Successful Software Project and Products: An Empirical Investigation

Richard Berntsson-Svensson
School of Information Systems,
Technology and Management
University of New South Wales
Sydney NSW 2052
Australia

z3167700@student.unsw.edu.au

Aybüke Aurum
School of Information Systems,
Technology and Management
University of New South Wales
Sydney NSW 2052
Australia

aybuke@unsw.edu.au

ABSTRACT

The circumstances surrounding the success and failure of software projects have been a topic of discussion among both practitioners and researchers for many years. A classical definition of project success is one that is within budget and on time. Some of the most common factors identified in the literature as leading to software project success are user involvement, management support and realistic requirements. Studies have indicated that managers have different perceptions from software practitioners when it comes to defining a successful software project. The observation of this difference of opinions has led us to the question: Could there be different perceptions about what effect various factors have on software project success among different industries? This paper presents an empirical study. Firstly, it begins with a detailed investigation of software product and project success factors. Secondly, it examines success factors for software projects and products across a selection of different industries, based on data collected from companies in Sweden and Australia. Thirdly, it studies how practitioners in industry define success factors for software projects and products.

Categories and Subject Descriptors

K.6.3 [**Management of Computing and Information Systems**]: Software Management – *software development.*

General Terms

Management, Measurement.

Keywords

Product success, Success factors, Successful project.

1. INTRODUCTION

Despite experiencing many successful software projects, software engineers still struggle to ensure the consistent success of their

projects. Most software engineers will concede that they have experienced one of the many software project failures during their careers. [6, 8, 27].

The CHAOS report from the Standish Group [20] indicates that over the years there has been great improvement in the delivery of software systems that meet business objectives within budget and on schedule. The report shows that in 1994, 31% of all software projects failed and only 16% of the projects were successful [18]. Four years later, only 28% of the projects failed and the success rate had increased to 26% [19]. Another two years later, the success rate had increased to 28% while only 23% of all projects failed [20].

While the CHAOS report presents an encouraging view, others have argued that the measure of 'success' will vary depending on how you define it. Successful software projects have been described as projects that are completed within budget, on schedule, and that meet business objectives [8, 12, 18]. Others have suggested that success depends on the perspective of stakeholders. Linberg [12] found that there are differences of opinion between project participants (developers) and managers when it comes to defining what constitutes a successful software project. Linberg's conclusion suggests that a new theory of success might be needed. This theory would account for differences in opinions and experiences across different industries with regard to success factors in software development.

In the context above, our literature review revealed three issues. Firstly, there are several studies in software engineering and information systems literature that investigate success factors in software projects. However, their findings do not always correlate with one another given the differing nature of the projects and the industries that have been investigated (see Table 1). Secondly, we found that the previous research findings for project success factors overlap with product success factors. In other words, project success factors are intertwined with project success factors [3, 25]. Thirdly, to the best of our knowledge, no study has specifically investigated how *software practitioners* define software product success factors in an industrial context.

The objective of this article is to explore project and product success factors in the software industry, namely the financial services, consulting and telecommunications industries. Furthermore, it aims to compare the views of respondents' of different types of industries as to the factors that lead to software project and product success and as to what constitutes a successful software project and product. This article presents the results of an empirical study, based on data collected from 27 software projects at 11 companies in Sweden and

Australia, in an attempt to assist practitioners and researchers to share their perspectives.

The contribution of this article is two fold: (1) it provides a comparison of success factors for software projects and products between different industries based on data from the industries themselves, and (2) it studies how practitioners in industry define success factors for software projects and products.

The remainder of this paper is organized as follows: In section 2 related works are reviewed. Section 3 presents the research methodology that was used and how the research design. Section 4 presents the results while section 5 discusses the findings. In section 6, the validity of the research is discussed and the conclusions are presented in section 7.

2. RELATED WORK

This section presents how the literature defines successful software projects and products as well as which key factors leads to project success.

2.1 Defining Project and Product Success

What is a successful software project? A classical definition of project success, as mentioned earlier, is one that is within budget and on time. The most common definition of project success is the one from the Standish study [18], which defines software project success as meeting budget, delivery, and business objectives. Kerzner [9] also defines project success as completed within time, within budget, within scope, meeting performance requirements, and obtaining user acceptance. According to Lewis [11], project success could be defined as meeting performance requirements, cost requirements, time restrictions, and project scope. There are instances, however, where projects that meet all of these factors are not necessarily viewed as successful. On the other hand, there are projects that do not meet above criteria, but that are considered successful nonetheless [11].

