What Contributes to the Success of IT Projects? An Empirical Study of IT Projects in the Norwegian Public Sector

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Abstract: Each year the public sector invests large amounts of money in the development and modification of their software systems. These investments are not always successful and many public sector software projects fail to deliver the expected benefits. *Goal.* This study aims at reducing the waste of resources on failed software projects through better understanding of the success factors and challenges. *Method.* We collected information about project characteristics, project outcome, perceived success factors, challenges and lessons learned from 35 software projects in 11 organizations in the public sector of Norway. *Results*. The respondents experienced that extensive involvement and competence of the client, high priority of the project, good dialogue between the clients and the external supplier and application of agile practices were main success factors. The main challenges were related to the involvement and competence of the client, project planning and management, software architecture and integration issues, transition of the product to the user organization and benefit management. Small and large software projects reported different challenges, especially related to project priority and access to skilled personnel. Projects with time and materials contracts with suppliers and that involved clients during project execution were more successful than other projects. *Conclusions*. Success factors are usually human factors, e.g., involvement, competence and collaboration. Challenges tend to be due to human factors as well as issues of a technical nature. Both aspects need to be addressed to enable successful software projects and avoid failures.

Key words: Agile, empirical study, public sector, software projects, success factors.

1. Introduction

Over decades, organizations have invested large sums in Information Technology (IT) and the budgets continue to grow. Naturally, they are interested in knowing the return on these investments. Some investments give good returns in terms of better services or higher efficiency, while others are of little or no avail. Recent surveys suggest that as much as 10–15% of all software projects are stopped before they deliver anything at all [1], [2] The potential for better performance of IT (software) projects, especially when it comes to delivered client benefits, is consequently large.

The SMIOS research project, led by the Simula Research Laboratory, started in April 2015 and includes 11 partner organizations from the public sector in Norway. These organizations offer services of high importance to the whole population of Norway, including services related to tax payment, social welfare support, student loans, pension funds, health and public transport. SMIOS is the Norwegian acronym for

"Success with IT-Projects in the Public Sector". The SMIOS project aims at generating and disseminating knowledge about how to increase the benefits and success rate of investments in IT development, based on experiences from completed software projects. The results reported in this paper are from the first phase of the project, during which information about 35 completed software projects in our partners' organizations was collected. We found that the success rate of the projects was approximately 70% and human factors such as involvement, competence and planning were considered as important success factors by the clients. Our results also give input on elements of successful development practices.

The remainder of this paper is organized as follows. Related work on the subject of success and failure of software projects is discussed in Section 2. Section 3 presents the study design while Section 4 presents findings on the project success rate and its relation to some characteristics of the projects. Section 5 summarizes the perceived success factors, challenges and the lessons learned as experienced by the clients. Section 6 includes a discussion of the findings and validity threats. Finally, Section 7 concludes the paper and briefly describes further work.

2. Related Work

Various models and measures have been proposed to measure the success of IT investments. Some of these models focus on the systems in use and their impact on users and organizations, e.g., the DeLone and McLean (D&M) models of 1992 and 2003 [3] and the Technology Acceptance Model (TAM) [4]. Other models focus more on the organizational perspective, e.g., the project management triangle (the "iron triangle") with the following three dimensions to control: time, cost and the specified functionality [5]. or they include a mixture of organizational, system and user satisfaction characteristics [6]. The measurement of success is therefore both complex and potentially misleading.

The importance of improving software development performance, including avoiding failures, has led to numerous surveys on failure factors of software projects, such as those reported in [1], [7]–[10]. Interestingly, the failure factors of the early surveys on software project failures appear to be very much the same as those reported in more recent surveys. The 2012 McKinsey-Oxford survey [11] for example, reports that unclear objectives, lack of business focus, shifting requirements, technical complexity, unaligned teams, lack of skills, unrealistic schedules and reactive planning are the failure factors of software projects. These failure factors are very much the same as in, for example, the survey conducted by Gotterer in 1967 [12]. i.e., lack of support from top management, lack of competent software professionals, changing technology, changing user requirements and insufficient project management. In spite of the 45-year separation, it seems that software projects fail for very much the same reasons as before.

