

CRITICAL SUCCESS ASPECTS IN PROJECT MANAGEMENT: SIMILARITIES AND DIFFERENCES BETWEEN THE CONSTRUCTION AND THE SOFTWARE INDUSTRY

João Varajão, Caroline Dominguez, Pedro Ribeiro, Anabela Paiva

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Project success is highly dependent on the project management process, and there are several aspects that need to be carefully considered. This article aims at responding to the research question: are there similarities in different industries in what concerns the critical aspects for the success of project management? Throughout a comprehensive survey applied to medium and large companies of the construction and software industries, we came to the conclusion that the two currently most important project management success aspects are common to both industries: "project planning" and "well defined objectives and requirements". The "project manager efficiency" is also in the top of the critical success aspects. On the other hand, other aspects show major differences in the studied industries.

Keywords: *aspects, construction, project management, software, success, survey*

Gledišta bitna za uspjeh u upravljanju projektom: sličnosti i razlike između građevinske i softverske industrije

Izvorni znanstveni članak

Uspjeh projekta uveliko ovisi o procesu upravljanja projektom i nekoliko je gledišta koja treba pažljivo razmotriti. Cilj je ovoga članka odgovoriti na pitanje: ima li sličnosti u raznim industrijskim granama u onome što se odnosi na gledišta bitna za uspjeh upravljanja projektom? Opsežnom anketom provedenom u srednjim i velikim kompanijama građevinske i industrije računarskih programa, zaključili smo da su dva, trenutno najvažnija gledišta za uspjeh upravljanja projektom zajednička za te dvije industrijske grane vezana uz "planiranje projekta" i "dobro definiranje ciljeva i zahtjeva". "Učinkovitost voditelja projekta" se također nalazi pri samom vrhu. S druge strane, postoje bitne razlike u odnosu na druga gledišta.

Ključne riječi: *anketa, gledišta, građevina, računarski program, upravljanje projektom, uspjeh*

1 Introduction

Construction projects are commonly criticized for their delays, budget deviations, low productivity and low product quality [1]. These problems are largely due to the fact that project management is a complex activity which often leads to a high degree of uncertainty. That is particularly true in the construction industry since uncontrollable aspects, like meteorological conditions for instance, may result in significant changes in the execution of the project regarding the original plan. Therefore, a very cautious management of several aspects is necessary for the global success of the project.

This paper aims at responding to the research question: are there similarities in different industries in what concerns the critical aspects for the success of project management? Aiming to answer this question, we carried out a survey applied to project managers of construction companies and to project managers of software development companies. The results were then compared, analysing similarities and differences between them. This allowed us to compare companies from a traditional engineering industry, in which project management practices are supposed to be well consolidated, with a more recent one.

In the next sections the work that was done is described and the main results achieved are presented. In Section 2, based on a literature review, the main concepts and common success aspects of project management are presented and discussed. In Section 3, the research methodology is described and the study is characterized. In Section 4, the results are presented and discussed. Finally, in Section 5, a global analysis is carried out and the main results obtained are summarized.

2 Background

2.1 Projects

According to the Project Management Institute (PMI), a project is a set of defined activities assigned to create a result with a clear beginning and end date [2]. It is a temporary endeavour planned to generate a product, service [3] or other result. A project is based on the development of something different from what is being produced, and all projects are unique. Although there are similar aspects from one project to another, at the end there is a product or service that differentiates itself from previous ones.

Each project life-cycle phase follows a timeline order of events, and entails the work to be performed and the necessary resources. It is characterized by the delivery of a specific and assessable outcome (deliverable). Project stages may vary according to the project itself or with the concerned activity sector [4]. Nevertheless, in the majority of cases, the project life-cycle follows these usual stages [2]: starting; planning; execution/monitoring; and closure. All stages are linked by processes that must be integrated.

2.2 Project success

Project success has several definitions and various aspects can influence it. According to Kerzner [5], the correct definition of project success is the one that assesses both primary and secondary factors. Primary factors include meeting deadlines, budget limit and the level of expected quality. The secondary factors consist, for instance, on the agreement and acceptance of the client to provide his name as a reference [6, 7, 8], the

competences of key personnel [9, 10], and the project complexity [9].

Regardless of the activity sector, during the development of any project, it is very difficult to accomplish all requirements, stay within the budget's limits, as well as meet deadlines and client expectations. For a project to succeed, it is necessary to manage all activities and aspects involving requirements, cost, risk and time, especially the ones that are critical for success.

