THE RELATIONSHIP BETWEEN PLANNING AND PROJECT OUTCOMES IN THE SOFTWARE INDUSTRY

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ABSTRACT: *This paper examines the impact of planning characteristics on planning performance and then on project outcomes. The planning characteristics are categorized as human, technical and management factors. Four specific planning performance criteria are considered (defining specifications and requirements, estimating project time & effort, scheduling and risk analysis) and analyzed as they related to different aspects of project outcomes (complete on time and within budget, non-financial benefits, and financial benefits). The study is based on data from 80 software projects in Vietnam. Regression analysis is used to testing the causal relationships. The finding suggests critical factors of planning, including project manager effort, team member ability, customer involvement and management support influence the project performance. This study also confirms the effect of planning performance on all project outcomes.*
Keywords: *planning characteristics, planning performance, project outcomes.*

Introduction

With the development of information technology, software engineering has become more and more important in all aspects of business. Software is made in-house by companies themselves or by outside professionals. A common problem is the high failure rate of software projects. For example, in the United States alone, the Standish Group estimated that companies and government spent $81 billion for canceled software projects (Chaos, 1995). In an other survey implemented also in the USA, 31 percent of software projects were canceled before completion and more than half the projects cost an average of 189 percent more than their original estimates (Whittaker, 1999).

97% of project managers have participated in managing the requiring specifications and spent about 12.3% of their time in planning (Sauer and Cuthbertson, 2003). However, the practice of planning is not always effective. Thayer, Pyster and Wood (1981) found that poor estimates and plans are common problems of software projects. A survey conducted by Kasser and Williams (1998) identified 34 risk – indicators for software project failure. The top three risks are poor requirements, poor plans and the failure of communication with the customer. In a recent empirical study in the context of a developing country, Nguyen (2003) found that, 85% project managers agree with these three common problems. The planning skill is also considered as one of important characteristics of successful project managers (Sauer and Cuthbertson, 2003). Planning, therefore is the most important task in the software development process. This stage has a strong effect on the outcomes of software projects. In an effort to improve the management of software project, this research considers the role of planning to software project outcomes in software companies. Planning is considered in terms of human, technical and management factors. A conceptual framework has been developed to construct the input factors of planning and consider how they affect the project outcomes. This conceptual framework was tested by an empirical study in the context of the Vietnamese software sector.

The purpose of this paper is to investigate the important factors in planning that will affect specific project outcomes. This paper presents the conceptual framework that is used to construct this empirical survey. Next, the sampling method is presented. Finally, but importantly is the analysis and the interpretation of research results.

Developing the conceptual framework

Planning has been mentioned as an important factor that strongly affects software project outcomes (Belout and Gauvreau, 2003; Nguyen, 2003). There is a need to study what factors influence the planning performance. Based on the previous study on the factors that influence the project outcomes and planning, these factors could be categorized as personnel, technical and management factors.

Human factors include external parties (usually customers) and internal personnel (the project team). The involvement of customer is a factor that many studies consider. Verner, Overmyer and McCain (1999) indicated that problems with customers and users affected nearly 50% of failed projects. One key problem is the insufficient involvement of the user community. According to Yeo (2002), the lack of user involvement and inputs from the beginning are the factors for project failure. Related to internal personnel, the important role of the project manager is affirmed in many previous studies. Callahan and Moretton (2001) have indicated the relationship between project leader and the time related to software development. Empirical research has confirmed the link between capable project managers and the likelihood of project success (Nguyen, 2003). Dealing with the role of team members, Krisnan (1998) found that a software team with higher personnel capability exhibits the significantly lower number of defects in their respective products. Barry *et al.* (2002) also specified project team skill as a variable that could influence the project performance. However there was no link between this factor and project effort and duration.

Technical factors refer to the quality of techniques and tool employed and their efficient use in planning stage. Verner, Overmyer and McCain (1999) concluded that applying appropriate and efficient techniques and tools in software development process will increase the chance for project success. The tools and techniques in planning stage in this study are categorized as the life-cycle methodology, estimation techniques and planning management techniques.

