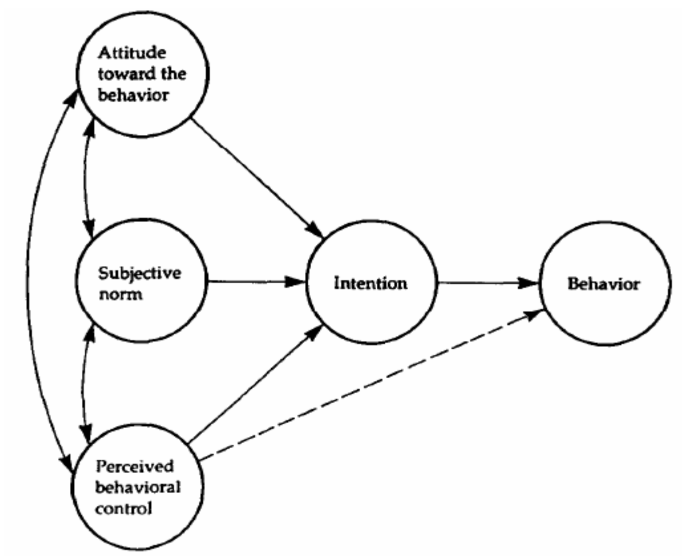


Figure 156: Theory of Planned Behavior (TPB) Model (Source: Ajzen, 1985)

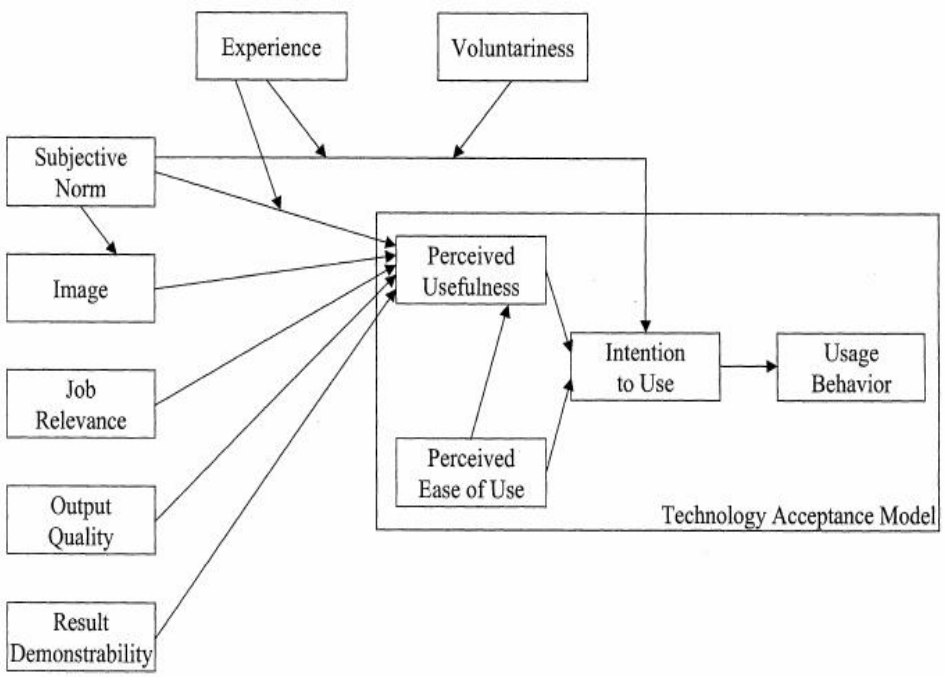


Figure [illegible] TAM [illegible]

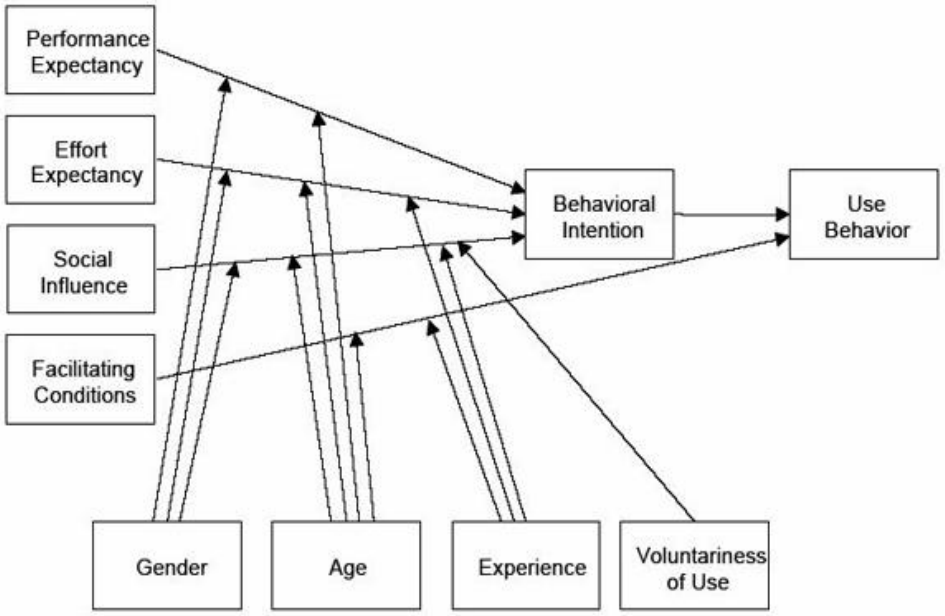


Figure [illegible] UTAUT [illegible]

VIII Ranking List PM Software

This 8th appendix includes the ranking list of all encountered PM software. This list shows all by the respondents entered PM applications. Further the list includes the records of how often each application was entered (N). The software is sorted by total score of the item's available means (most right column), but all individual means of each item (e.g. 'Reliability', 'Usefulness', 'Satisfaction') are included as well. Even every highest (maximum) and lowest score (minimum) is listed.

Ranking List of PM Software

PM Software (Firm)		Reliability	[illegible]	Assessment of [illegible] of Features	Overall Satisfaction	Efficiency	Efficacy	Costs	Implementation Time	PM Process Support	Organizational Development	Total Score
01 [illegible] (Logic Software)	Mean	7.0	7.0	7.0	6.0	7.0	4.0	7.0	7.0	7.0		6.8
	Minimum	7	7	7	6	7	[illegible]	7	7	7		6.8
	Maximum	7	7	7	6	7	[illegible]	7	7	7		6.8
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]		[illegible]
02 dotProject	Mean	6.0	6.0	6.0	7.0	6.0	[illegible]	7.0	7.0	6.0	6.0	6.2
	Minimum	6	6	6	7	6	[illegible]	7	7	6	6	6.2
	Maximum	6	6	6	7	6	[illegible]	7	7	6	6	6.2
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
03 [illegible]	Mean	6.0	5.0	6.0	6.0	6.0	[illegible]	6.0	[illegible]	7.0	6.0	6.0
	Minimum	6	5	6	6	6	[illegible]	6	[illegible]	7	6	6.0
	Maximum	6	5	6	6	6	[illegible]	6	[illegible]	7	6	6.0
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
04 OPX2 (Planisware)	Mean	7.0	6.0	6.0	5.0	6.0	6.0			6.0	5.0	[illegible]
	Minimum	7	6	6	5	6	[illegible]			6	[illegible]	[illegible]
	Maximum	7	6	6	5	6	[illegible]			6	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	1	1			[illegible]	[illegible]	[illegible]
05 [illegible] ([illegible])	Mean	6.0	6.0	6.0	5.0	[illegible]	[illegible]	5.0	4.0	6.0	6.0	[illegible]
	Minimum	[illegible]	[illegible]	[illegible]	5	5	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]
	Maximum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
