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The Service Industries Journal
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713636505

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Online Publication Date: 01 December 2007
To cite this Article: Zwikael, Ofer and Globerson, Shlomo (2007) 'Quality Management: A Key Process in the Service Industries', The Service Industries Journal, 27:8, 1007 - 1020
To link to this article: DOI: 10.1080/02642060701673661
URL: http://dx.doi.org/10.1080/02642060701673661

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Quality Management: A Key Process in the Service Industries

OFER ZWIKAEL and SHLOMO GLOBERSON

Project management is a developing area in the service industry, as more unique and customer-tailored services are being developed. This paper presents a benchmarking research study, aimed at improving project planning capabilities in the service industry. Based on data collected from 275 project managers from several industries, including 79 from the service sector, project management strengths and weaknesses within the service industry were investigated. It was found that project managers from the service sector excel in cost and procurement planning processes, compared to project managers from other industries. On the other hand, project managers from the service sector achieve the worst score in quality management processes. Moreover, in the service industry quality management was found to have the most significant impact on project success. Hence, managers in the service sector would benefit from acquiring proper knowledge and techniques relating to quality management in the planning phase of projects. It was also found that the success level of projects performed in the service sector depends most on the qualifications of the project manager. A project manager in the service sector gets very little support from the organisation itself. Support processes should focus on the main weaknesses of the service industry, mainly 'developing project management procedures' and 'increasing the extent of training of their project managers'. The paper presents and analyses strengths and weaknesses of the service industry in project planning and suggests a detailed roadmap for improvement.

INTRODUCTION

Project management is not at the core of the service sector, since this sector excels in serving customers on an ongoing basis. Hence, the number of projects performed is very low, compared to other industries, such as software development or construction. Moreover, managers in the service sector lack the knowledge, tools and experience required for efficient project management. A common way to achieve managerial

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The Service Industries Journal, Vol.27, No.8, December 2007, pp.1007–1020
ISSN 0264-2069 print/1743-9507 online
DOI: 10.1080/02642060701673661 © 2007 Taylor & Francis

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improvement is by learning from other organisations that excel in a specific area. This is referred to as *benchmarking*.

Benchmarking is a process of continuously measuring and comparing an organisation's business processes against business process leaders anywhere in the world to gain information, which will help the organisation take action to improve its performance [American Productivity and Extent of Use Center, 1992]. It is an efficient tool that allows an organisation to continuously improve by learning from superior ones. An organisational performance can be compared to its direct competitors, to the best organisation in the industry, or to the best in the world. It allows overcoming the employees' resistance, because it suggests standards that have already been achieved by other organisations [Elnathan and Kim, 1995].

The benefits of benchmarking include reduced costs, higher productivity, improved customer service, quality and competitiveness. Additionally, benchmarking facilitates strategic planning, providing a clearer focus for strategic target and goal setting [Camp, 1992; Markin, 1992; Gable *et al.*, 1993; Yasin and Zimmerer, 1995; Whymark, 1998; Dorsch and Yasin, 1998; Smith, 2000]. As an ongoing process, evaluation can be done from time to time, in order to ensure the effectiveness of corrective actions and the improvement of processes.

Benchmarking is widely used in many organisations. For example, Xerox Corporation benchmarks Kodak for high volume production, Toyota for extent of use processes and AT&T for R&D processes. Many industries continuously benchmark the extent of use in the 'Six-sigma' model, while Lobo and Zairi [1999] give an example of an air cargo organisation which identifies its key advantage in the model. The main problem of benchmarking is the lack of ability to collect confidential data from other organisations; some of which may be direct competitors [Drew, 1995].

Project management capabilities are very important for increasing the chances for successful projects in organisations. Since the project management processes are generic for all industry types, it is possible to compare the extent of use of project management processes among industries.

Hence, the main objective of this paper is to compare specific project management capabilities in the service sector to those in other industry types. In doing so, we will be able to identify project management-related strengths and weaknesses in the service sector.

