Software project management and planning: the case of the Greek IT sector

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Abstract: Some of the most important factors that affect the competitiveness of the companies within the IT/IS sector are the use of modern management techniques and state-of-the-art production tools. This research attempts to examine the production process adopted and the management practices used by Greek IT/IS sector. A structured questionnaire was addressed to project managers of almost all Greek IT/IS companies. The results show that, although very experienced and highly educated people are involved in the production process, most companies are not using any formal development methodology and they do not plan or manage their development process in the right way.

Keywords: information system development; IS development methodologies; IS project management.

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1 Introduction

The goal for all project managers is to bring a project to completion on time, within the budgeted costs, and to meet the planned performance or end-product goals by orchestrating all resources assigned to the project effectively and efficiently (Simpson, 1987). As a result, managers of software development projects increasingly recognise the importance of planning and estimation (Lederer and Prasad, 1995;

Deephouse et al., 1996) for the successful completion of their projects. However, although they have many sophisticated tools at their disposal, many systems are still delivered way behind schedule, cost far more to produce than original budget estimates, and fail to meet user requirements (Johnson, 1996; Lederer and Prasad, 1995; Simmons et al., 1993; Barki et al., 1993). It has been reported that, on average, software systems are delivered a year behind schedule, only 1% of software projects finish on time and to budget, and more important, 25% of all software-intensive projects never finish at all (Stockman and Norris, 1991).

Thus, it is not surprising that improving software product quality and performance as well as development team productivity has become a primary priority for almost every organisation that is involved in the development of IT/IS systems (Moller and Paulish, 1993). Nevertheless, surveys in the UK (KPMG, 1990; Fairbrain, 1989) report that there are still major quality problems with commercial systems. While computer hardware performance has been doubling approximately every three years, improvements in software productivity have been increasing at a modest 4% annual rate (Putnam, 1991).

The problem caused by this phenomenon, often referred to as the 'software crisis' (Glass, 1994), can be attributed not only to the non-application of principles and methods, but also to inadequate project management caused by a lack of recognising and understanding what the real problems are in carrying out software development (Ratcliff, 1987).

Unfortunately, the main strategies adopted for planning the development process are various 'rules of thumb' developed by project managers, which are based only on their personal experience. "Effort estimates are, therefore, usually best guesses based on a series of best guesses about the project and staff resources" (Jordan and Machesky, 1990).

Another strategy is to follow the old adage, "estimate the cost and then double it". However, it is most likely that cost will still be underestimated (Bowen and Hinchey, 1995).

A number of studies focusing on the efficiency of software development have been presented in the literature (Banker et al., 1991; Mahmood et al., 1996). Many attempts have also been made to examine the scale effect on the software production process (Banker and Kemerer, 1989; Byrnes et al., 1993). Later, Banker et al. (1994) reported the existence of both economies and diseconomies of scale in software development.

Finally, it is recognised (Lauer, 1996; Bubenko, 1995; Keil, 1995; Boehm, 1991) that most of the problems still have their roots not only in the technical (software) issues but also in managerial, organisational, economical and social issues.

The last decade was for the Greek IT/IS sector a period of a rapid growth and expansion. This can be attributed to the fact that the market became more mature (after its initial steps in the early 1980s), the introduction of many companies in the Athens Stock Exchange, and finally, the EU funding of many IT/IS projects. This research attempts to provide a snapshot of the Greek IT industry today. The main aim is to understand how Greek IT/IS companies organise and manage their development process.

This paper is structured as follows: Section 2 provides a brief literature review, while Section 3 describes the research methodology adopted. Section 4 presents the results and finally, Section 5 summarises the findings and highlights some of the limitations of this research.

2 Literature review and underlying theoretical framework

Planning is an iterative process because there are a large number of interacting variables and first assumptions can be proved incorrect (Youl, 1990). Project managers usually have to make early estimates without knowing the detailed requirements. The project team members and their abilities may also be unknown. However, no one can afford to wait until the end of the Requirements Capture and Analysis (RCA) stage to start planning for the rest of the project.

Planning and managing the system development process depends on a method of estimating the resources (cost, effort, timescale) required for the completion of different stages of the development process. In addition, the estimating method must be able to take into account the sensitivity of the development resources to various product, project and environmental factors. Resource estimation must also be able to take past experience into account, particularly the relevant experience of the department or business in the development of similar systems (Rook and Wingrove, 1990).