06 [illegible]	Mean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Minimum	[illegible]	7	[illegible]	7	5	[illegible]	1	[illegible]	1	[illegible]	[illegible]
	Maximum	[illegible]	7	[illegible]	7	5	[illegible]	1	[illegible]	1	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
07 [illegible] ([illegible])	Mean	6.0	7.0	[illegible]	6.0	4.0	5.0	5.0	[illegible]	7.0	[illegible]	5.4
	Minimum	[illegible]	7	4	[illegible]	4	[illegible]	[illegible]	[illegible]	7	4	5.4
	Maximum	[illegible]	7	4	[illegible]	4	5	5	[illegible]	7	4	5.4
	N	[illegible]	[illegible]	[illegible]	[illegible]	1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
08 [illegible] ([illegible])	Mean	5.0	5.0	6.0	5.0	5.0	[illegible]	5.0	4.0	5.0	4.0	5.0
	Minimum	[illegible]	[illegible]	[illegible]	4	5	[illegible]	[illegible]	[illegible]	4	[illegible]	4.0
	Maximum	[illegible]	[illegible]	7	[illegible]	7	[illegible]	7	[illegible]	7	7	6.0
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
09 [illegible] ([illegible])	Mean	6.0	6.0	5.0	4.0	[illegible]	[illegible]	5.0	1.0	6.0	5.0	5.0
	Minimum	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.0
	Maximum	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.0
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10 [illegible] (Project Management Group)	Mean	4.0	6.0	5.0	5.0	5.0	[illegible]	5.0		5.0	5.0	5.0
	Minimum	4	[illegible]	[illegible]	5	5	[illegible]	[illegible]		[illegible]	[illegible]	5.0
	Maximum	4	[illegible]	[illegible]	5	5	[illegible]	[illegible]		[illegible]	[illegible]	5.0
	N	[illegible]	[illegible]	[illegible]	[illegible]	1	1	[illegible]		[illegible]	[illegible]	[illegible]
11 [illegible]	Mean	4.5	4.4	5.0	4.5	5.0	[illegible]	[illegible]	4.0	4.7	4.6	4.7
	Minimum	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	2	2	[illegible]
	Maximum	7	7	7	[illegible]	7	[illegible]	[illegible]	7	7	7	6.0
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12 [illegible] PLANTEL	Mean	3.0	5.0	6.0	6.0	7.0	[illegible]	4.0	[illegible]	5.0	3.0	4.7
	Minimum	[illegible]	[illegible]	[illegible]	6	7	[illegible]	4	[illegible]	[illegible]	[illegible]	4.7
	Maximum	[illegible]	[illegible]	[illegible]	6	7	[illegible]	4	[illegible]	[illegible]	[illegible]	4.7
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13 [illegible]	Mean	5.0	6.0	4.0	5.0	5.0	4.0	4.0	4.0	6.0	4.0	4.7
	Minimum	[illegible]	[illegible]	4	5	5	4	4	4	[illegible]	4	4.7