LITERATURE REVIEW

Different industries face different challenges when managing projects. For example, software development organisations have to deal with high technology uncertainty, while construction organisations are usually more troubled by engineering or finance problems.

In recent literature, engineering and construction organisations were found to have high maturity levels and capabilities for performing project processes [i.e. Ibbs and Kwak, 2000; Pennypacker and Grant, 2003]. These results are mainly attributed to leadership, information sharing and degree of authorisation [Cooke-Davies

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and Arzymanow, 2002]. High-tech manufacturing and telecommunications organisations also score high on project management capabilities [i.e. Ibbs and Kwak, 2000; Pennypacker and Grant, 2003]. Telecommunications organisations especially excel in managing multiple projects [Cooke-Davies and Arzymanow, 2002].

Findings regarding the information systems industry were ambivalent. In some studies, organisations belonging to that industry scored the lowest [Pennypacker and Grant, 2003]; while in others, they achieved high project management performances [Ibbs and Kwak, 2000]. Another interesting finding relates to the maturity level of the type of ownership of the company [Mullaly, 1998].

Project management efficiency benchmarking among countries shows major differences as well. For example, a new service was launched in 57 weeks in Canadian banks, compared to 27 weeks in US banks and 23 weeks in Japanese banks [Drew, 1995]. Zwikael *et al.* [2005] found major differences in management styles in an inter-country comparison.

This paper focuses on the planning stage of projects as being a critical stage in the project life cycle. If planning is faulty, even proper execution following the approved plan will end in a faulty project. Studies have identified planning as one of the critical success factors in a project [e.g. Pinto and Slevin, 1989; Meredith & Mantel, 1995; Johnson *et al.*, 2001]. Thus, high quality of planning increases the chances that the project will be properly executed and completed.

Planning is the second phase of a project, following initiation and prior to execution and closure [PMI Standards Committee, 2004]. The techniques of planning are diverse, ranging from simulation, buffer management, risk management and iterative planning, as dependent on project uncertainty, whether it is 'variation', 'foreseen uncertainty', unforeseen uncertainty' or a 'chaos' project [De Meyer *et al.*, 2002].

Meredith and Mantel [2003] identified six planning sequences, including preliminary coordination, detailed description of tasks, adhering to project budget, adhering to project schedule, a precise description of all status reports and planning the project termination. Russell and Taylor [2003] identified seven planning processes – defining project objectives, identifying activities, establishing precedence relationships, making time estimates, determining project completion time, comparing project schedule objectives and determining resource requirements to meet objectives.

The Project Management Body of Knowledge (PMBOK) [PMI Standards Committee, 2004] suggests a more detailed construct of processes for the planning phase. It identifies 21 planning processes out of the 44 processes required to manage a project. That is to say, planning processes consist of 47 per cent of all processes that should be properly performed by a project manager during the entire life cycle of a project.

Since no industry benchmarking research focusing on project planning has ever been conducted before, our research hypotheses will be derived from the global project management literature cited earlier. The research hypotheses are:

1. Understanding the low importance project management has in the service industry, as stated in the literature review, we may assume little managerial attention to this area and thus low performance. Hence:

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H_0: *Service sector projects have similar success, as compared to other industries.*
H_1: *Service sector projects have lower success, as compared to other industries. Success is measured by cost overrun, schedule overrun, technical performance and customer satisfaction.*

2. In the literature review, it was found that the construction and engineering industry have the best performance in project management practices. Hence, we tend to assume that similar results will be found while focusing on the planning phase of the project:
   H_0: *Construction and engineering sector projects have similar success, as compared to other industries.*
   H_2: *Construction and engineering sector projects have the best success, as compared to other industries.*
   Success is measured by cost overrun, schedule overrun, technical performance and customer satisfaction.
3. The last hypothesis derives from the fact that the service sector performs less large scale projects, as compared to other industries. Hence, we may assume that the constructive support that an organisation gives its project managers is different from those in other sectors:
   H_0: *Project managers from the service sector get similar organisational support from their organisations while managing projects, compared to other sectors.*
   H_3: *Project managers from the service sector get less organisational support from their organisations while managing projects, compared to other sectors.*

The study uses the Project Management Planning Quality (PMPQ) model recently formulated by Zwikael and Globerson [2004]. The model is used in this study as a vehicle for identifying the extent of use of project planning processes by project managers in different sectors. The next section briefly describes the model, followed by data analysis.