2.3 Project management

Project management plays a major role in the planning and organization of resources in order to achieve a pre-determined goal. According to LaBrosse [11], project management is the discipline responsible for the organization and management of resources, which aims at a project being completed [8] within a pre-defined time and budget [12].

Project management provides an organization with powerful tools that enhance the ability to plan, execute and control activities, people and all the involved resources [13].

To accomplish (or even surpass) the requirements and expectations of stakeholders, project management applies knowledge, skills, tools and techniques to project activities [3].

The growing importance of project management and its increasing use by companies of all sectors, have led to the emergence of working groups and the proposal of several frameworks, which have contributed to the development of this area. For instance, the PMBoK (Project Management Body of Knowledge) created in 1976 by the PMI (Project Management Institute), defines techniques, methods and processes for project management. Currently, this is a good example of standard practices used in the area of project management.

PMBoK defines several knowledge areas: scope management; time management; cost management; quality management; human resources management; communications management; risk management; procurement management; and integration management. Each of these areas has its own characteristics and levels of complexity, and they are closely interrelated. Nevertheless, according to the situation these areas may have different levels of importance and project managers must be aware of and master all of them [2].

Baccarini [36, 37] identified two distinct components of project success: Product success - this deals with the effects of the project's final product; Project management success - this focuses upon the project process and, in particular, the successful accomplishment of cost, time, and quality objectives. It also considers the manner in which the project management process was conducted.

2.4 Success in construction project management

Measuring the performance of a construction project and its management in terms of success or failure is a difficult task. Not only because of the increasing complexity of the projects themselves, but also because of

the existence of several different stakeholders in the construction process.

In the literature, success criteria for project management evaluation often refer to the traditional Atkinson [14] triangle elements (cost, time and scope). In the construction sector, some authors like Chan and Chan [15] have added health and safety conditions to these factors which are very important items to be taken into account.

In order to achieve success, several aspects of project management should be carefully considered.

Belout and Gauvreau [16] discuss the relevance of human aspects in project success. Great emphasis is given to them in several reviewed papers. White and Fortune [17] state, for example, the importance of senior management support in a large range of sectors. The results of a survey conducted in large Vietnamese construction companies and related organizations by Nguyen et al. [10] also show that the success management aspects, grouped under the main categories like competence, commitment and communication, are much more related to human aspects rather than to technical ones.

Research developed in Australia presents a more recent perspective of construction project management [9]. Several critical aspects for success are highlighted, as for instance, detailed planning, cost control, support and communications, clear and well-defined project milestones, among others. This paper focuses on a variety of success aspects, both technical and human related.

Besides the internal management aspects to be considered, Carú et al. [18] show that the successful outcome of a project highly depends on the management of the relationship with the client during the project cycle.

2.5 Success in software development project management

As in the construction industry, managing a software development project entails the confrontation of various adversities. The majority of software development projects are not completely or well developed and some of them are even cancelled [19, 39]. It is widely accepted that one of the main causes for this failure is inefficient project management [20]. Thus, the success of software development projects depends upon the rigorous processes of project management [21].

Aspects such as "Top managing involvement", "Proper project planning", "Well-defined requirements", "Frequent checkpoint controls", "Skilled working teams", and "Team project effort", are major players in success [19, 22].

As in the construction industry, one basic criterion for success evaluation refers to the ability that a project has to achieve its goals [23].

Important aspects that influence the success of project management are the lack of clear specifications and ambiguous definitions of the goals [38]. Pivotal to any activity of system development analysis and design is the process of specifying requirements [24, 25], being one of the main causes of failure located in the requirements engineering phase [26]. Furthermore, the modification of these aspects during a project's execution influences the success of the outcome. Apart from the initial

requirements and the project size, the environment is always changing during the project cycle. This contributes to changes in the project requirements and may increase the required efforts to complete the project. Moreover, delays and frequent interruptions during the development of a project may also contribute to an increased endeavour, each time the work restarts [27], with its consequent chronogram delay [7]. Bearing this in mind, a critical aspect of project management success is the clear, correct and unambiguous characterization of project scope and environment [28].

Another aspect that constrains project success is the lack of cost management. A proper cost estimation is one of the most challenging and demanding activities of software development. Software industries are known for not accurately estimating project costs. Incorrect project cost estimation leads to bad project planning, which then leads to chronogram delay, lack of human resources, bad systems quality and, in some cases, project cancellation [8].

Even though time, cost and environment project control are essential aspects for success, quality also has a relevant role to play. Efficient quality control has been shown to be the most important factor that separates a well-executed project from a failed or aborted one [29]. Taking this into account, it is important that a project fulfils initial established requirements as well as a client's needs. Moreover, tight control is fundamental, as well as a software review to detect and remove defects in order to guarantee quality [7].