	Maximum	[illegible]	[illegible]	4	5	5	4	4	4	[illegible]	4	4.7
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PM Software (Firms)		Reliability	Ease of Use	Usefulness & Function and Features	Overall Satisfaction	Efficiency	Effective	Cost	Implementation Time	PM Process Support	Organizational Development	Total Score
14. [illegible] ([illegible] Systems)	Mean	4.5	5.0	4.5	4.5	5.0	5.0	4.0	4.5	5.0	4.0	4.6
	Minimum	4	5	4	4	4	4	4	4	4	[illegible]	4.0
	Maximum	5	5	5	5	5	5	5	5	5	5	5.0
	N	2	2	2	2	2	2	2	2	2	2	2
15. [illegible]	Mean	5.0	5.0	4.0	3.0	5.0	5.0	5.0	5.0	3.0	4.0	4.3
	Minimum	5	5	4	3	5	5	5	5	3	4	4.3
	Maximum	5	5	4	3	5	5	5	5	3	4	4.3
	N	1	[illegible]	[illegible]	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]
16. Custom built ([illegible])	Mean	4.0	5.0	5.0	3.0	4.5	4.5	4.0	4.0	5.0	4.0	4.3
	Minimum	3	4	[illegible]	[illegible]	4	4	2	1	[illegible]	4	4.2
	Maximum	5	5	5	4	5	5	6	5	5	4	4.5
	N	2	[illegible]	[illegible]	[illegible]	2	2	2	[illegible]	[illegible]	[illegible]	[illegible]
17. Project [illegible]	Mean	4.0	4.7	4.3	4.3	3.0	3.7	5.5	4.0	4.3	4.3	4.1
	Minimum	3	4	[illegible]	[illegible]	[illegible]	3	[illegible]	1	[illegible]	[illegible]	[illegible]
	Maximum	5	5	5	[illegible]	[illegible]	4	7	4	[illegible]	5	5.0
	N	3	3	3	3	3	3	2	1	3	3	3
18. [illegible]	Mean	3.6	5.0	4.5	4.4	4.4	4.0	4.0	4.0	5.0	4.4	4.4
	Minimum	3	4	3	3	2	3	3	3	4	4	3.1
	Maximum	4	5	5	5	5	5	7	5	5	5	4.7
	N	5	5	5	5	5	5	5	4	5	5	5
19. Open Workbench	Mean	5.0	5.0	6.0	2.0	5.0	5.0			4.0		4.4
	Minimum	5	5	5	2	5	5			1		4.4
	Maximum	5	5	5	2	5	5			1		4.4
	N	1		[illegible]	[illegible]	1	1			[illegible]		[illegible]
20. PROJECT Insight	Mean	3.5	4.5	4.5	3.0	3.5	3.8	4.0	5.0	5.0	4.3	4.1
	Minimum	2	3	4	2	[illegible]	2	[illegible]	4	4	3	3.6
	Maximum	5	5	5	5	4	5	4	5	5	5	4.7
	N	[illegible]	4	4	4	[illegible]	[illegible]	2	1	1	4	4
21. [illegible] ([illegible])	Mean	3.4	4.8	3.4	4.0	3.4	4.8	4.0	3.4	4.0	4.0	4.1
	Minimum	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum	7	[illegible]	7	[illegible]	7	7	6	[illegible]	7	7	4.4
	N	5	5	5	5	5	5	2	5	5	4	5
22. [illegible]	Mean	4.5	4.5	4.5	4.5	3.5	4.5	4.5	3.0	4.0	4.0	4.2
	Minimum	4	3	3	3	2	4	3	2	3	3	3.5
	Maximum	5	5	5	5	7	5	5	4	5	5	5.0
	N	2	2	2	2	2	2	2	2	2	2	2
23. CA Clarity / [illegible]	Mean	4.5	3.5	4.5	4.0	4.4	4.5	4.4	4.3	4.0	4.0	4.2
	Minimum	3	2	2	2	3	2	4	2	1	2	3.0
	Maximum	5	7	5	5	6	5	5	7	5	5	5.0
	N	2	2	2	2	9	2	2	2	2	2	2