THE MODEL

The PMPQ model evaluates the overall extent of use of project planning processes. It is based on the processes to be performed during the planning phase of a project by the project manager. The model analyses project planning processes as defined by PMBOK [PMI Standards Committee, 2004], which is recognised as the main body of knowledge in the project management area, and is accepted as a standard by the American National Standard Institute (ANSI). It is assumed that the more frequently a certain process is performed by a project manager, the more competent the project manager is in that process. Since every process hopes to conclude with some type of finished product, a major product was identified for each of 16 planning processes. For example, the major product that project managers should generate as an output for the 'scope definition' planning process is a Work Breakdown Structure (WBS) chart. The extent of use, in which a planning product is generated, is easy to estimate and, therefore, was used to assess the extent of use in which a process is performed.

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However, the quality of planning is not affected only by processes that are performed by a project manager, but also depends on organisational support. Therefore, the second group of items in the PMPQ model includes 17 organisational support processes. Altogether, there are 33 products in the PMPQ model. A questionnaire was used to collect the data required.

Participants were requested to evaluate the extent of use of the planning products, by using a scale ranging from one (low extent of use) to five (high extent of use). Participants were also requested to evaluate the following four project success dimensions: cost overrun and schedule overrun, measured in percentages from the original plan; technical performance and customer satisfaction, measured on a scale of one to ten (1 representing low technical performance and low customer satisfaction, and 10 representing high technical performance and high customer satisfaction).

The model's reliability was calculated using a number of statistical tests, such as Cronbach's alpha. Results were considerably higher (0.91 and 0.93 respectively) than the minimum value required by the statistical literature [Garmezy *et al.*, 1967], both for the entire model, and for its components. Results were also found to be independent of the person answering the questions, be it a project manager or a senior manager.

An overall Project Planning Index (PPI) was calculated out of the questionnaires as the weighted average of all 33 items. This index presents the overall extent of use of planning processes on a scale of one to five. The model's validity was evaluated by comparing the overall PPI with the projects' success. It was found that the overall project planning index was highly correlated with the perception of project success, as measured by cost, time, performance envelope and customer satisfaction. A summary of the analysis is presented in Table 1. All results are statistically significant with p-values under .01.

The PPI was found to be highly correlated with each of the project's final results. The conclusion from the above statistical analysis is that the PMPQ model is reliable and valid and can be used to evaluate the extent of use of project planning.

DATA COLLECTION

The questionnaire was administered to 337 project managers in Israel, in 19 different workshops, nine of which were administered as part of an internal organisational project management training programme. Each of these nine workshops included an average of 13 individuals. The other ten workshops were open to project managers

TABLE 1
VALIDITY TESTS FOR THE PMPQ MODEL

Success measure	The intersect	Regression slope	R	p-value
Cost overrun (%)	108%	−25%	0.52	<0.001
Schedule overrun (%)	94%	−18%	0.53	<0.001
Technical performance (1–10 scale)	6.2	0.5	0.57	=0.001
Customer satisfaction (1–10 scale)	6.1	0.6	0.51	<0.001

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from different organisations. Fifty-eight of the questionnaires were collected from the service industry, including banks, tourism, education and financial organisations. Other questionnaires were categorised into three more organisation types, including Construction and engineering (i.e. building companies), Software and communications (i.e. telecommunications companies) and Production and maintenance (i.e. the food industry).

A questionnaire was dropped from the final analysis if less than 80 per cent of its data had been completed. Using this criterion, 275 questionnaires remained for the final analysis [Globerson and Zwikael, 2002]. Based on these questionnaires, an analysis of project results and the intensity of use of different project processes are described below.