In addition, *product* success is not readily defined, although it is generally regarded as being a product that satisfies user requirements. There is little information in the literature about the definition of successful software products. Existing studies [7, 25] that discuss software products usually refer to them in the context of software projects, without detailed and dedicated discussion.

2.2 Project Success versus Product Success

Baccarini [2] argues that project success requires a combination of *project management success* and *project product success*. Project management success is related to the efficiency of the project management process in terms of cost, time and quality. On the other hand, project product success is related to the effectiveness of the end product. According to Baccarini [2] project success can be summarized as follows:

Project success = project management success + project product success

Several researchers point out the causal relationship between project management success and project product success [2, 15, 22]. On the one hand, a project that is over budget and over time can be considered a failure; however, the end product can still be a success [22]. On the other hand, a project within budget and on time may be considered successful; however the end product may be a failure [3, 12].

2.3 Identifying Project Success Factors

In order to obtain a better understanding of software project success factors we examined project success factors across non-software related industries e.g. new product development in the toy industry [3]. Interestingly, we found out that there was no detailed process model for new product development. Instead, the focus was on building prototypes until the product was right, met the necessary quality standards and was ready to be manufactured. Once the product was delivered to manufacturing, updates and changes were uncommon as this was seen as an expensive process. That is, a great deal of effort was put into perfecting the design process. In software development, developers (who effectively 'manufacture' the software product) are relatively more flexible with updating and changing the end product, even after design phase has been completed. In the toy industry, project and product success can be equated. In the software industry, as mentioned earlier, this is not the case.

However, in terms of project and product success factors both industries have addressed similar issues. Table 1 illustrates software project factors from various studies. As illustrated in Table 1, results from 8 separate studies present different success factors. This may be due to the fact that the studies were conducted in different industries or at different companies. Alternatively, the nature of the software project may play a role in the outcome of these studies. Regrettably, this sort of information was not available in the articles that we reviewed.

2.4 Project Categories

A software project can involve software development, maintenance or an enhancement. The present study categorizes software projects based on specific customer-supplier relationships as follows:

- Bespoke software development: the supplier develops a new custom-made product or service for one or a couple of customers.
- Market driven software development: the supplier develops a product for a specific market without a predefined customer.
- A mix of bespoke and market driven software development: the supplier develops a product for a specific market, but with the intention that it is possible to sell the product to customers with customization.
- In-house software development: the supplier also is the customer. The system is developed for the own company or organization.

In this paper, when presenting our research we use above classification.

Table 1. Literature success factors

Literature	Project type	Product type	Project size	Company type	Country	Success factors
Linberg [12]	Bespoke	Medical instrument	2 years with a budget of US $ 1 million	Medical instruments	USA	Technical challenge, working product, well designed product, high performing project team, no schedule pressure
Standish Group [20]	NA	NA	NA	NA	USA	User involvement, executive support, experienced project manager, clear business objectives, minimized scope, firm basic requirements
Nah et al. [13]	NA	Enterprise systems	NA	NA	NA	Top management support, business plan and vision, effective communication
Milis and Mercken [14]	NA	Information communication technology systems	1 year with a budget over € 1.5 million	Banks and insurance	Belgium	Management involvement and support, Project definition, project team, project plan, change management, proper project resources
Procaccino et al. [16]	NA	NA	NA	Financial institution	NA	Customer/user involvement, sponsor support, project manager authority, enough time for requirement elicitation
Verner and Cerpa [23]	NA	NA	NA	Insurance, banks, finance	Australia	Skilled project manager, good and complete requirements, good schedule and estimates, working long hours
Procaccino et al. [17]	NA	NA	NA	NA	USA	Clear and understandable requirements, skilled team, feedback from project manager, defined methodology
Verner and Evanco [24]	In-house	NA	NA	Banks, financial institutions, insurance	USA	Good project manager, good requirements, good project vision, project manager communication skills, working long hours

NA: Not available

3. METHODOLOGY

The primary objective of this study is to investigate software project and product success factors in software industry. The following research questions provided a focus for our empirical investigation in Swedish and Australian companies:

(1) What is the effect of certain factors on the success or failure of projects across various industries?
(2) How do various industries define *project* success and are there any differences across industries?
(3) How do various industries define *product* success and are there any differences across industries?