Management factors are the most complicated aspects to consider. Whittaker (1999) found that a lack of management involvement and support is the common reason for project failure. Callahan and Moretton (2001) considered the early involvement of sales and marketing in development process and have found that the higher involvement, the shorter software development time. Belout and Gauvreau (2003) also confirmed the positive correlation between management support and project success. Besides the management support factor, the objectives of a project also affect its outcomes. The results of Yeo (2002) also indicated that weak definition of requirements and project scope is one of top failure factors of a software project. Belout and Gauvreau (2003) found the link between project mission and project success. Another management factor previous research is project management style. Loo (2002) indicated which leadership styles are commonly adopted in project management; these are people-oriented, participative, transformational and situational leadership. However, through the pilot survey, there is a problem that most interviewees didn't know all these leadership styles. The project management style therefore is modified as popular leadership styles such as people-oriented and work-oriented; some decision making styles are also added. Communication and the availability of resources influence directly the project outcomes (Chatzoglou & Macaulay, 1998 and White and Fortune, 2002).

Figure 1 shows the relationship between human, technical and management factors and planning performance and project outcomes. The model postulates that the appropriate personnel, technical or management factors of planning process could contribute to improve planning performance which leads to improve project outcomes. In this model, the project outcomes are evaluated through both quantitative criteria as time, cost and quality and qualitative criteria as customer satisfaction, organizational benefits and project team satisfaction. Planning performance is considered in the fours aspects: Requirements and technical specifications definition; Timeline and effort estimation; Scheduling and Risk analysis.

Personnel involved in planning include customer and project team. In this study, personnel factors are considered through experience and effort of project manager in managing the project; knowledge and experiences in system development and requirements analysis of project team; and the level of customer involvement during planning process. This study examines the proposition that a positive relationship exists between these personnel factors and planning performance.

Technical factors are methods and techniques applied during planning process. In this study, the following methods or techniques are considered: project management, system development and life cycle method. A proposition of applying these methods in planning process relating to the planning performance is tested by this study.

Management factors include types and level of management support, objectives of the project, level of availability of resources and management styles. These factors are supposed to influence the planning performance. This study also hypotheses a positive relationship between planning performance of a project and its outcomes. These relationships are tested by empirical research on the context of software sector in Vietnam. Research methodology and main results of this survey is presented in the next section.