Directing a project team based on bad planning and/or organization may compromise the project. Likewise, lack of liability, support and focus of project team actors might compromise the overall project outcome. Correct human resource management is required to achieve the maximum commitment of each person within the project. An environment where many people interact is prone to the occurrence of conflicts. These must be resolved before the project is affected.

In addition, little involvement of the client in the project may create misleading expectations about the final outcome. Hence, it is important that the client is involved in the overall process. From the beginning, clients need to be aware of the project plan, the financial resources involved and the overall project benefits [8].

According to Day [30], success depends mainly on the human ability to communicate. Lack of communication also hampers project success. The project is compromised if a continuous information exchange among all the project actors does not exist. When a project fails, the strategic aims of an organization will not be met as planned, scarce resources will be wasted and the client's expectations of benefits will be unfulfilled. Additionally, the organization's performance will be heavily affected [31].

2.6 Synthesis

As shown in the literature about construction and software development projects, several aspects are underlined as being important to project success management. From technical to human aspects related to the project manager and the project team, through to the

client's involvement, they all seem to contribute to the overall success of a project. The traditional success aspects continue to be mentioned as key elements [35], although a set of broader and richer considerations are also highlighted by different authors.

3 Method

A research was conducted with the aim of answering to the question: are there similarities in different industries in what concerns the critical aspects for the success of project management? In order to answer this question, the construction and software development industries were surveyed. The survey was undertaken from February 2008 to May 2009 and the general methodology involved a questionnaire that was sent to project managers of Portuguese companies. After three rounds, 80 usable questionnaires were received and the data collection process was concluded. A careful application of survey techniques was done, especially those related to institutional permission and subject anonymity.

3.1 Questionnaire

A survey instrument was developed to obtain feedback from project managers. The structure of the questionnaire addressed several key aspects of project management with nominal, Likert and ordinal scales. The questionnaire was divided into several sections, each one with well-defined objectives. The proposed questionnaire was used in a previous survey [32] and pre-tested with a sample of six project managers to validate its content and readability and to improve some aspects of the questions. The necessary changes were made to the final questionnaire which was edited in an online survey tool. This final questionnaire was used to get feedback from both groups of project managers.

3.2 Subjects

The subjects of this study were 40 construction project managers and 40 software development project managers. In the case of the construction companies, the sample consisted of 40 project managers of 40 different construction companies selected from the list of the 750 medium and large companies provided by the Portuguese Instituto Nacional da Construção e Imobiliário – INCI (National Institute of Building and Real Estate). In the case of software development companies, the managers were selected from the group of 1000 large companies [33]. Both casual and convenience sample methods were used.

A briefing letter was sent by e-mail to the project managers regarding the scope and goals of the study including a link to a Web site, which permitted the completion of the questionnaire online. In order to ensure the same number of companies of each industry and to enable the comparability of results, several reminders were sent to companies.

The choice of medium and large organizations seemed to be the most appropriate, since the complexity involved in bigger projects demands more efficient project management practices.

Table 1 Characteristics of project managers

Characteristics	Construction		Software	
	Number	%	Number	%
Gender				
Male	33	82,5	30	75
Female	7	17,5	10	25
Age				
Less than 30 years	12	30	3	7,5
30 to below 35	9	22,5	10	25
36 to below 40	2	5	14	35
41 to below 45	5	12,5	7	17,5
Greater than 45	12	30	6	15
Time working in current company				
Less than 5 years	13	32,5	15	37,5
5 to below 10 years	9	22,5	16	40
11 to below 15 years	6	15	5	12,5
Greater than 15 years	10	25	4	10
Without answer	2	5	0	0
Experience in project management				
Less than 2 years	7	17,5	9	22,5
2 to below 5 years	9	22,5	7	17,5
6 to below 10 years	9	22,5	15	37,5
Greater than 10 years	15	37,5	9	22,5

3.3 Characterization of the survey sample

The characteristics of the respondents are shown in Tab. 1.

The participant software project managers represent a broad range in terms of experience. In general, the majority of software project managers are male (75 %), over 35 years old (67,5 %), have been working in their current companies for more than 5 years (62,5 %) and have more than 5 years' experience in project management (50 %). Regarding education, 92,5 % of the participants have a university degree, 60 % of them in the computer science field.