The survey on the characteristics of successful software projects reported in [13] includes the success dimensions time control, budget control, quality of system, project efficiency, delivered functionality and client benefit, i.e., to which degree a project delivers the expected benefits for the client. It is argued that evaluation of client benefits is frequently neglected in software development studies, in spite of being the most important success dimension. The survey found similar success rates for both public and private sector software projects. About 5% of projects were evaluated as successful on all success dimensions, while about 50% of projects were not successful on at least one success dimension.

There are numerous earlier studies on success and failure factors of outsourcing projects from the suppliers' perspective; see e.g., [14], [15]. We believe that the study reported in this paper may add to the body of knowledge on success and failure of software projects by including the experiences of and the evaluations by the project owner (the client) and the user organization and emphasizing client benefit as a success dimension.

3. Study Design

Information was collected by asking each of the 11 partners of the SMIOS project to select their 2–4 last completed or stopped IT projects in 2014. An emphasis on the last projects aimed to avoid a self-selection bias, such as a bias toward the most successful projects. A few of the organizations used not only the last projects, but also selected projects they considered as good examples of successful and not so successful projects. This deviation was not likely to significantly affect the results of the study. We ended up with a sample of 35 software projects of various sizes, types and outcomes.

For each project, we performed semi-structured interviews with at least one person per role, representing:

- The project owner: Those who requested and financed the project and took high-level decisions on scope, priorities and deliveries.
- The project management: The project leader responsible for the performance of the project and delivering the product. Frequently, project managers invited senior software professionals with technical expertise and/or system architects to the interviews as well.
- The user: A person representing the users of the system, who could evaluate the usefulness and quality of the delivery, often including a person from system operations management.

The roles generally represent the *client side* of the projects. In total, 107 interviews were conducted between May 2015 and February 2016. Each interview lasted 30–60 minutes. Interview questions were sent to the interviewees beforehand. The researchers of the SMIOS project conducted the interviews, registered and coded the responses and analyzed the collected data. Through the interviews we collected material that included information about:

- Project characteristics: Goal, type, budget, contractors, contract type, start and end dates and deliveries;
- Applied processes: Processes for cost and effort estimation, project management, software development, resource management and benefit management;
- Project performance in terms of cost, quality, delivered functionality and client benefits;
- Perceived success factors, challenges and what should be done differently next time in a similar situation (lessons learned). The questions on challenges and lessons learned focused on what had caused problems and should be improved in the next projects, taking the step from knowing why to knowing how to improve the situation.

All the responses on success factors, challenges and lessons learned were coded using categories that emerged from repeated reading and analysis of the responses. Whenever possible, we collected information from the organizations' own documents about the projects as well.

4. Project Success and its Relation to the Characteristics of the Projects

For the purpose of our analysis, we defined a successful project as:

A successful project is a project that is assessed by its project owners and users as having delivered the expected client benefits or more, and where none of the respondents report large or very large problems on the other success dimensions (time control, budget control, quality and delivered functionality).

Admittedly, the definition of success is subjective. Interestingly, the respondents in the different roles had very similar judgments on the degree of success and problems in the project.

Using the definition of success given above, 25 of the projects were categorized as successful (having no problems), five as problematic and five as very problematic (including two projects that were stopped before completion). We further categorized projects based on different characteristics and analyzed the success rate in each group. Some interesting findings are presented below.

Project size: The planned budget of the projects varied between 10 000 and 100 million euros. The

median budget was around four million euros. The larger projects (>10 million euros) had a success rate of 77%, projects of medium size (1-10 million euros) had a success rate of 78%, while smaller projects (<1 million euros) had a success rate of 62%. We did not find any strong connection between project size and success. Of the 10 projects that had problems, three were categorized as large, two as medium and five as small. Larger and smaller projects, however, encountered different challenges, as later discussed in Section 6.