A quantitative questionnaire [3] was designed to evaluate the research questions. Several pilot studies performed to validate the questionnaire. The questionnaire included 33, mostly close-ended questions. However, open-ended and weighted questions were also included in the questionnaire. Ethical clearance was obtained before the research was conducted in Australia.

The questionnaire consisted of three parts. Part 1 contained questions for gathering background information about the subjects. This included demographic information such as contact details, gender, academic background, experience in software development, position at current company, and company information. Part 2 contained close-ended questions about the subjects' last completed software project. The questions addressed different factors and were answered using a six-point or a three point scale. Part 2 also contained open-ended questions to allow participants provide

answers using their own thoughts and words. Part 3 contained questions about software products for which the subjects were involved in development. This part contained open-ended questions and a question that allowed participants to assign weights to a series of options. This made it possible for us to ascertain the relative importance of each factor. The subjects were given 1000 points to spend among nine factors (subjects had the opportunity to add their own factors). Subjects could spend the points however they wished (i.e. one factor could be assigned 1000 points); with the only exception being that two factors could not be given the same number of points.

3.1 Data Collection

Data was collected from Swedish and Australian companies. The population in this study was software practitioners and managers from the financial services, consulting, and telecommunications industries. A probability sampling method was used because it provides the researcher with a good selection process of samples from a large known population [1]. Samples were selected in two different ways: through contacts we had working at companies and from a list of randomly selected software development companies. The participants (subjects) from each company were selected by the contact person at that company. This study used two forms for data collection: structured interviews and emailed questionnaires. Emailed questionnaires were used to facilitate larger sample sizes and to minimize the time taken for data collection and analysis. There are potential risks with emailed questionnaires, such as lack of interest and time, and a low response rate. Therefore, structured

interviews were used to increase the reliability of the data collected [1].

To obtain an understanding of the collected data we use the phenomenology [5] method. First we sorted the data into different sources and put the collected data onto paper. Then we start to divide the data into small piles of categories and put a name on each pile, descriptive of the content of the pile. We read each pile over and over until a deeper understanding of the piles was obtained.

4. RESULTS

Our sample size was relatively small; however it was large enough to conduct relevant analysis to provide some awareness of the different definitions of project success between different industries. The questionnaire for this study was sent to 15 companies (eight in Sweden and seven in Australia) resulting in 27 responses. Some companies provided more than one response due to their involvement in a variety of different projects. Thus, it was possible to treat the responses as independent of one another for the purposes of statistical analysis. The industry-wise spread of responses was: 10 from the telecommunications industry (1 market-driven development, 8 mix of bespoke and market-driven development, and 1 in-house development), 9 from the consulting industry (3 bespoke development, 2 market-driven development, 2 mix of bespoke and market-driven development, and 2 in-house development), and 8 from the financial services industry (6 in-house development, 1 market-driven development, and 1 bespoke development).

4.1 Demographics and Project Background

Although from different industries, the subjects of this study shared commonalities in terms of their backgrounds. About half of the subjects had a Bachelors degree and 55% of them were managers. In addition, about 75% of the subjects were male and 25% were female. The average age group for the financial services was 36-40 years while the average years the subjects had spent working at their current company was 16 years. Notably, for the consulting and telecommunications industries the average age of participants was 31-35 years. Projects in financial services typically involved 35 people with project duration averaging 12 months. In the consulting industry team size averaged 19 people with an average project duration of 16 months. In the telecommunications industry the average team had 61 people with average project duration being 13 months. All three industries had approximately 75% success rate for their software projects.

4.2 Software Project Success Factors

In analysing research question 1, this section examines the project success factors for three industry types. After detailed examination of the literature, we considered 15 factors related to project success and failure, as illustrated in Table 2. We asked subjects to examine each factor and decide which factors most strongly characterized the projects that they participated in. Table 2 presents the number of successful and failed projects that were characterized by each factor, sorted by industry. We found that the factors had differing effects on project success and failure depending on the industry concerned. For example, in the financial services industry, 33% of all successful projects changed their project manager, whereas in failed projects, 100% of the projects changed their project manager. Although this seems to be an interesting result, when we examine the results from

the consulting and telecommunications industries, the findings were not necessarily consistent with the financial services industry. In other words, in both the consulting and telecommunications industries, although 50% of the failed projects changed their project manager, for successful projects, this was only 57% and 63% respectively. The following summarizes our findings.