Concerning the construction project managers, the majority are male (82,5 %), less than 36 years old (52,5 %), have been working in their current companies for less than 11 years (55 %) and have more than 5 years of experience in project management (60 %). 85 % of the respondents have a university degree, 70 % of them in the construction field.

Considering both groups together, the surveyed project managers are mainly male (about 78 %), over 35 years old (57,5 %), have been working in their current companies for more than 5 years (65 %) and have more than 5 years of experience in project management (60 %).

The project managers' characteristics indicate that the survey's results obtained in this study represent a good picture of the current practice of project management in the studied industries.

4 Data analysis and results

The project managers were asked to rank the following success aspects that resulted from the literature review: "Project planning"; "Top management involvement"; "Customer involvement throughout the process"; "Well defined objectives and requirements"; "Cost control"; "Project monitoring"; "Frequent control checkpoints"; "Project strategy"; "Involvement of the team in achieving the objectives"; "Project manager

efficiency"; "Way of resolving conflicts" and "Communication efficiency". Each of these aspects was classified using a Likert scale where the respondents specified the level of relevance between 1 (not important) to 5 (very important). The data was then analysed using descriptive statistics.

The graph in Fig. 1 shows the average importance attributed to each critical aspect in each area of activity under survey, as well as in both industries together. Tab. 2 shows the ranking of the 12 success aspects assessed for construction and development software activities.

As shown in Fig. 1 and Tab. 2, the aspects "Project Planning" and "Well-defined objectives and requirements" occupy the top ranking places in both cases. Following these two main aspects, for construction, the 3rd aspect is "Project manager's efficiency", the 4th is "Involvement of the team in achieving the objectives", and the 5th is "Cost control". Whereas for software development, these places are occupied by the following aspects: "Customer involvement throughout the process" (3rd), "Project manager efficiency" (4th) and "Top management involvement" (5th).

As previously mentioned, the aspects placed at the top of the ranking are the same for construction and software development industries. This fact reveals the importance given to planning and to the definition of the requirements for project management success. These are the foundations of the whole project. If efficient planning that covers all the requirements and the necessary tasks for its accomplishment is not done, there is the risk that the project will go in a different direction from its real objectives. If this happens and the project is built on a wrong basis, it is almost certain that the final results will be compromised.

Therefore, project managers must allocate the necessary resources in the planning process because the project's success directly depends on it. It is important to highlight the "project manager efficiency", that is also in the top of the critical success aspects.