RESULTS AND DISCUSSION

In this section, the analysis of the extent of use of planning processes will follow the comparison of project success among the industries.

Project Success Analysis

This section introduces the overall results followed by a comparison of the service sector with other sectors. In order to explore the differences in project success among the industries, results were categorised accordingly and are presented in Table 2.

Table 2 presents average project success for the four industries, measured according to four success measures. Analysing the first two measures, we found that service organisations have the lowest scores in the technical performance of the project and their customers are less satisfied than in other sectors. These results were found to be significant (p-values of 0.03 and 0.02 for the first two success measures).

Analysing the two other success measures, it was found that service organisations have a significantly higher schedule overrun (p-value = 0.03), as compared to the other three sectors. However, analysing cost overrun for the service sector, we found an average overrun of 22 per cent from the planned project budget. This cost

TABLE 2
PROJECT SUCCESS INDICES FOR THE SERVICE SECTOR, COMPARED TO OTHER SECTORS

Industry type	**SE**	**CE**	**SC**	**PM**
Number of questionnaires	79	49	132	15
Technical performance (1–10 scale)	7.8	8.3	8.1	8.1
Customer satisfaction (1–10 scale)	7.9	8.4	8.2	8.2
Schedule overrun (%)	35	17	30	42
Cost overrun (%)	22	16	24	44

Abbreviations:
SE – Services
CE – Construction and engineering
SC – Software and communications
PM – Production and maintenance

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overrun is not significantly different (p-value = 0.24) from other sectors. Yet, since the service sector achieves significantly worse performances in three out of four success measures, we may reject the first null hypothesis and claim that service sector projects achieve lower performances than projects from other industries.

Construction and engineering organisations finish their projects with significantly (p-values < 0.01) better results for all four project success measures compared to other organisations belonging to the other three industries. These results fit findings quoted by other studies [e.g. Ibbs and Kwak, 2000; Pennypacker and Grant, 2003], in which construction and engineering organisations have the highest level of project maturity and therefore support the second hypothesis of this paper.

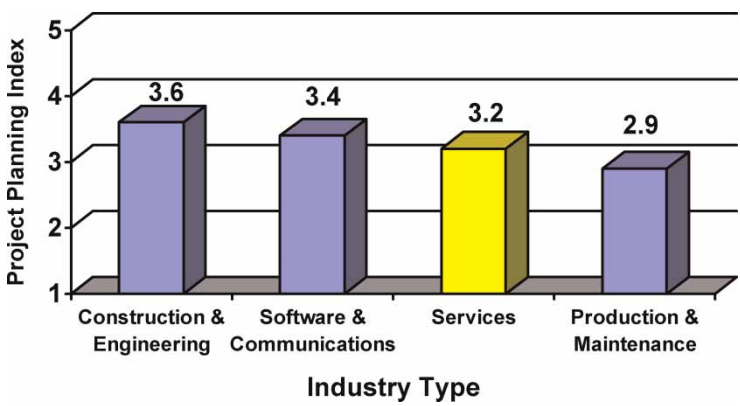
Production and maintenance organisations were found to be the poorest performer for all four criteria, which may result from the fact that projects are not part of such companies' regular operations.

After comparing the project's final results, the next section will benchmark the project managers' planning capabilities in the service sector, as compared to other industries.

Planning Processes Analysis

The PPI index, which was calculated for each industry, presents the weighted overall extent of use of all 33 planning processes included in the model. Figure 1 presents PPI values for the four industries. As can be seen in the figure, the service sector has a moderate PPI score, with 3.2 on the planning scale of one to five. Construction and engineering organisations, which scored high on project success, obtained the significantly (p-value < 0.01) highest PPI score. Production and maintenance organisations, which scored the lowest on project success, received the significantly (p-value < 0.01) lowest PPI score as well.