Applying agile practices: The majority (all but eight) of the projects we analyzed used agile development methods when constructing the software (mostly variants of Scrum; www.scrum.org). The actual use of agile practices varied greatly; in particular, the difference in the agile projects' flexibility of scope and the frequency of delivery into production seemed to increase projects' success. Fig.1. shows an overview of the applied development process and the success rate of the projects.

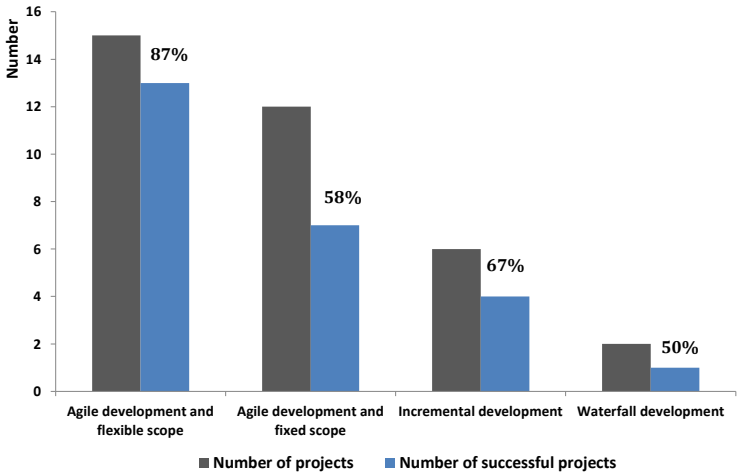

Fig. 1. Flexible scope increased the success rate of agile projects.

The relation between the success rate of projects and the frequency of delivery during project execution is (excluding two projects that were stopped):

- Projects with only one delivery into production had a success rate of 64% (12 projects).
- Projects with a few deliveries into production (four or less) had a success rate of 77% (13 projects).
- Projects with frequent deliveries (more than four) had a 100% success rate (8 projects).

In fact, all (8) agile projects with flexible scope and frequent deliveries were successful.

Type of contract with suppliers: Typically, the projects included management and technical personnel from both the client side and external suppliers, while the domain experts were mainly from the client side. Types of contracts used with suppliers were fixed price (4), time and material (12), risk sharing/target price (15) and other (2). Some risk sharing contracts had lower and upper limits for risk sharing (9) while others did not have such limits (6). We argue that risk sharing contracts with an upper limit for payment (financial loss for the supplier in situations with high cost overruns) are similar to fixed price; consistent with the findings in [16]. Using this categorization, we found that 38% of projects with fixed price contracts were successful, compared to 83% of projects with time and material contracts. We observed that clients using a fixed price type of contract tended to have a stronger focus on low price and a weaker focus on evaluating supplier competence when selecting suppliers (fixed price behavior). Additionally, projects with fixed price contracts were less likely to deliver frequently or implement benefit management during project execution, which are practices frequently mentioned as important to the success of the projects (see Section 5).

5. Success Factors, Challenges and Lessons Learned

In total, we collected over 200 responses on success factors, 120 responses on challenges and 100 responses on lessons learned. The responses were coded using eight categories that emerged from reading and analyzing the responses. Table I. shows success factors most frequently mentioned by the clients with examples of responses and their frequency as a percentage of the total number of responses.

Table 1. Success Factors as Experienced by the Clients and Their Frequency

Success factor	Frequency
Involvement by the stakeholders; e.g., good dialogue between the client and the supplier, high priority by the client (including top management), good cooperation between stakeholders and the involvement of the right users	26%
Adequate Project management and development processes; e.g., the ability to change the scope based on external changes and learning, frequent delivery, good management of the project and thorough testing	25%
Competence: Competent project personnel e.g., competent clients with good domain knowledge, competent suppliers, skilled developers and competent project leaders	23%
Proper Initiation and planning phase: e.g., defining the right scope, enough (but not too much) analysis of requirements, and realistic estimations	9%
Human resource management: e.g., a good process for selecting competent developers and the co-location of the client and supplier	8%
Benefit management, e.g., a clear and feasible business case, plans for realizing the expected benefits and processes for managing benefits followed the above success factors in frequency	5%