24. [illegible] ([illegible])	Mean	4.0	5.0	5.0	4.0	5.0	3.0	5.0	4.0	4.0	4.0	4.0
	Minimum	[illegible]	2	2	1	5	3	2	1	1	[illegible]	3.3
	Maximum	[illegible]	2	2	1	5	2	2	1	1	[illegible]	3.3
	N	[illegible]	1	[illegible]	[illegible]	1	[illegible]	[illegible]	[illegible]	[illegible]	1	1
25. [illegible] ([illegible])	Mean	3.0	3.0	3.0	5.0							3.3
	Minimum	3	3	3	5							3.3
	Maximum	3	3	3	5							3.3
	N	[illegible]	1	[illegible]	[illegible]							1
26. Project Progress	Mean	3.3	4.5	5.0	3.8	5.0	3.3	5.7	5.0	3.8	4.0	4.1
	Minimum	3	4	[illegible]	1	5	2	4	4	2	2	3.4
	Maximum	[illegible]	5	5	5	6	[illegible]	7	5	5	5	4.1
	N	4	4	4	4	4	4	3	3	4	4	4
27. Project Manager ([illegible])	Mean	4.0	4.0	5.0	6.0	5.0	5.0			5.0	5.0	5.3
	Minimum	[illegible]	4	5	5	6	5			5	6	5.3
	Maximum	[illegible]	4	5	5	6	5			5	6	5.3
	N	[illegible]	1	[illegible]	[illegible]	1	[illegible]			[illegible]	1	1
28. [illegible] ([illegible])	Mean	4.0	3.5	4.5	3.0	4.0	4.5	4.0	3.5	5.0	3.5	4.0
	Minimum	3	[illegible]	1	1	4	4	3	3	4	2	3.5
	Maximum	5	3	[illegible]	5	4	5	[illegible]	5	[illegible]	4	4.6
	N	2	2	2	2	2	2	2	2	2	2	2
29. AMS Realtime Project	Mean	7.0	3.0	5.0	4.0	5.0	4.0		4.0	4.0	3.0	4.1
	Minimum	7	3	3	4	5	4		4	4	3	4.1
	Maximum	7	3	3	1	5	[illegible]		1	1	3	4.1
	N	1	1	2	2	1	2		2	2	1	1

Appendixes
Ranking List of PM Software

PM Software (Firms)		Reliability	Ease of Use	Usefulness & Function and Features	Overall Satisfaction	Efficiency	Effective	Cost	Implementation Time	PM Process Support	Organizational Development	Total Score
30 [illegible] Project	Mean	4.0	4.0	5.0		[illegible]	[illegible]	5.0	5.0	4.0	3.0	4.[illegible]
	Minimum	4	4	[illegible]		[illegible]	3	6	5	4	[illegible]	4.[illegible]
	Maximum	4	4	[illegible]		3	3	6	[illegible]	4	2	[illegible]
	N	1	[illegible]	[illegible]		1	1	1	[illegible]	[illegible]	[illegible]	[illegible]
31 [illegible]	Mean	[illegible]	3.[illegible]	[illegible]	[illegible]	[illegible]	3.[illegible]		3.[illegible]	4.0	[illegible]	[illegible]
	Minimum	5	3	3	3	[illegible]	3		3	4	4	3.[illegible]
	Maximum	5	4	[illegible]	[illegible]	[illegible]	[illegible]		4	4	4	[illegible]
	N	2	2	[illegible]	2	2	2		[illegible]	[illegible]	[illegible]	[illegible]
32 PROJECT [illegible]	Mean	3.7	[illegible]	4.1	[illegible]	[illegible]	3.6	4.5	[illegible]	[illegible]	[illegible]	[illegible]
	Minimum	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible].4