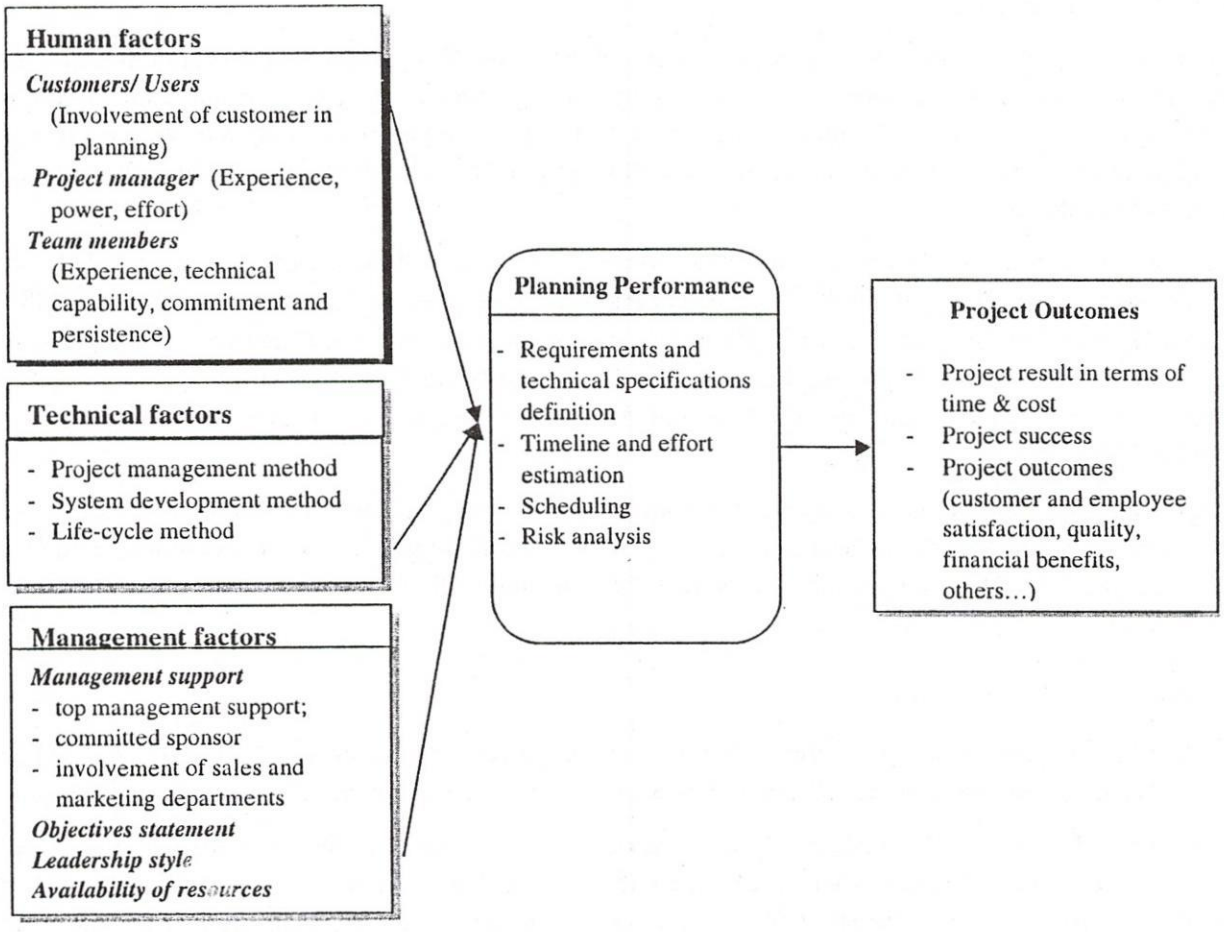

Figure 1: Conceptual framework

Research methodology

Questionnaire design

To clarify the research issues related to planning in software projects, an empirical study was conducted. First a pre-pilot survey was implemented by in-depth interviews with 13 project managers involved in different kinds of software projects from a variety of software companies. Based on this pilot-survey, a questionnaire was designed for self-administrated answer. This questionnaire was pre-tested to ensure all of questions are clear and understandable without any additional explanation.

Sampling

The unit of analysis of this survey was professionals involved in software projects. The sampling frame was based on the list of software companies. There are some available lists of software companies, such as Yellow pages, Hochiminh City Computer Association (HCA), Vietnam Software Association (VINASA) and Vietnam IT Directory. The list of Vietnam IT Directory (2002) is most complete. Based on this list, 375 companies that involved in software development activities were identified, in which 265 located in Hanoi and Hochiminh City. This group is used as the sampling frame.

According to Neuman (2000), sample size is frequently defined purposively – a commonly accepted approach. For small population (under 1,000) in this case, the sampling ratio should be large, about 30 percent. Applying this rule, sample size for the survey should be 80.

Totally 400 questionnaires were sent (300 in the first time and 100 sent separately to selected companies which did not answer in the first) and 80 qualified responses were received from 65 software companies (20%). Some companies had more than one response (from different software projects). This sample size was acceptable.

Sample Characteristics

In the sample, 58.5 % were local private or joint- stock companies; 29.2% were foreign investors and the rest (12.3%) were state-owned. Software companies in Vietnam were very young and small. Most (61%) have been established within 1- 5 years, 27% from 6 – 10 years, and only 4% were established more than 15 years. 44% were small companies having less than 20 employees and only 10% had more than 140 employees.

The software products of software companies were applications in Finance & accounting (62.5%) and in Commerce & Service (58%). Some other common software were for Education and Training (45%); Government administration (45%); Telecommunication (34.4%) and Manufacturing (36%). Very few companies had software in the engineering area (such as software for construction or specific sectors). Only 7.8% companies were specified in one field, most companies produced software for 2 – 4 application fields (64%).

Most of companies produced software for both local and foreign clients. Their main overseas clients were in North America (36%) and Europe (36%), an emerging overseas market was Japan. In the local market, their products served mainly private organizations (79.5%) and government organizations (70.5%).

Results

Recall the conceptual model presented in Figure 1, planning performance is hypothesized to depend on human, technical and management factors; and project outcomes depend on the planning performance.