Financial Services

In the financial services industry, the factors that influenced most project success were:

- Complete and accurate requirements from project start
- Good schedule estimates
- Enough time for requirements elicitation
- Well-defined project scope
- Rewarding staff for working long hours

Identifying risk before the start of the project was a factor that most successful projects fulfilled in the financial services industry. However, since 40% of failed projects also identified risks before project start, it was not possible to state that risk identification was related to project success. The two factors that were related to project failure were:

- Changing the project manager
- Adding extra personnel to meet schedule estimates

We found out that the remaining factors had no effect on project success or project failure for financial services. They were:

- Support for working long hours
- Complete requirements (when not complete from project start) during the project
- Use of a specific method for requirements gathering
- Project manager understood the customer's problem
- Customer/user involvement
- Commitment and support from sponsor/project champion
- Risk identification before project start

Subjects were asked who was responsible for estimating the project schedule however, due to the many variations and combinations of answers we received; it was not possible to find any patterns in terms of a) who was consistently responsible for estimation and b) a particular person consistently being responsible project success or failure.

Consulting

As illustrated in Table 2, the following factors affected project success:

- Complete and accurate requirements from project start
- Enough time for requirements elicitation
- Good schedule estimates

Since half of all failed projects for the consulting industry had a well defined project scope, it was not possible to conclude that a well defined project scope was related to project success.

We found that the following two factors played a major role in project failure:

- Project manager support working long hours
- Adding extra personnel to meet schedule estimates

It was not possible to relate "staff rewarded for long hours" to project failure because half of all successful projects rewarded their staff for working long hours. Interestingly, more failed projects had an experienced project manager than did the successful projects. As in the case of the financial services industry, there were no pattern with respect to who was responsible for estimating project schedules or to indicate that a specific person consistently led to project success or failure due to the many variations and combinations of answers we received.

Telecommunication Industry

For the telecommunication industry, the following factors influenced project success:

- Complete and accurate requirements from project start
- Completing the requirements (if not complete from project start) during the project
- Enough time for requirements elicitation
- Use of a specific method for requirements gathering

We were unable to identify any specific methods that were used for requirements gathering due to there being too many variations in the answers received from subjects. Furthermore, no patterns could be found based on a) who was consistently responsible for estimation and b) a particular person consistently being responsible project success or failure. Commitment and support from sponsor/project champion may be related to project success since 100% of all successful projects had obtained such a commitment. However, half of all the failed projects also had commitment and support from sponsors/project champions. Therefore, we could not conclude that this factor was related to project success for the telecommunications industry. Additionally, 60% of all projects used their project manager for creating the schedule. Eighty-six of these projects were successful. Thus, the use of a project manager to create the schedule was positively related to project success.

None of the factors were found to be related to project failure, i.e. the remaining 11 factors (Table 2) did not have any effect on

project success or failure for the telecommunications industry. Furthermore, more failed than successful projects had a well defined project scope. This was not inline with previous findings in the literature [14, 24] that suggested the importance of a well defined project scope in achieving project success.

4.3 Contrasting Industry Perceptions of Project Success

This section refers to research question 2, i.e. how project success is defined by the industry. Based on detailed examination of empirical work in literature and after conducting three pilot studies, we identified 18 factors that were related to project success. We asked subjects to select the three most important as well as three least important factors for a project to be successful based on their personal beliefs. The findings for all three industry types are presented in Table 3.

From Table 3 we see that subjects from both the consulting and telecommunications industries agreed that "understanding the customer's problem" was an important factor in project success. Apart from this agreement, each industry felt that different factors characterized successful projects. Interestingly, not a single respondent from any industry thought that "good schedule" was an important factor for project success. This was an interesting finding since the subjects' personal views of a good schedule differed from the results they provided when asked about the characteristics of the last project they participated in. That is, subjects from financial services and consulting industries had stated earlier that good schedule estimates were related to project success for the last software project they were involved in (see Table 2). Furthermore, subjects from the financial services considered a "committed sponsor" and "overall good requirements" as among the three most important factors for project success, while these two factors were considered among the three least important by subjects from the consulting industry.