	Maximum	4	5	[illegible]	5	[illegible]	5	5	5	5	[illegible]	4.[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]
33 [illegible]	Mean	[illegible]	[illegible]	5.0	5.0	[illegible]	4.0	[illegible]	[illegible]	4.0	4.0	4.[illegible]
	Minimum	5	[illegible]	[illegible]	5	5	4	3	[illegible]	4	4	4.[illegible]
	Maximum	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	4	4	[illegible]
	N	1	[illegible]	[illegible]	[illegible]	1	1	1	[illegible]	[illegible]	[illegible]	[illegible]
34 [illegible] ([illegible])	Mean	4.0	5.0	[illegible]	3.0	[illegible]	[illegible]	[illegible]	3.0	[illegible]	[illegible]	[illegible]
	Minimum	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	2	[illegible]	4	4	[illegible]
	Maximum	4	5	4	[illegible]	[illegible]	5	[illegible]	[illegible]	4	4	4.[illegible]
	N	1		[illegible]		1	1	1			[illegible]	[illegible]
35 Microsoft Project (Microsoft)	Mean	4.5	3.5	4.[illegible]	3.6	4.[illegible]	4.[illegible]	4.0	4.[illegible]	3.5	3.[illegible]	3.[illegible]
	Minimum	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
	Maximum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	54	[illegible]	[illegible]	[illegible]	[illegible]
36 [illegible]	Mean	4.[illegible]	4.[illegible]	3.[illegible]	3.[illegible]	4.[illegible]	4.0	4.1	4.[illegible]	3.[illegible]	3.[illegible]	[illegible]
	Minimum	2	[illegible]	[illegible]	[illegible]	[illegible]	3	1	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37 [illegible]	Mean	4.3	4.[illegible]	3.[illegible]	3.0	[illegible]	3.5	4.3	4.[illegible]	4.0	3.[illegible]	3.[illegible]
	Minimum	[illegible]	4	[illegible]	[illegible]	[illegible]	3	[illegible]	4	[illegible]	[illegible]	[illegible]
	Maximum	5	5	[illegible]	3	5	[illegible]	5	5	[illegible]	3	[illegible]
	N	[illegible]	4	4	[illegible]	[illegible]	[illegible]	3	4	4	4	4
38 [illegible]	Mean	3.[illegible]	4.[illegible]	4.[illegible]	4.0	4.5	4.0	4.[illegible]	[illegible]	4.[illegible]	3.[illegible]	3.[illegible]
	Minimum	[illegible]	4	[illegible]	[illegible]	4	4	4	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum	4	[illegible]	[illegible]	[illegible]	5	[illegible]	4	[illegible]	[illegible]	4	[illegible]
	N	2	2	2	2	2	2	2	2	2	2	2
39 [illegible]	Mean	5.[illegible]	[illegible]	3.[illegible]	4.0	4.0	4.0	[illegible]	[illegible]	[illegible]	3.[illegible]	3.[illegible]