Factor analysis was used to reduce the number of variables. The variables and measurements are presented in Table 1. Cronbach alpha, a commonly used statistic to assess the internal reliability of multi-item variables, was computed for the relevant variables. The Cronbach alpha coefficients of these constructs ranged from 0.72 – 0.93, which was considered as satisfactory (see Table 2).

Table 1: Variables and scaling

Dependent variables	Variable description
Planning performance	Planning performance was evaluated in terms of: Requirements and technical specifications definition; Timeline and effort estimation; Scheduling and Risk analysis.
Success of the project	Success of the project was evaluated by customer;

	parent company and by customer
Project outcome in term of time	Level of completion on time of project
Project outcome in term of cost	Level of completion within budget of project
Non-financial benefit of the project	Including: quality delivery; customer satisfaction; company image enhancement; team member capability improvement.
Financial benefits of the project	Including: financial benefits to company and to team members
Independent variables	**Variable description**
Human factors	
- Project managers experiences	Number of years has worked as project manager
- Project manager effort	Level of effort spent; extent of control over product specification
- Team members capability	Knowledge – Experience of team members on system development and requirement analysis; commitment and persistence
- Customer involvement	Level of customer involvement in planning
Technical factors	
- Applying Project management method	Yes/ No
- Applying System Development method (2 most frequently: Object-oriented & RUP)	Yes/ No
- Applying Life-cycle method (2 most frequently: Waterfall & Spiral)	Yes/ No
Management factors	
- Management support	Level of authority of Project manager; level of participation of functional department in planning
- Project objectives	Time & cost oriented; customer oriented
- Leadership and decision making styles	Levels of adopted styles in project management
- Availability of resources	Level of availability of human resource & time; level of availability of budget and infrastructure.

Table 2: Homogeneity measures of the construct

Variable	Alpha
Planning performance	.769
Success of the project	.751
Non-financial benefit of the project	.729
Financial benefits of the project	.741
Project manager effort	.767
Team members capability	.828
Management support	.685
Availability of resources	.777
Objective 1: Cost & time oriented	.835
Objective 2: Customer oriented	.834

Results of correlation and regression analyses are presented in Table 3, 4 and 5. Discussion of the qualitative responses obtained is incorporated with the statistical results since they help shed light on some of the seemingly counter-intuitive statistical results.

The first part of the model describes the relationship between human, technical and management factors and planning performance. The regression result in Table 4 indicated that, together the sixteen

variables explain 85 % of the variation in planning performance (r^2 = .856) and the model is statistical significant at the 0.05 level (F-test).

The effect of the Human Factors on Planning Performance

Regression results indicated a significant positive relationship between Team member capability, Project manager efforts, customer involvement and planning performance. The interview discussion also revealed that the project managers usually remember the project that they spent more efforts, and they think that with effort they spent, they got the good plan. Although many project managers said their customer didn't deeply understand the software engineering and sometimes could not define clearly their requirements, but the more customer who involved, the better plan they could develop. The involvement of customer in early stage of project helped the project team understand customer's needs and capture their requirements. The role of team members was also important in producing a good plan. Their knowledge in system development and requirement analysis had contributed much to define software specifications, and this is a basic to produce an initial plan. The result did not show the relationship between project manager's experience and planning performance, but there is a significantly positive relationship between PM' experience and project success. This demonstrated that role of PM's experience was important to the overall project rather than in planning only.

Table 4: Regression Results (dependent variables – planning performance)

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	-1.032	.456	-2.264	.027
Team members ability	.281	.104	2.690	.009
PM effort	.431	.095	4.540	.000
Customer involvement	.147	.066	2.236	.029
Waterfall	-.104	.095	-1.099	.276
Management support	.189	.066	2.853	.006
Cost & time oriented	.106	.056	1.980	.045