Table 2. Percentage of projects fulfilling each factor

Factor	Financial services		Consulting industry		Telecommunication industry	
	Successful	Failed	Successful	Failed	Successful	Failed
Project changed PM	33%	100%	57%	50%	63%	50%
PM supported long hours	50%	50%	33%	100%	100%	100%
Staff rewarded for long hours	17%	0%	50%	100%	50%	50%
Use of specific requirements method	100%	100%	100%	100%	100%	0%
Completed and accurate requirements form the start	17%	0%	29%	0%	29%	0%
- If not, completed during project	100%	100%	100%	100%	67%	0%
Enough allocated time for requirements elicitation	67%	0%	71%	0%	50%	0%
Project's scope well defined	83%	0%	83%	50%	38%	50%
Extra personnel added to met schedule timetable	33%	100%	29%	100%	71%	100%
Commitment and support from sponsor/project champion	100%	100%	71%	100%	100%	50%
Experience project manager	90%	70%	40%	50%	80%	60%
Project manager understood the customer's problem	80%	90%	70%	60%	70%	40%
Customer involved in the project	80%	70%	60%	60%	80%	50%
Risk identification before project start	70%	40%	80%	60%	80%	50%
Good schedule estimations	60%	20%	80%	30%	60%	40%

Another interesting difference was in how the industries viewed "good relations between personnel" as affecting project success. While it was viewed as the most important factor for project success in the telecommunications industry, the financial services subjects considered it to be one of the least important factors. Furthermore, financial services subjects considered good estimations as one of the three least important factors bearing on project success. Not a single subject from financial services considered "good estimates" as being an important factor, which is surprising since "good estimations" is mentioned in previous literature [23] as an important factor for project success.

Subjects from financial services personally viewed "customer involvement" and a "committed sponsor" as the two most important factors for project success, which was not inline with the characteristics of their latest project (Table 2). Although 80% of all successful projects involved the customer and 100% of the successful ones had commitment from a sponsor, these factors could not be conclusively stated as important factors for project success. This is because 70% of all failed projects also involved the customer while 100% of failed projects had commitment from a sponsor.

The consulting industry subjects' personal views indicated that "understanding the customer's problem" was an unimportant factor for project success. This did not align with the characteristics of their latest project (Table 2). Although "understanding the customer's problem" was not a factor related to project success for subjects from the consulting industry, it was still an important factor

in general. This is illustrated in Table 2 where 70% of all successful projects involved an understanding of the customer's problem.

Subjects from the telecommunications industry personally viewed "complete and accurate requirements" as a success factor. This was inline with the characteristics of their latest project, allowing a positive relationship to be inferred between complete and accurate requirements and project success (Table 2). Furthermore, the subjects considered "understanding the customer's problem" as an important factor for project success. Even though understanding the customer's problem is related to project success based on the characteristics of their latest project, table 2 illustrates the importance of this factor (70% of the successful projects understood the customer's problem).

4.4 Software Product Success Factors

In analyzing research question 3, this section examines how "product success" is defined by subjects from all three industries. We identified 10 potential factors from previous literature. The subjects were asked to rank the importance of each factor for product success by assigning points to each factor. They were told no two factors could be assigned with the same amount of points and no factor could have a zero value. Table 4 presents the three most and least important factors for product success and how many points (percentage of total points spent by each industry) each factor received from the subjects.

Table 3. Software project success factors according to software practitioners

	Financial services	Consulting industry	Telecommunication industry
Three most important success factors	Customer involvement	Very good project manager	Good relation between personnel
	Committed sponsor	Understanding customer's problem	Understanding customer's problem
	Overall good requirements	Well defined communication	Complete and accurate requirements
Three least important success factors	Good schedule	Good schedule	Good schedule
	Good relation between personnel	Committed sponsor	Experienced project manager
	Good estimates	Overall good requirements	Committed sponsor

Table 4. Software product success factors according to software practitioners

	Financial services	Consulting industry	Telecommunication industry
Three most important success factors	Satisfied customer (22%)	Satisfied customer (20%)	Satisfied customer (30%)
	Great quality (17%)	The product works (15%)	Customer comes back (18%)
	Satisfied top management (13%)	Economic benefit for the supplier (13%)	The product works (15%)
Three least important success factors	Project team satisfaction (1%)	Project team satisfaction (1%)	Many sold copies (4%)
	Good reputation for the supplier (4%)	Satisfied top management (2%)	Economic benefit for the supplier (5%)
	Many sold copies (4%)	Many sold copies (4%)	Satisfied top management (5%)

The results show that the subjects from all three industries agreed that a "satisfied customer" was the most important factor for product success. Subjects from both the consulting and telecommunications industries considered "a working product" as an important factor. Furthermore, subjects from both the financial services and consulting industries considered project "team satisfaction" as unimportant for product success. Also among the least important factors for product success (as agreed by the various industries) was "many sold copies".