FIGURE 1
PROJECT PLANNING INDEX FOR SEVERAL INDUSTRIES



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It may be surprising to note that despite a high extent of use level of planning in software and communications organisations, these organisations still often conclude projects with poor results. This may be due to riskier technology and environment, poor control or making unrealistic commitments to the customer.

Project Manager's Expertise versus Organisational Support Analysis

Since PPI, as presented in the previous section, is a combination of two major groups included in the model, 'manager's expertise' and 'organisational support', it is of interest to analyse the score of each. Table 3 present PPI and the contribution of each group of the model, for four industries.

Although the overall extent of use of planning processes was found to be mediocre for the service sector, the detailed analysis in Table 3 identifies its strengths and weaknesses. The manager expertise group of the service sector scored high, compared to other industries. This means that project management capabilities are much mature and that project managers in the service sector, on an individual level, can manage projects as well as in other sectors.

On the other hand, organisational support groups scored low in the service sector, meaning that the individual project manager gets very little support from his organisation regarding project management. Analysing the service sector, it was found that the PPI of organisational support processes (3.1) was found to be significantly ($p < 0.01$) lower than the PPI of the manager's expertise group (3.3). This may be because the service sector does not view projects as their core business. The number of projects being performed in these organisations is small and service organisations rely heavily on the individuals that run the projects. This means that the level of success of projects in the service sector depends mostly on the qualifications of the project manager, who receives very little organisational support.

It was also found that both construction and engineering and software and communication industries derive their project planning strength from the 'organisational support' group ($p < 0.01$). This means that in the organisations belonging to these industries, management is highly involved in the planning phase of projects. The

TABLE 3
EXTENT OF USE OF PLANNING PROCESSES FOR THE SERVICE SECTOR, COMPARED TO OTHERS

	Industry type			
Planning component	**SE(n = 79)**	**CE(n = 49)**	**SC(n = 132)**	**PM(n = 15)**
Overall extent of use (PPI)	3.2	3.6	3.4	2.9
Manager expertise group	3.3	3.4	3.3	3.0
Organisational support group	3.1	3.7	3.4	2.8

Abbreviations:
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reason for this may be the strategic importance of projects in these organisations. After analysing the overall PPI of planning processes, major findings in each of the two groups (manager's expertise and organisational support) will be presented and analysed.

Analysis of the Manager's Expertise Processes

Manager's expertise processes are performed by project managers and consist of the nine knowledge areas specified in the PMBOK [PMI Standards Committee, 2004]. Table 4 presents the average extent of use of planning scores for each project knowledge area for each industry type.

It was found that project managers from the service sector achieve relatively high scores in planning processes that are included in the 'Integration', 'Cost' and 'Procurement' knowledge areas. On the other hand, the 'Quality' knowledge area was found to be the main weakness of the service sector. This means that these project managers do not plan well regarding quality processes to be performed in the project, such as ensuring the quality of decision making or testing the final output of the project before implementing it to customers. Hence, in general, we can advise project managers from the service sector to acquire the proper knowledge and techniques related to quality planning, since it is one of the greatest weaknesses of the service sector as compared to other industry types.

The structure of the model, where each knowledge area contains several planning processes, allows the strongest and weakest products for each industry to be identified. It was found that the main strengths of project managers from the service sector are: (1) developing a Work Breakdown Structure (WBS) chart to identify the activities of the project; (2) developing a Gantt chart; and (3) preparing a risk management plan. On the other hand, together with quality planning, the process

TABLE 4
EXTENT OF USE OF PLANNING PROCESSES BY KNOWLEDGE AREAS

	Industry type			
Knowledge area	**SE(n = 79)**	**CE(n = 49)**	**SC(n = 132)**	**PM(n = 15)**
Integration	4.1	4.2	3.8	3.9
Time	3.9	4.1	4.0	3.7
Scope	3.8	4.0	3.9	3.6
Human resources	3.4	3.9	3.8	3.4
Cost	3.3	3.3	3.3	3.1
Procurement	3.1	3.1	2.9	2.9
Quality	2.8	3.0	2.9	2.8
Risk	2.7	2.8	2.8	2.5
Communications	2.4	2.3	2.5	2.3

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of choosing the right employees for the project team is a weakness of the service sector. This may be due to the limited responsibility of the project manager, who usually serves as a functional manager, and is limited in decision-making regarding other departments of the organisation.