The effect of Technical Factors on Planning Performance

The specific methods or techniques that indicated in regression model were what most chosen by respondents. The regression results did not show the relationship between technical methods applied in project and planning performance. However, the Pearson correlation analysis showed the correlation between applying PM method and planning performance ($r = 0.262$; $p<0.05$). This confirmed the finding of a previous study (Nguyen, 2003). Considering the applying project management methods together the applying other technical methods, the relationship between applying project management method and planning performance became not significant. In fact, the application of the project management techniques and methods (including life-cycle methods) in software companies is not very systematic, except in some big companies like FPT Corporation or Paragon Solution Vietnam (PSV). The software projects usually apply basic tools for project management, many project managers didn't know about the life-cycle method. This was reason why application the methods or tools have not much influenced the planning performance and project outcomes. Software projects usually apply MS Project tools. Very few projects apply methods that are specific designed for software project. Some companies design project management procedures and tools for themselves. In previous studies, White and Fortune (2002) considered only project management techniques while Verner, Overmyer and McCain (1999) studied the influence of applying different life-cycle methods on project outcomes. There was not any research studying the role of applying different methods or techniques of project management, system development and life- cycle that usually use in software project. This study, however, did not find evidence of relationship between applying these methods/ techniques and planning performance.

The effect of Management Factors on Planning Performance

Regression results in Table 4 indicated the positive relationships between management support and the planning performance. This means more management support was required for better planning performance. This results has been confirmed many previous findings (Whittaker, 1999 and Callahan and Moretton, 2001). The management support included the support from top management as well as functional department of the software company to its project. Although the Pearson correlation analysis in Table 3 showed the correlation between planning performance and both project objectives, but not all these correlations was significant in the regression model. Only the project objective of Cost and time oriented impacted on the project's planning performance, the other one – Customer oriented did not.

There were no causal relationships between Resource availability or any leadership styles and planning performance as well. The reason is most of projects had a small size; constraint of resource therefore was not project's problem. Related to leadership or decision making styles, in fact, projects did not shape a clear style for themselves, this could be the reason why didn't exist the relationship between management style and planning performance.

The effect of Planning Performance on Project Outcomes

The effect of planning performance on Project outcomes was considered by regression models in which the independent variable was planning performance and dependent variables were project outcomes. In this study, project outcomes were considered through five items: project success, non-financial benefits, financial benefit, completion on time and completion within budget of project. Doing five regression models with different dependent variables and planning performance (as independent variable), the results are presented in Table 5.1 – 5.5.

Table 5.1: Regression Result 1: Dependent variable: Project success

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	2.035	.277	7.358	.000
Planning performance	.490	.584	6.354	.000

The first regression was between planning and the evaluation of project success in different viewpoints. The model was statistical significant at the 0.05 level (F-test) with $R^2 = 0.341$ that explain 34% of variation in project success. This causal relationship indicated that the better planning performance, the higher chance for project success.

Table 5.2: Regression Result 2: Dependent variable: Non-financial benefits

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	2.876	.236	12.177	.000
Planning performance	.347	.066	5.270	.000

Table 5.3: Regression Result 3: Dependent variable: Financial benefits

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	2.191	.322	6.813	.000
Planning performance	.384	.090	4.288	.000

Similar to the first regression model, the relationships between planning performance and project financial benefit and non-financial benefits as well are presented in Table 5.2 and 5.3. These regression models were significant at the 0.05 level with R^2 are 0.263 and 0.191 respectively. The results indicated that planning performance contributes to both financial benefit and non-financial benefits (such as improving capability for staffs, goodwill for company).

Table 5.4 Regression Result 4: Dependent variable: Completion time

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	4.931	.376	13.124	.000
Planning performance	-.695	.105	-6.631	.000

Table 5.5 Regression Result 5: Dependent variable: Completion cost

Independent variables	(β)	S.E (β)	t – value	Sig.
(Constant)	3.753	.481	7.801	.000
Planning performance	-.445	.134	-3.317	.001

Tables 5.4 and 5.5 showed the regression results between planning performance and completion time and cost. These regression models were significant at the 0.05 level with R^2 are 0.360 and 0.124 respectively. These negative relationships indicated that the better planning performance, the shorter project completion time as well as lower project cost. Along with the causal relationships between planning performance and other project outcomes like financial and non-financial benefits, this result underlines the role of planning toward overall project outcomes.

The results of Dvir *et al.* (2002) also found a positive relationship between project planning and overall project success, in which the project success was evaluated by fours measures, including meeting planning goals, end-user benefits, contractor benefits and overall project success. This study not only confirms but also complements their finding by considering more criteria of project success.

Planning performance plays its role of an explanation variable in the model. It indicates the influence of project manager effort, team member' ability, customer involvement and management support on project success through their effect on planning performance.