	Minimum	[illegible]	[illegible]	3	4	[illegible]	[illegible]	4	[illegible]	3	3	3.[illegible]
	Maximum	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	3.[illegible]
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40 [illegible]	Mean	2.[illegible]	5.[illegible]	4.[illegible]	2.0	4.0	4.0		4.0	5.[illegible]	4.[illegible]	3.[illegible]
	Minimum	[illegible]	[illegible]	4	[illegible]	4	4		4	[illegible]	4	[illegible]
	Maximum	[illegible]	[illegible]	4	[illegible]	4	4		4	[illegible]	4	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	1	1		[illegible]	[illegible]	[illegible]	[illegible]
41 [illegible] ([illegible])	Mean	[illegible]	[illegible]	5.[illegible]	4.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Minimum	[illegible]	[illegible]	[illegible]	4	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].4
	Maximum	[illegible]	4	[illegible]	4	3	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
42 [illegible]	Mean	3.[illegible]	4.[illegible]	5.[illegible]	3.0	4.0	[illegible]	3.[illegible]	[illegible]	5.[illegible]	3.[illegible]	3.7
	Minimum	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum	[illegible]	4	[illegible]	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
43 Time [illegible] ([illegible])	Mean	4.[illegible]	4.[illegible]	5.[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	4.[illegible]	3.[illegible]	[illegible]
	Minimum	4	4	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]
	Maximum	4	4	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
44 [illegible]	Mean	[illegible]	4.[illegible]	5.[illegible]	4.[illegible]	[illegible]	4.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Minimum	[illegible]	4	[illegible]	4	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Maximum	[illegible]	4	[illegible]	4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	N					1	1					
45 [illegible]	Mean	4.[illegible]	4.[illegible]	3.[illegible]	5.0	3.0	4.0	[illegible]	4.0	4.[illegible]	3.[illegible]	3.[illegible]
	Minimum	4	4	[illegible]	5	3	[illegible]	[illegible]	[illegible]	4	[illegible]	[illegible]
	Maximum	4	4	[illegible]	5	[illegible]	4	[illegible]	4	4	[illegible]	[illegible]
	N	[illegible]	[illegible]	[illegible]		1	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PM Software (Rank)		Reliability	Ease of Use	Customer Support and Reviews	Overall Satisfaction	Price	Features	Cost	Collaboration Tools	PM Experts Support	Organizational Compliance	Total Score