Analysis of Organisational Support Processes

A similar analysis was performed for the organisational support group. The areas of 'Organisational systems' and 'Organisational cultures' are considered to contain strategic support, such as project oriented organisational structure or selecting the right project manager to fit the characteristics of the project. 'Organisational structure' and the 'Project office' areas include tactical support, such as ongoing project management training or establishing a project office. Table 5 presents the average score for the four organisational support areas.

As can be observed from Table 5, the service sector suffers from a lack of organisational support. While comparing the service sector scores to those projects from all other industries using a t-test, significant differences were found ($p < 0.001$, $p = 0.004$, $p = 0.005$, $p = 0.002$ for all four supporting areas respectively). These findings support the third hypothesis of this paper, which claims that project managers from the service sector get less organisational support from their organisations while managing projects, compared to other sectors. The main weakness of this industry lies in the establishment of a project office, which has the lowest score among all industries. This organisational function is a common solution in many organisations, aimed at supporting all project managers with generic project management procedures, training and project control.

In general, the two strategic areas (organisational systems and organisational cultures and styles) obtained significantly ($p < 0.001$) higher scores than the tactical ones (organisational structure and project office). The only tactical support process, which is properly supported by the industries, is the purchasing of project management software. In other words, with the exception of construction and engineering organisations, all other industries still do not fully understand the importance and the impact of equipping project managers with proper support, as a means of impacting project success.

TABLE 5
AVERAGE EXTENT OF USE OF ORGANISATIONAL SUPPORT AREAS, BY INDUSTRY TYPE

Supporting area	**SE(n = 79)**	**CE(n = 49)**	**SC(n = 132)**	**PM(n = 15)**
Organisational systems	3.4	4.0	3.8	2.7
Organisational cultures and styles	3.4	3.8	3.6	3.1
Organisational structure	2.9	3.3	3.2	2.6
Project office	2.9	3.6	3.1	2.8

Abbreviations:
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Drilling down the analysis of the organisational support group, the strongest and weakest processes were identified for the service sector. Some strength includes involving the project managers in the initiation phase of a project, measuring project success and developing an organisational risk management plan. In all these processes, service organisations perform best, compared to other industry types. On the other hand, major organisational support weaknesses include developing project management procedures, project management training, project data documentation and identification of new project management tools and techniques.

Using this benchmarking analysis, service sector organisations that want to improve project management success should support their project managers. Support processes should focus on the main weaknesses of the service sector, including developing project management procedures and increasing the extent of training of their project managers. This will help them learn new techniques and remain at the forefront of their fields as compared with project managers from other organisations.

Critical Success Processes for the Service Sector

The last analysis of this paper includes the identification of critical planning processes, the execution of which will significantly improve project success in the service sector. A planning process may be considered as 'critical' if its impact on project success is greater than most of the other planning processes. First, the relative impact on project success of each planning process was calculated. A multi-variable

TABLE 6
RANKING OF CRITICAL SUCCESS PROCESSES IN ISRAELI SERVICE ORGANISATIONS

	Success measure	**Impact on project success – ranking**			
Planning process	**Customer satisfaction** $n = 79$ $R^2 = 0.39$ $F = 0.81$	**Technical performance** $N = 79$ $R^2 = 0.33$ $F = 0.04$	**Schedule overrun** $N = 79$ $R^2 = 0.21$ $F = 0.45$	**Cost overrun** $N = 79$ $R^2 = 0.26$ $F = 0.19$
Activity definition	11	1	1*	6
Activity duration estimating	1	2	14	10
Communications planning	2	9	5	1
Quality planning	12	7	2	7
Schedule development	13	14	9	2
Activity sequencing	6	13	8	9
Cost budgeting	4	4	6	8
Cost estimating	7	15	7	12
Organizational planning	3	6	4	5
Procurement planning	10	11	10	3
Project plan development	5	3	3	4
Resource planning	16	16	11	16
Risk management planning	14	10	13	13
Scope definition	8	12	12	11
Scope planning	15	8	16	14
Staff acquisition	9	5	15	15

* $p < 0.05$.