Conclusions

Although there are some claims from project managers that they never match their plan, they also agreed that planning gives them a frame for operation management and helped to reduce uncertainty, increased the likelihood of project success. The study results defined critical factors for best planning performance. The human factor, that is considered as Project manager effort and experiences, team member' capability and customer involvement, was evaluated as most important. There was not enough evidence to confirm the influence of applying different project management, system development and life cycle methods on planning performance. Among management factors, management support and project objective of minimizing cost and time overrun had significant relationships to planning performance. The result also demonstrated the explanation role for planning performance with different aspects of project outcomes.

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MỐI QUAN HỆ GIỮA HOẠCH ĐỊNH VÀ KẾT QUẢ DỰ ÁN TRONG NGÀNH CÔNG NGHIỆP PHẦN MỀM

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TÓM TẮT: *Bài báo này xem xét ảnh hưởng của các yếu tố trong hoạch định lên kết quả thực hiện của nó và kết quả của dự án. Các yếu tố của hoạch định được phân loại thành: các yếu tố về con người, kỹ thuật và quản lý. Kết quả thực hiện của hoạch định được xem xét trên bốn khía cạnh, bao gồm: xác định yêu cầu và đặc tính sản phẩm; ước lượng thời gian và nỗ lực thực hiện dự án; lập tiến độ và phân tích rủi ro. Từ đó phân tích tác động của kết quả hoạch định lên kết quả dự án – được đánh giá trên nhiều khía cạnh khác nhau như hoàn tất đúng hạn và trong phạm vi ngân sách cho phép, các lợi ích phi tài chính và các lợi ích tài chính. Nghiên cứu được thực hiện trên dữ liệu từ 80 dự án phần mềm tại Việt nam. Kỹ thuật phân tích hồi qui được sử dụng để kiểm chứng những mối quan hệ nhân quả trên. Kết quả nghiên cứu đưa ra những yếu tố quan trọng của hoạch định đối với kết quả thực hiện của nó, như nỗ lực của nhà quản lý dự án, năng lực của thành viên nhóm dự án, sự tham gia của khách hàng và sự hỗ trợ về quản lý. Nghiên cứu này cũng khẳng định ảnh hưởng của hoạch định lên tất cả các thành quả của dự án.*

Từ khóa: *các yếu tố của hoạch định; kết quả thực hiện của hoạch định, kết quả dự án*

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Table 3: Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1																
2	.797**	1															
3	.528**	.481**	1														
4	.104	.074	.289**	1													
5	.221*	.218	.282**	.131	1												
6	-.002	.000	-052	-.181	.163	1											
7	-.099	-.047	.072	.173	.207	-.003	1										
8	.057	.148	.153	.091	-.025	.093	.119	1									
9	-.072	-.226*	-.051	.145	.000	-.126	.097	-.240*	1								
10	.617**	.609**	.455**	.082	.178	.026	-.050	.004	-.076	1							
11	.249*	.212	.129	-.120	-.119	.158	-.057	.051	-.056	.125	1						
12	.337**	.280**	.275*	.231**	.128	-.039	.017	.112	-.187	.320**	-.286*	1					
13	.510**	.475**	.323**	.067	.126	-.069	-.189	-.016	-.104	.335**	.060	.228*	1				
14	.053	.016	.014	-.027	.170	.051	.042	-.120	-.017	-.052	-.002	-.177	.141	1			
15	-.061	-.017	.227*	.020	-.037	-.156	.069	.049	-.015	.063	-.117	.135	-.062	-.696**	1		
16	-.086	.022	.049	.193	.036	-.155	.110	-.009	.130	.080	-.111	.018	.103	-.022	.099	1	
17	**.840****	**.844****	**.606****	**.100**	**.262***	**.040**	**-.007**	**.056**	**-.114**	**.703****	**.291****	**.325****	**.483****	**.024**	**.008**	**-.044**	**1**

1=Team members ability	5=Apply PM method	10=Management support	14=People oriented
2=PM effort	6=Object - oriented	11=Cost & time oriented	15=Work oriented
3=Customer involvement	7=RUP	12=Customer oriented	16=Consulting
4=PM experiences	8=Waterfall	13= Resource availability	17=Planning performance
	9=Spiral		