#1 Cyber Plan (Rank)	Mean	9.5	9.5	4.5	9.5	9.5	9.5	9.5	9.5	4.5	4.0	9.1
	Minimum	9	9	4	9	9	9	9	9	4	4	9.1
	Maximum	4	5	5	5	5	5	5	5	5	5	9.5
	N	2	2	2	2	2	2	2	2	2	2	2
#2 Cyber Core	Mean	4.5	4.5	3.5	3.0	4.5	4.5	3.5	4.5	3.5	4.0	9.5
	Minimum	4	4	3	3	4	4	3	4	3	4	9.5
	Maximum	4	4	3	3	5	4	3	4	3	5	9.5
	N	2	2	2	2	2	2	2	2	2	2	2
#3 World (Rank)	Mean	3.5	4.0	4.5	3.0	4.5	4.0	3.5	3.5	3.5	3.0	9.3
	Minimum	3	4	4	3	4	4	3	3	3	2	9.3
	Maximum	4	4	4	3	5	4	3	4	3	3	9.3
	N	2	2	2	2	2	2	2	2	2	2	2
#4 Cyber Exe	Mean	3.5	4.5	3.5	3.0	3.5	4.5	3.5	3.5	3.5	3.0	9.3
	Minimum	3	4	3	3	3	4	3	3	3	3	9.2
	Maximum	4	5	4	3	4	5	4	4	4	3	9.3
	N	2	2	2	2	2	2	2	2	2	2	2
#5 Arrow	Mean	3.5	3.5	3.5	3.0	3.5	3.5	4.5	4.5	3.5	3.5	9.1
	Minimum	3	3	3	3	3	3	4	4	3	3	9.1
	Maximum	4	4	4	3	4	4	5	5	4	3	9.1
	N	2	2	2	2	2	2	2	2	2	2	2
#6 Progress	Mean	3.5	3.5	3.5	3.0	3.5	3.5	3.5	3.5	3.5	3.0	9.1
	Minimum	3	3	3	3	3	3	3	3	3	3	9.0
	Maximum	4	4	4	4	4	4	4	4	4	4	9.1
	N	2	2	2	2	2	2	2	2	2	2	2
#7 Exe	Mean	3.5	4.5	3.5	3.0	3.5	3.5	4.5	4.5	3.5	3.0	9.2
	Minimum	3	4	4	3	3	4	4	4	3	3	9.1
	Maximum	4	5	4	3	4	4	5	5	4	3	9.3
	N	2	2	2	2	2	2	2	2	2	2	2
#8 Cyber	Mean	3.5	3.5	3.5	3.0	3.5	3.5			3.5	3.0	9.1
	Minimum	3	3	3	3	3	3			3	3	9.1
	Maximum	4	4	4	3	4	4			4	3	9.1
	N	2	2	2	2	2	2			2	2	2
#9 Microsoft	Mean	3.0	3.0	4.5	3.5	3.0	3.0	3.5	3.0	3.5	3.5	9.1
	Minimum	3	3	4	3	3	3	3	3	3	3	9.1
	Maximum	3	3	5	4	3	3	4	3	4	4	9.1
	N	2	2	2	2	2	2	2	2	2	2	2
#10 Project	Mean	4.0	4.0	3.5	3.5	3.0	3.0	3.5	3.0	3.5	3.5	9.2
	Minimum	4	4	3	3	3	3	3	3	3	3	9.2
	Maximum	4	4	4	4	3	3	4	3	4	4	9.2
	N	2	2	2	2	2	2	2	2	2	2	2
#11 Project	Mean	3.0	3.0	4.5	3.5	3.0	3.0	3.5	3.0	4.5	3.5	9.2
	Minimum	3	3	4	3	3	3	3	3	4	3	9.2
	Maximum	3	3	5	4	3	3	4	3	5	4	9.2
	N	2	2	2	2	2	2	2	2	2	2	2
#12 VUE (Ways to Solutions)	Mean	3.0	3.0	4.5	3.5	3.0	3.0	3.5	3.0	4.5	3.5	9.2
	Minimum	3	3	4	3	3	3	3	3	4	3	9.2
	Maximum	3	3	5	4	3	3	4	3	5	4	9.2
	N	2	2	2	2	2	2	2	2	2	2	2
#13 Power	Mean	3.0	3.0	4.5	3.5	3.0	3.0	3.5	3.0	4.5	3.5	9.4
	Minimum	3	3	5	3	3	3	3	3	5	3	9.4
	Maximum	3	3	5	4	3	3	4	3	5	4	9.4
	N	2	2	2	2	2	2	2	2	2	2	2
Total	Mean	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	9.2
	Minimum	3	3	3	3	3	3	3	3	3	3	9.0
	Maximum	5	5	5	5	5	5	5	5	5	5	9.5
	N	201	201	201	132	132	132	132	132	132	132	132

Table 02 - Ranking list of PM software (2007)