Software development can be seen as an economic production process (Banker et al., 1994) whereby inputs (e.g., the effort of systems development professionals) are converted into outputs (systems deliverables), often measured as the size or complexity of the delivered system, using such metrics as Source Lines of Code (Kemerer, 1987; Cusumano and Kemerer, 1990) or Function Points (Low and Jeffery, 1990; Kemerer, 1993). A large stream of research examines a number of factors that affect the time required to complete a project and its overall productivity.

Studies have shown (Locke and Latham, 1990; Rasch and Tosi, 1992, Constantine, 1993; Nidumolu, 1995; Lauer, 1996) that some of the most important factors that affect the software development process are:

- human factors
- technical factors
- management factors (Ali and Seiford, 1993; Constantine, 1993).

Nevertheless, studies have pointed out that the project manager's expertise is not captured by the existing models (Mukhopadhyay and Kekre, 1992; Subramanian and Breslawski, 1995). Instead, software community pays too much attention to the technical factors at the expense of these other contexts. One often cited reason is the difficulty of quantitatively measuring human factors (Perry et al., 1994). Nevertheless, the need to improve IS human resources is quickly emerging as a high priority in the 1990s among IS executives (Neiderman et al., 1991). Information systems development is not considered any more just as a technical process of building an information system, but also as a social process involving stakeholders from multiple organisational units (Kirsch, 1997). Successfully building systems, therefore, require effective management of relationships among these stakeholders to elicit their contributions and cooperation, while at the same time, maintaining progress towards the project's goals (Beath and Orlikowski, 1994; Walz et al., 1993).

Human factors must include factors concerning both developers (Rasch and Tosi, 1992; Macala et al., 1996) and users. The degree and effectiveness of participation depends on the relative ability of users and developers to exert influence, their relative power positions and the ability and willingness of each party to communicate

(Markus and Bjorn-Anderson, 1987). A model on how users participate in system development is presented by Newman and Robey (1992) and a comprehensive review of the latest research on users' participation is given by Cavaye (1995). Nevertheless, the argumentation for user participation has been largely uncorroborated by research evidence plagued, however, with inconclusive and sometimes contradictory results (Hartwick and Barki, 1994; Hunton and Price, 1997; Lawrence and Low, 1993; DeLone and McLean, 1992; McKeen et al., 1994; McKeen and Guimaraes, 1997).

Furthermore, not only tools and methods, but also personnel experience and skills are important. The latter are indicated as key variables that influence overall software development effort (Wrigley and Dexter, 1991) as well as software development management and productivity (Subramanian and Zarnich, 1996).

Above all, software development is a collaborative effort that relies on effective communication and interaction between various stakeholder groups: managers, end-user groups and systems development professionals (Newman and Robey, 1992). Effective communication facilitates the exchange of information that is essential for the derivation of systems requirements and the eventual success of a systems development effort. Individual stakeholders have only partial knowledge of the problem domain, and domain knowledge is "… fragmented, in different forms, with different individuals, and in different physical locations" (Flynn and Warhurst, 1994, p.190). It is only as requirements accumulate and evolve that a full and complete understanding of the problem domain can emerge (Darke and Shanks, 1997).

Additionally, other studies have shown that some of the most important factors that influence the productivity within the software development process are:

- size of project team (Banker et al., 1994; Jordan and Machesky, 1990; Youl, 1990; Banker and Kemerer, 1989)
- product complexity, requirements volatility, schedule constraints and software tools that are used (Rasch and Tosi, 1992)
- team cross-functionality and team independence (Carmel, 1995)
- learning, training, and communication overheads (Rodrigues and Williams, 1997).

Nevertheless, previous research investigating the productivity effects of various software engineering management variables involving homogeneous datasets (i.e., data from similar project types at the same firm) have typically reported results with low statistical significance. For example, Kemerer (1987) reported that the addition of the large numbers of productivity factors did little to improve the relationship between size and effort on a set of 15 homogeneous MIS-type projects. Banker et al. (1991) also suggested that a relatively small number of critical factors might explain a large amount of the variation in productivity at a specific site.