The financial services subjects felt that the satisfaction of top management was one of the most important factors in determining product success, while the consulting and telecommunications industry subjects considered this factor as unimportant. In addition, consulting industry subjects considered economic benefits for the supplier as important. However, the telecommunications industry subjects saw this as unimportant for achieving product success. Furthermore, financial services subjects did not consider the good reputation of the supplier as an important factor for product success. In fact, it was seen as one of the three least important factors.

5. DISCUSSION

The section presents a discussion around perceived relationships based on the results presented in Section 4. We were unable to conduct statistical calculations to uncover significant connections between factors and project success due to the limited number of data points. All stated relations between factors and project success or failure were arrived at through the use of deductive logic.

5.1 Effect of Certain Factors on the Success or Failure of Projects

There were both differences and similarities between the industry types when it came to perceptions of what affect certain factors had on project success and failure. There were two factors that all three industry types considered as important for project success: (1) complete and accurate requirements from project start and (2) having enough time for requirements elicitation. It was not surprising to see that complete and accurate requirements lead to project success, confirming what was stated in the literature [17, 20, 23, 24]. In this research study not a single failed project and less than a third of the successful projects started with complete requirements. Since the importance of complete requirements is well known, why do projects start without complete and accurate requirements? One explanation could be time to market. It is important to release software at the right time, otherwise competitors may release it first or the software may be too old or no longer meet customer requirements. Another explanation could be that requirements elicitation is a continual process, for example, prototyping. In fact, one subject stated:

"They can never be "completed"…there is always more…"

Alternatively it could be the lack of time for requirements elicitation. More than half of the successful projects from each industry had enough time for requirements elicitation. However, none of the failed projects from any industry type had time for requirements elicitation. This result could explain why the failed projects started without complete requirements. Why would a supplier start projects without enough time for requirements elicitation? Is it because of pressure from customers and stakeholders etc.? What is surprising is that completion of requirements during the project itself was only found to be related to the success of projects in the telecommunications industry. This factor was reported by subjects as having no effect on the success of software in the financial services and consulting industries. One explanation for this difference is that requirements were completed during the project for both the successful and failed projects for the financial services and consulting and therefore could not be seen as a success factor.

Subjects from both the financial services and consulting industries considered a good schedule to be an important factor in project success, which aligned with findings in the literature [24]. However, subjects from the telecommunications industry did not agree on this point. A well-defined project scope is stated in the literature [19, 20] as a success factor, but this study shows that only subjects from the financial services industry supported such a finding. More failed than successful projects had a well-defined project scope in the experience of subjects from the telecommunications industry. This was surprising because, if there is no clear vision of the project it may lead to poorly defined goals, poor requirements, unrealistic deadlines, and a poor project plan [3]. It is also common sense that if you do not know what should be included in the project, then it is difficult to deliver on time, within budget, and what the customer wants.

Adding extra personnel to meet the project schedule was found to be related to project failure in the financial services and consulting industries. Adding more personnel to a late project only increased the risk of project failure [3]. However, adding more personnel did not always lead to project failure, as illustrated in Table 2. It would be interesting to find out at what stage the extra personnel were added to successful projects. If they were added during the requirements elicitation phase they may not affect the project as much since it is an early phase of the project. Alternatively, the successful projects may have merely added more software testers to run test cases. This would not affect the success of a project as much as, for example, a new developer having to learn the code in detail with assistance from others. For the consulting industry, support for working long hours seems to be related to project failure. However, based on the results in this study it was not possible to state conclusively whether supporting working long hours affected project success. This is because the results merely indicated that the project manager *supported* working long hours, not if they actually *worked* long hours. As one subject stated:

"PM supported, but was no need for long hours"

Changing the project manager may be related to project failure for the financial services industry. However, it was not possible to state conclusively in this study that this was the case, as there were no follow-up questions about *why* the project manager was changed. This is one of the issues that need to be studied further in future.

Although the literature [20] emphasizes end user (customer) involvement as an important factor for project success, this finding was not reflected in this study. Another surprising finding was related to the absence of a relationship between experienced project managers and successful projects, which was strongly emphasized in [20, 23, 24]. It is also surprising because the subjects commented the importance of an experienced project manager when asked why their project was successful. One subject said:

"...an experienced PM stepped into the arena that was experienced enough to question customer originally requirements, own organization estimates etc. and creating a good (open, honest) communication climate."