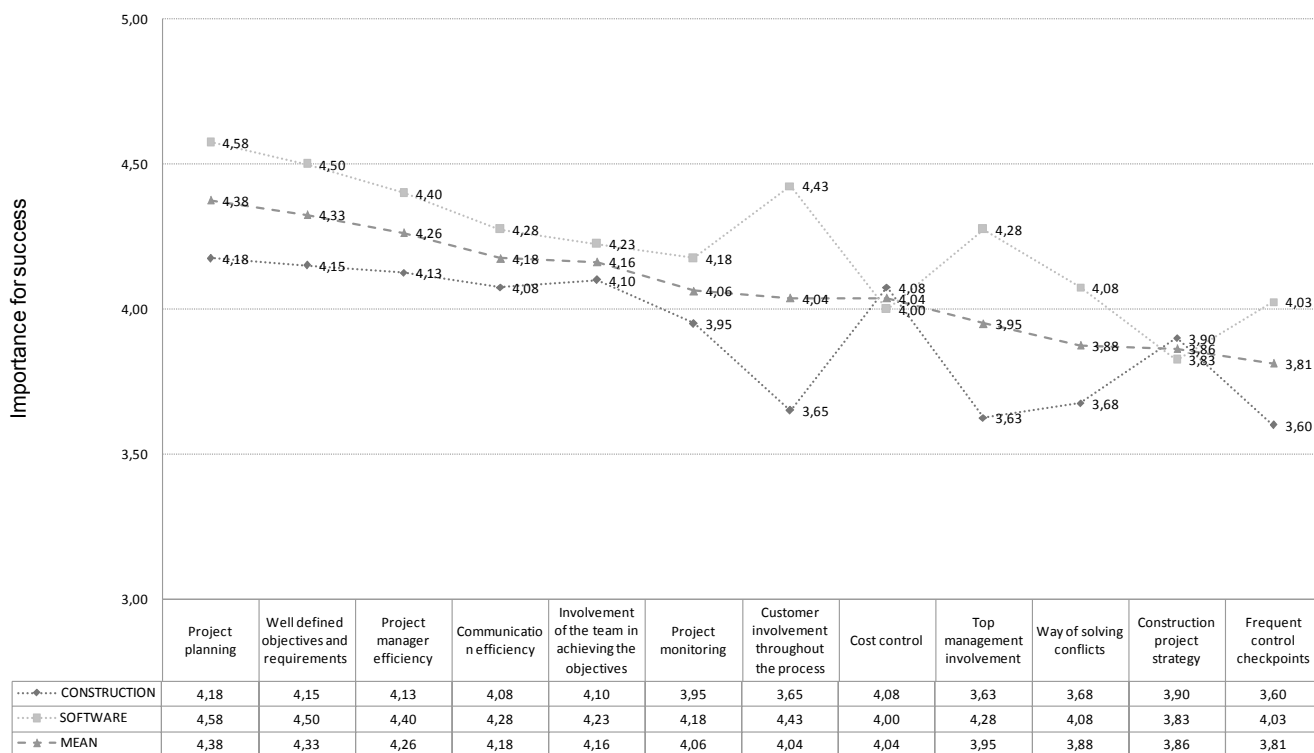


Figure 1 Success aspects – comparison between construction and software development industries

Table 2 Success aspects – comparison between construction and software development industries

Construction	Critical aspects for success	Software development
1 st place	Project planning	1 st place
2 nd place	Well defined objectives and requirements	2 nd place
3 rd place	Project manager efficiency	4 th place
4 th place	Involvement of the team in achieving the objectives	7 th place
5 th place	Cost Control	11 th place
6 th place	Communication efficiency	6 th place
7 th place	Project monitoring	8 th place
8 th place	Project strategy	12 th place
9 th place	Way of solving conflicts	9 th place
10 th place	Customer involvement throughout the process	3 rd place
11 th place	Top management's involvement	5 th place
12 th place	Frequent control checkpoints	10 th place

It is also important to note three aspects that are positioned differently in the industries studied: "Customer involvement throughout the process" is positioned in the 3rd place in development software, but falls to the 10th position in the construction ranking; "Top management involvement" occupied the 5th position in software development ranking, but is only the 11th in the construction ranking. Finally, "Cost control" is placed in the 5th position for construction, but is in the 11th place in the software development ranking.

The importance given to these aspects related to client and top management, observed in the two industries is significantly different. This can be explained by the inherent final product characteristics. The construction industry deals with more stable and formalized requirements, which turns aspects, such as client involvement, less relevant. On the other hand, it is surprising to observe that "Cost control" has been positioned so differently in the two activities. In general, in the software industry, all aspects related to control and

monitoring occupy lower ranking places: 8th, 10th and 11th places.

5 Conclusion

Modern organizations are faced with pressures from the ever changing external economic, technological, social and political environments. Therefore, they have to continuously adapt their priorities, processes, products, services and relationships with their partners, customers and suppliers, in order to be compliant with new business rules and market constraints [34]. In this context, project management plays a major role, being decisive to identify the critical aspects for success.

In order to identify similarities and differences between the construction industry and the software industry concerning the critical aspects for project success, a survey was carried out. Eighty project managers participated in this survey.

We found that there is a total agreement on the top two most important aspects in both industry sectors.

These are: "Project Planning" and "Well-defined objectives and requirements". With respect to the less important aspects, there are also two factors that coincide in both industries: "Frequent control checkpoints" and "Way of resolving conflicts". Aspects such as "Customer involvement throughout the process", "Top management involvement" and "Cost control" are the ones that show major differences in the rankings obtained from the software development and construction industries.

These results lead to the conclusion that, despite the great differences between the industries studied, the top ranking aspects in project management are similar. This result can help researchers, practitioners and training institutions focus their attention on the factors that are most important for project management success, regardless of the industry. On another hand, for the other factors, it is important to define more targeted practices and training programs according to their relevance for each industry, thus being an important field for future work.

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Authors' addresses

João Varajão, PhD

University of Minho, Centro Algoritmi
Campus de Azurém, 4800-058 Guimarães, Portugal
E-mail: joao@varajao.com

Caroline Dominguez, PhD

University of Trás-os-Montes e Alto Douro
Quinta de Prados, Apartado 1013, 5001-801 Vila Real, Portugal
E-mail: carold@utad.pt

Pedro Ribeiro, PhD

University of Minho, Centro Algoritmi
Campus de Azurém, 4800-058 Guimarães, Portugal
E-mail: pmgar@uminho.pt

Anabela Paiva, PhD

University of Trás-os-Montes e Alto Douro, Centro C-MADE
Quinta de Prados, Apartado 1013, 5001-801 Vila Real, Portugal
E-mail: apaiva@utad.pt