Most of the studies reported in the literature thus far have focused on overall software development. It is suggested (Kitchenham and Taylor, 1985; Subramanian and Breslawski, 1995) that the best approach is the planning of software costs or efforts by phase and activity and the adoption of the bottom-up estimation. Bottom-up estimation is based on estimating the effort for individual tasks, and the effort for the entire project is assumed to be the sum of the effort for each task. As Kitchenham and de Neumann (1990) as well as Lederer and Prasad (1992) suggest, to improve standards of cost and effort estimation, it is necessary to adopt an estimation process,

based on using different estimation methods and measures at different stages in a project lifecycle, and incorporating feedback mechanisms to improve individual estimating expertise and the accuracy of estimation models.

3 Research methodology

More than four improved versions of the research instrument (questionnaire) were designed and tested. The final questionnaire was divided into six sections, each one dealing with a different aspect of the development process. It must be stressed that most of the questions referred to the last project each respondent was involved in.

Despite the fact that all the formal data collection procedures were adopted, no more than 65 correctly completed were received. A possible for this relatively low response rate is probably the time the data collection process took place (summer – holiday season). The SPSS statistical software was used to analyse the data.

4 Analysis of findings

The sample consisted mainly of Project Managers or Program Leaders (81.5%). It is important that they are quite experienced since, on average, they have participated in eight similar projects. Most of the projects are software projects (77%) that are developed for external customers (91%). The majority of them are for Generic use (73%) and tackle well-defined problems (70%).

Most developing organisations (81.5%) have a formal system development procedure. However, and in accordance to what is happening in other countries, it is found that a relatively small percentage (54%) of the Greek IT/IS companies are using formal development methodologies during the system development process. Nevertheless, nearly all of these methodologies are structured ones and compatible with other methodologies/methods/tools used by the same companies. Only a few of them covered the RCA stage of the development process, while no tool or technique was in use for ensuring that enough requirements were captured. Furthermore, 66% of the methodologies were supported by a tool responsible for automating the process, while 54% of the methodologies included a project management tool. It is encouraging though that the main reasons these specific methodologies were chosen are first, the quality of the outcomes produced by their use and, second, the compatibility and suitability level of each methodology with the characteristics of each specific project.

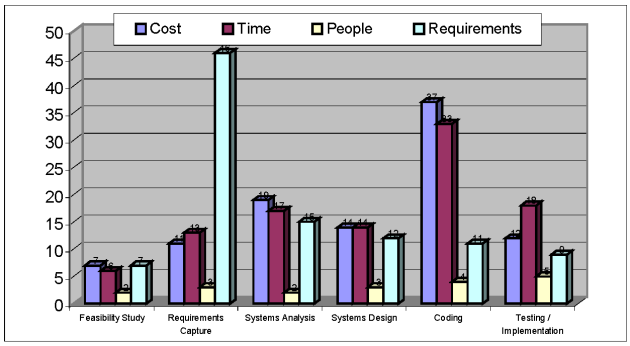
To continue, it was reported that the main size metric used for the requirements document is the ‘number of pages’ metric (anything from 4 to 500 pages, with average size 85 pages), while for the whole project the size metric used is the number of code lines written (anything from 2.200 to 400.000 LOC, with average size 92.000 LOC). The main programming languages used are C++ and Java.

Furthermore, one of the most interesting finding is the resource allocation pattern used by the Greek IT/IS companies and the effectiveness of this pattern. More specifically, it is found that in 64% of the projects, the development team consisted of less than six people. In detail, only one or two persons were responsible for the development of the Feasibility Study (in 54% of the projects), one to three persons were involved in the RCA process (72% of the projects), one or two persons had undertaken

the Analysis and Design task (63%), up to four people were responsible for the writing of the actual code (72%), and finally, up to five persons were involved in the testing and implementation process (in 54% of the projects).

As far as the elapsed time and effort allocated to each stage of the system life cycle are concerned, it is found that projects are developed within 2–36 months (23 months on average), while the effort needed for their completion is from 1 to 600 man-months (240 man months on average). However, it is shown that the stage where the highest percentage (33%) of the total elapsed time and effort was allocated to is the Coding stage. On the other hand, only 13% of the total elapsed time and effort was allocated to the RCA stage (Figure 1). Similarly, while the total cost of project development is from 60.000 euros up to 600.000 euros (mean = 185.000 euros), Coding is the single stage of the development process with the highest cost (37% of the total cost). The RCA stage accounts only for 11% of the total development cost. Despite this resource distribution pattern, most of the requirements (46%) are captured within the RCA process, while there is a volume (20%) of the requirements that are captured during the Coding and Testing stages. This can explain why although 25% of the respondents were not satisfied with the amount of requirements captured during the RCA stage, 82% of them reported that more than 85% of the requirements captured during all the stages of the development process had finally been used and accommodated into the system designed. This resource allocation pattern indicates that Greek IT/IS firms put emphasis mainly on the coding stage of the system development process.