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regression was calculated using 16 planning processes (as independent variables) and a project success measure (as the dependent variable). The linear coefficients (beta) were used to evaluate the importance of a planning process on a project success variable. Then, the 16 planning processes were ranked by their impact on project success. This calculation was repeated four times for all four project success indices. Table 6 ranks the 16 planning processes for each project success measure, sorted by the 'schedule overrun' ranking.

In order to identify a critical success process, a proper definition must be developed. In this paper, a critical planning process is one that has a significant impact on at least one project success measure. In other words, a critical planning process is one that is ranked among the first two most influential planning processes (for at least one of the four success measures). Table 6 introduces five critical planning processes for the service sector. These processes include 'Activity definition', 'Activity duration estimating', 'Communications planning', 'Quality planning' and 'Schedule development'.

Differences among Industries

Since results presented in previous sections of this paper may differ among industries, we further analysed the data according to the following three industries: engineering, software development and service organisations. Searching for differences among them, we found some unique characteristics as presented in Table 7.

From Table 7 we see that 'Activity definition' and 'Schedule development' are critical success processes for all the investigated industries. These processes are the core when developing a Gantt chart, which is performed by most project managers,

TABLE 7
PROCESSES THAT WERE IDENTIFIED AS 'CRITICAL PLANNING PROCESSES' FOR THE WHOLE SAMPLE AND FOR EACH INDUSTRY

Planning Process	Engineering industry	Software industry	Service industry
Activity definition	+	+	+
Activity duration estimating		+	+
Activity sequencing	+		
Communications planning			+
Cost budgeting	+		
Cost estimating	+		
Organisational planning		+	
Procurement planning			
Project plan development	+	+	
Quality planning			+
Resource planning		+	
Risk management planning			
Schedule development	+	+	+
Scope definition	+		
Scope planning		+	
Staff acquisition		+	

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and have a positive impact on project success. Hence, a reliable project schedule plan should be developed and approved, regardless of the industry.

The uniqueness of the service sector is expressed by CSP, such as 'quality planning' and 'communications planning'. The relative importance of these two may result from the unique characteristics of the service sector, which requires heavy interaction with stakeholders.

CONCLUSION

By analysing the extent of use of project planning in different industries, it was found that in the service sector, the level of project success depends mostly on the qualification of the project manager, who receives very little organisational support. Project managers from the service sector excel in planning processes including in 'Integration', 'Cost' and 'Procurement' knowledge areas.

A correlation between the extent of use of planning processes and project success was also found. Five planning processes, which have a significant impact on project success, were identified for the service sector. These processes include activity definition', 'activity duration estimating', 'communications planning', 'quality planning' and 'schedule development'. Project managers from the service sector execute four of these planning processes with a high or medium extent of use, relative to other sectors. However, the process of quality planning is rarely performed in this sector and has the worst extent of use of all investigated industries. Hence, taking into consideration the importance of this process and the low attention which is paid to it by managers, we may claim that quality management is the main issue to focus on when managing projects in the service sector.

Quality management processes are taken to reach the totality of features and characteristics of a service that bear on its ability to satisfy a customer's given needs. Processes within this knowledge area include: quality planning, quality assurance and quality control. According to the PMBOK [PMI, 2004], the recommended tools that a project manager may use in order to improve project quality management include:

(1) For quality planning – cost–benefit analysis, benchmarking and cost of quality.
(2) For quality assurance – quality audits, process analysis, cost–benefit analysis and benchmarking.
(3) For quality control – cause and effect diagram, control charts, flowcharting, histograms, Pareto charts, run charts, scatter diagrams and inspections.

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