Involving stakeholders (especially resources from the user organization) and competence were frequently mentioned among challenges as well, with 23% and 14% of responses among challenges, respectively. Additionally, the initiation and planning phase of the projects was perceived as challenging for public sector IT projects (19%); for example, because of poor estimates, unrealistic scope and unclear requirements. Interestingly, technical issues, such as architecture choices and integration with COTS (Commercial-Off-The-Shelf products), were mentioned among the challenges (7%) but not among the success factors. Finally, benefit management was experienced as challenging with 7% of the responses among challenges: e.g., poor benefit management processes, underestimating the complexity of changing the organization's processes to deliver the benefits and low focus on real benefits.

The lessons learned tended to be related to the challenges. Some examples of lessons learned formulated as what the respondents would do differently next time in a similar situation are:

- Be ambitious, but do not try to do everything in one large project. Think big, start small.
- Deliver early to representative groups of users and get feedback.
- Plan for and integrate benefit management into the development process.
- Include good processes for resource selection and management.
- Identify integration and architectural risks early.
- Involve operations and maintenance personnel early in the project and plan the transition to the user organization.

6. Discussion

Some of our results support findings of earlier studies on success and failure factors, such as the

importance of top management support and competent software professionals (see Section 2). Our study, however, provides new insights. For example, larger projects were not perceived by the clients to be more problematic than smaller ones. Given high priority and good support by top leaders, the larger projects managed to attract the attention of the client organization and involve highly skilled personnel, which was a challenge for the smaller projects. However, the complexity and coordination needs of software projects typically increase with their length and size. In fact, the recent guidelines from the public administration in Norway advise the public sector to "Think big. Start small" [17], i.e., be ambitious about the digitization of services and products, but do not try to do all of it in one large project.

Our results also give input on elements of successful development practices. Our results suggest that it is not sufficient to be agile in the construction phase. The success of agile development seems to be dependent on having a flexible scope and on frequent delivery into production.

The main threats to the validity of our results are, we believe, the following:

- *External validity*: The selected sample of public organizations may not be representative of public organizations in Norway and, even less, for public organizations in other countries. Many of the organizations participating in this study are among the more competent public organizations in Norway. This should lead to a careful interpretation of the results.
- *Internal validity*: Some of the information reported by the respondents reflects their perception of performance, e.g., their subjective evaluation of the degree to which the project delivered the expected client benefits or whether a cost overrun was problematic or not. The project data regarding time, budget and scope were, however, more objective. The success factors, challenges and lessons learned reflect the respondents' experience and beliefs about causal mechanisms increasing or decreasing the probability of success or failure. The validity of the results consequently relies to a large extent on whether we believe the respondents were knowledgeable and able to identify causal mechanisms.

It is not meaningful to single out an individual factor or to give a recipe on how to succeed with software projects. It may, nevertheless, be useful for a client or project manager to be extra aware of the success factors and challenges pointed out as the most important ones in our study. This includes focus on human factors (such as involvement and competence) and proper planning of the project. Technical issues appear, however, under the challenges and need to be addressed to avoid failed software projects.

7. Conclusion

This study presents results of an empirical study of 35 software projects conducted by organizations in the public sector in Norway. The focus of this study is on the Norwegian public sector software projects, but, as argued in our previous survey, there seem to be only small differences in success and failure factors between public and private software projects [13]. The results contribute, we hope, to the body of empirical knowledge on the characteristics of successful software projects and typical challenges. The reported results have been presented to the organizations participating in the SMIOS project and to many other public and private organizations and will hopefully positively influence their practices.

We plan to follow up this work with more studies to gain experience on a few selected topics. These include the processes for benefit management (because of the increased focus on getting benefits from the digitalization investments in the public sector) and competence management since client and supplier competence is crucial for the success of software projects.

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