One explanation for this finding in terms of the financial services and telecommunications industries is that most of the successful and failed projects had experienced project managers (Table 2). For the consulting industry more failed projects had experienced project managers' than successful ones. One reason could be the nature of the projects themselves. For instance, the failed projects could have been so called "breakthrough" projects, seen as difficult projects, or using new and unknown technology which also has higher risk of failure.

5.2 Important Factors for Project Success

The various industry subjects had the same perceptions about the three most important characteristics for a successful project,: meeting business objectives, on time and within budget completion, and meeting quality requirements. This definition is inline with the Standish group [18] definition. This means that the literature and industry use the same definition. However, it is not always easy to define what a successful project is. Even if the project fulfills all the requirements for a successful project, it can still be a failure. This statement is supported by one of the subjects that said:

"If a project is run perfectly according to books it's a "good project", but not necessarily a successful one"

The subjects also support Baccarini [2] definition of project success, which is illustrated in Section 2.2. The subjects explained why their project was successful:

"Business people still using the product after 2 years"

"Delivered a successful product to a previous customer"

One subject explained why the project failed:

"When software finally was delivered, business situation had changed which meant that the product was never used"

There was a difference between financial services, consulting, and telecommunications industries when it came to the subjects listing the most important factors for project success (Table 3).

The financial services industry subjects were the only ones to consider customer involvement as important. One explanation for this could be that the consulting industry considers this factor as obvious since they are hired directly by their customers. The telecommunications industry on the other hand has a different kind of customer-supplier relationship. Most of the projects (80%) in telecommunication industry had a mix of bespoke and market driven customer-supplier relationship, which is not the case in financial services or consulting industry. This may be the explanation to why the subjects from telecommunication industry do not see customer involvement as important. Another explanation could be that the subjects considered "understanding customer's problem" as an important factor for project success. If the problem is understood, it may not be needed for the customer to be involved. Furthermore, subjects from the financial services industry did not view understanding the customer's problem as important, while the consulting and telecommunications industries did. One explanation for this could be that the financial services interpreted the importance of ensuring customer involvement (important factor for project success according to financial services) as a way to understand the customer's problem. If the customer is involved, the supplier has the ability to ask questions, which is the same as understanding the problem. That the financial services consider customer involvement as an important factor for project success is not inline with the findings from a study by [17].

Another interesting finding is how subjects from the financial services and telecommunications industries rate the influence of "good relations between personnel" on project success. This factor was seen as the most important factor for project success by subjects from the telecommunications industry, while subjects from the financial services industry saw this as one of the least important factors. It is surprising to see that a "good schedule" is not seen as an important factor for any of the industries. Having a good schedule is stated in literature [20] as an important factor for project success. Subjects from the financial services industry considered "overall good requirements" and "committed sponsor/champion" as important factors for project success. These two factors were seen as two of the three least important factors by subjects in the consulting industry, while subjects in the telecommunications industry rated committed sponsor/champion among the three least important factors for project success. Subjects from the consulting industry were the only ones to view "very good project managers" as an important factor for project success. This is surprising considering the results presented in Table 2 which shows that the consulting industry had fairly inexperienced project managers involved in their successful projects.

5.3 Important Factors for Product Success

There were interesting findings when comparing the personal views of subjects across all three industries on what constituted important success factors for products. Firstly, all subjects considered a satisfied customer as being the most important factor for product success. This is not surprising; if the customer is unhappy they may not return to the supplier in the future. In addition, subjects from the financial services industry considered great quality as important, while subjects from the consulting and telecommunications industries considered a working product as an important factor for product success. This result may be due to differences in their interpretation of the meaning of 'great quality' (great quality may include a working product). This was supported by two statements from the subjects:

"Quality of the product kept to customer's expectations"

"Delivering good-enough quality products that satisfy requirements and that is PERCEIVED by the customer to be of high quality and meet requirements."