Figure 1 Resources allocated and requirements captured within each stage of the development process



Furthermore, to support what was found by other researchers (Youl, 1990), the development process used by Greek IT/IS companies is an iterative process. However, the number of iterations is different for each separate stage of the development process. Additionally, different, as well, is the reason why the targets within each stage had not been accomplished and, therefore, one more iteration had to be performed. For instance, only two iterations of the Feasibility Study (in 54% of the projects) and the Design stages (in 63% of the projects) were performed and the main reason for not accomplishing their targets was 'lack of time'. On the other hand, three iterations of the RCA process occurred mainly because there was a communication problem between the developers and the 'sources of information'. The last iteration of this stage is usually performed for validation and verification purposes. Finally, cost seems to be the main reason why the Analysis stage is performed only once in most of the projects.

Moreover, the way some important factors (human, technical, etc.) affect the previously mentioned project management parameters (time, effort, cost) was examined. The majority of the respondents consider as very significant the following factors: team members' experience, team members users' communication, team management, and resources available and their coordination. It should be stressed, though, that the same people reported than the significance of the factors does not determine the actual level of each of the factors. More specifically, it is found that the level of the following factors is high to very high: team members' experience, team members' knowledge, customers' dedication to the project, management commitment, project management style, development tools/techniques used and finally, resources available (Table 1). In the majority of the projects included in this survey, the effect of these factors on time, effort, cost and outcomes was positive. The most important factors were found to be:

- team members' experience
- team members' knowledge
- team members' persistence and commitment.

On the other hand, it is reported that the factors project managers should work on to improve both the quality of the project outcomes and the economic parameters of the projects are:

- users' involvement
- team members users' communication.

As for project management, respondents suggested that improvement is necessary, especially in planning and organising the project management process.

Table 1 Level of factors and their impact on resources (Time, Effort, Cost) and outcomes

Factors	*Level* (*value*)	*Impact on resources and outcomes*
Team members' experience	Very high	High
Team members' knowledge	High	High
Team members' commitment and persistence	High	High
Team size	Satisfactory	Medium
Users' involvement	Satisfactory	Medium
Users' communication with team members	Satisfactory	High
Users' motivation	Satisfactory	Medium
Users' abilities	Low	Low
Conflict between users	Low	High
Users' understanding of the system under development	Satisfactory	High
Customers persistence and commitment to the project	High	Medium
Developing organisation's commitment	High	High
Project management	High	High
Tools and techniques available	High	High
Resources available	High	High
Resource coordination	High	High

5 Summary, conclusions and research limitations

The main findings of the research presented in this paper indicates that Greek IT industry focuses mainly on the development of small size, generic software, solving medium or well-defined problems and targeting small to medium size customers. The experience of the people who are participating in the development process is satisfactory and this can partly explain their good knowledge on and understanding of the problems they are facing during the development process. It comes as a surprise that a rather large number of developing organisations do not use a development methodology; it seems that they are heavily relying on the experience and knowledge of the people who participate in the development team. However, since there are not many experts in this field in Greece, companies are always facing the threat of losing their most experienced personnel. On the other hand, it is quite promising that those companies that are using a development methodology are doing so for specific reasons (compatible with other methods used, suitable to the characteristics of the specific project, etc.).

The fact that 'lack of time' was reported as the main obstacle for not delivering what was promised is a strong indication that mainly planning but also management are not performed in a proper way. To support this argument, it is shown that the iteration process of some of the system development stages did not produce the expected results mainly because there was not enough time allocated to these stages.

Finally, it becomes obvious from both the literature review and the findings of this research that the successful completion of the IT/IS projects very much relies upon the knowledge, experience, and commitment of both team members and users. However, the most important factor was found to be the communication between developers and users. It seems though that the Greek IT/IS developers do not pay the appropriate attention to some of these important human factors, but neither to some other technical factors (e.g., use of methodologies).

This research has some major limitations. First of all, mainly software houses were included in the sample and, as a consequence, the findings refer only to this IT/IS sub-sector. Second, although the size of the sample could be considered as satisfactory, it might not be a good representative of the population, because some of the biggest and well-known companies refused to participate. Last, the data collection process took place 36 months ago and things might have changed since then.

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