Furthermore, subjects from the financial services industry considered a satisfied organization/top management as an important factor for product success while subjects from the consulting and telecommunications industries saw this as one of the least important factors. One possible explanation for this result may be related to what category the different projects from each industry belongs to. In financial services, 75% of the participated projects are in-house projects, while this figure is only 10% for telecommunications industry and 22% for the consulting. Since a majority of the financial services projects are in-house, the organization/top management needs to be satisfied with the developed system to be

able to consider the product successful. Another difference between responses received from subjects in the consulting and telecommunications industries was the economic benefits for the supplier. While subjects from the consulting industry saw this factor as the third most important for project success, subjects from the telecommunications industry considered economic benefits to be the second least important success factor for product success. Our findings were consistent with literature i.e. it is not easy to define a successful product. One subject indicated that the word "success" needs to be defined before it is possible to ask what a successful product is:

"Can not be answered it depends on what type you produces, there are excellent products that does not sell anything and vise versa. So the word success has to be defined"

Another subject defined a successful product in the case of a mix of bespoke and market-driven development as:

*""**Mix of bespoke and market driven"** is successful if the product is actually used by a customer"*

The following section focuses on validity threats of this study.

6. VALIDITY

Four types of threats should be addressed in this study [26].

Internal Validity: This threat is related to issues that may affect the causal relationship between treatment and outcome. We believe that there is low threat to internal validity in this study. The research instrument in this study was developed with close reference to literature relating to success factors for projects and products. In addition, several pilot studies were performed to ensure that the questions in the research instrument related to the stated research objectives of this research study. The selected participants in this study had to participate in at least one completed (delivered or cancelled) software project. The differences in academic backgrounds, industry experience, and roles in participants' organizations were also documented.

External Validity: This threat is concerned with the ability to generalize the findings beyond the actual study. There are two such threats to external validity that are relevant for this study: interaction of selection and treatment, and interaction of history and treatment [26]. The participants selected for this study were from different geographic locations in Sweden and Australia. Both male and female participants were represented. Companies were selected through a random selection technique. The sample size was another threat to the external validity of this study. The small sample size in this study may affect the conclusions and hence we may not be able to generalize the results to the whole software engineering industry. The timing of the study may be a threat to external validity. However, this study is based on data from already completed (delivered or cancelled) software projects. Another aspect is that the subject' latest completed software projects should be referred to when answering the questions. This would minimize the threat that the software practitioners may have forgotten what really happened in the project.

Construct Validity: This threat is concerned with issues related to the design of the study and social threats. This study was carefully designed, with the design being piloted and a detailed analysis of constructs such as different definitions of projects considered. To avoid evaluation apprehension, complete anonymity from other participants and the companies was guaranteed. Hypothesis guessing (where a participant tries to guess the hypothesis and then support the result depending on their attitude towards the hypothesis) can mean that participants introduce bias to the collected data in this research. This is a threat to our study. Another validity threat lies in the question that asked subjects to rank and include additional factors if the list provided to them was inadequate. Subjects may have thought that it was easier to rank the provided factors than propose new factors. This means that important success factors may be missing.

Conclusion Validity: Threats to conclusion validity arise from a lack of statistical calculations or misuse of statistical assumptions that lead to incorrect conclusions by the researcher. There is a risk that conclusions from this study are inaccurate due to low statistical power. No statistical calculations are used to find patterns in the results. Instead, deductive logic was used because of the limited data points in some categories. To obtain highly reliable measures and to avoid poor question wording and poor layout (which may introduce bias into the collected data, confuse the participant and lead to unsuitable answers) several pilot studies were conducted. To avoid threats from treatment implementation emailed questionnaires were used as often as possible. However, when the participant requested an interview, questions were asked in exactly the same way as they were asked in the questionnaire, reducing bias in the collected data.

7. CONCLUSION

This research set out to investigate software project and product success factors in the Australian and Swedish software industries.

Generally speaking, our findings complement the results from other studies. That is, a well defined project scope, complete and accurate requirements, good schedule estimations, customer/user involvement and so forth are perceived as contributing to project success. Similarly adding extra personnel to meet schedule estimations is perceived as contributing to the likelihood of project failure, which was also discussed in previous studies.

Our contribution is the discovery that there are differences in which factors are important for project/product success across industries. This indicates that we need to take into account the industry type when addressing project/project success factors. The current definition of what factors are important for software project/product success does not consider what type of system is being developed (e.g. a simple game, a life saving system, nuclear reactor system etc.). Nor does the definition consider whether the system is being developed from scratch or whether the project merely involves adding/updating the features and functionality of an already existing system. In summary, our findings indicate that software developers in the financial services, consulting, and telecommunications industries identify different factors as important for software project success.

Additional data is required to achieve more generalizable results. As previously discussed, a larger sample size and statistical calculations would be of great value. In addition, studying the same types of projects from each industry will increase the validity of the results. Future studies will involve the investigation of software project/product success factors for various customer supplier relationships.

8. ACKNOWLEDGEMENT

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