

Software development project success and failure from the supplier's perspective: A systematic literature review

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Received 28 February 2011; received in revised form 2 June 2011; accepted 19 July 2011

Abstract

In this paper, we consider software development project success and failure from the supplier's perspective. First we clarified concepts in order to be able to exclude review articles on in-house projects, continuous services, the customer's perspective, and software product development, with the aim of providing valid results for supplier firms. We divided success criteria into project success and project management (PM) success, and, in seven articles, identified three success criteria from the supplier's perspective: customer satisfaction, short-term business benefits, and long-term business benefits. In contrast, no definition of software development project failure was found. Articles were found in seven different journals, showing that knowledge on software development project success from the supplier's perspective is fragmented. This impedes the growth of knowledge on this topic.

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Keywords: Software development project; Outsourcing; Project management; Project failure; Project success; Customer; Supplier; Literature review

1. Introduction

Why do software development projects fail? This question has long exercised the minds of both researchers and practitioners. Although software has been successfully applied in a large variety of areas, software development projects have a reputation for failure. Moreover, researchers have questioned whether we have learned enough to ensure that our software development projects are successful (Cerpa and Verner, 2009).

Before any software development project can be determined to have succeeded or failed, the criteria used in assessment should be agreed upon. In order to support software development the ISO (International Organization for Standardization) and the IEC (International Electrotechnical Commission) have

jointly developed various standards, in one of which a project is defined as “an endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements” (ISO/IEC, 12207, 2008, p. 5). Based on the standards and tradition in the software development field, the most common combination of criteria used to measure the success of a project concerns meeting time, cost, functionality and quality goals (e.g. Anda et al., 2009; Atkinson, 1999; El Emam and Koru, 2008; Kappelman et al., 2006; Lai, 1997; Sumner et al., 2006; Yeo, 2002).

However, de Bakker et al. (2010) question these criteria. They argue that, based on their literature review, using the traditional project success criteria, i.e. time, budget, and requirements, easily leads to the conclusion that a software development project has failed. They report that the publications investigated for their paper indicate that during the course of a software development project, the requirements originally defined will almost certainly change, and this will influence the schedule and the costs. Therefore, it is almost impossible to provide adequate time and budget estimates at the beginning of a software development project. Because the traditional project

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success criteria appear to be widely used in these publications, they suggest a definition with additional aspects that define project success (e.g. Shenhar et al., 2001) as well as take into account the individual stakeholder's opinion of project success (e.g. Agarwal and Rathod, 2006; Procaccino and Verner, 2006).

The same problem in software development projects was also discussed by Glass (2001) almost one decade earlier, when he collected a list of frequently forgotten fundamental facts about software development. According to him, most software estimates are performed at the beginning of the software development process before the problem is understood, and furthermore, they are not made by the people who will develop the software or by their managers but by either upper management or marketing. These estimates are rarely adjusted later, and therefore estimates are made at the wrong time by the wrong people and are quite flawed. As a result, he argues that there is little reason to be concerned when software projects do not meet cost or schedule targets.

The literature review carried out by de Bakker et al. (2010) covers the period from 1997 to 2009. When we reviewed recently published articles included in their review, we did not see a transition from use of the traditional success criteria to the use of new success criteria. Therefore, research on software development project success seems to adhere to the traditional project success criteria, and unfortunately this seems to support the claim that software development projects fail, although successful software implementation is globally pervasive.

We note that general project management research has moved further than software development research in examining project success. In this field we find the use of the concepts *project success* and *project management success* (PM success). Two recently published reviews on project success, one by Jugdev and Müller (2005) and another by Ika (2009), emphasize the complexity of the concept, but also highlight the distinction between project success and PM success. Moreover, Papke-Shields et al. (2010) take this distinction into account when defining measures for their study on assessing the use of project management practices. They also note the link between the use of project management practices and project success. Other studies differentiating project success from PM success include Baccarini (1999), Cooke-Davies (2002), de Wit (1988), Dvir et al. (1998, 2003), Lipovetsky et al. (1997), Munns and Bjeirmi (1996), Sadeh et al. (2000), and Shenhar et al. (1997). The same distinction is made by Pinto and Prescott (1990), and Pinto and Mantel (1990), who have used the concepts efficiency of the project implementation process and external efficiency. The first concept refers to PM success whereas external efficiency consists of the perceived value of the project and client satisfaction.

The definitions presented by Munns and Bjeirmi (1996) for project and project management clarify the distinction between these concepts. They define a project as “*achievement of a specific objective, which involves a series of activities and tasks which consume resources*” (Munns and Bjeirmi, 1996, p. 81). This highlights the importance of understanding and attaining the project goals, and a project is a means to achieving those goals. Project management is defined as “*the process of controlling the achievement of the project objectives by*

applying a collection of tools and techniques” (Munns and Bjeirmi, 1996, p. 81). Thus PM success is considered to be measurable (e.g. time/cost/quality) while project success goes further, focusing on longer-term and customer-oriented results (Papke-Shields et al., 2010). For this reason, Ika (2009) advises against confusing project management objectives (time/cost/quality) with project success.

It has been said that “*a project can be a success despite poor project management performance and vice versa*” (de Wit, 1988, p. 165), and one example of this is the Sydney Opera House. Although it took 15 years to build and the budget was overrun 14 times, it is now generally agreed to be an engineering masterpiece (Jugdev and Müller, 2005). However, it should be realized that whereas PM success may lead to project success, the opposite is not necessarily true (Ika, 2009), as was pointed out also by de Wit: “*Good project management can contribute towards project success but is unlikely to be able to prevent failure*” (de Wit, 1988, p. 165). The distinction between project success and PM success can also be expressed thus: “*the operation was a success, but the patient died*” (Jugdev and Müller, 2005, p. 22). Therefore, PM success and project success should be evaluated as separate but interlinked measures.

This paper focuses particularly on project success and PM success within software outsourcing. When software development is outsourced to an external supplier, there are two parties involved, so the distinction between both perspectives becomes important. We might assume that PM success may be the same for both parties but the thesis of this paper is that project success means different things to the customer and the supplier. Although de Wit noted over 20 years ago that the aim of the customer is to minimize the costs of the project whereas the aim of the supplier is to maximize the profit (de Wit, 1988), a clear distinction between these different perspectives is not commonly made when discussing software development project success or failure (e.g. El Emam and Koru, 2008; Procaccino et al., 2005; Whittaker, 1999). Only recently have studies appeared which note that the customer and the supplier may have different perceptions of risk, risk management, and project success (Jun et al., 2010; Taylor, 2007). Moreover, while the outsourcing literature has extensively discussed subjects related to software development acquisition from the customer's perspective (see e.g. the survey and analysis by Dibbern et al. (2004) and the historical review by Hätönen and Eriksson of outsourcing generally (2009)), little attention has been paid to research from the supplier's perspective (Dibbern et al., 2004; Goles and Chin, 2005; Levina and Ross, 2003; Taylor, 2007). As a consequence, the software development community has, to date, gained little knowledge of outsourced software development projects and their success from the supplier's perspective.

One project that is difficult to categorize as a success or a failure has been recently described by Ahonen and Savolainen (2010) in a study analyzing five canceled software development projects. In one of the cases the supplier finished the software development project practically on time. However, the customer was not satisfied with the new system and never used it, but still paid the invoice. Hence, from the customer's perspective the project was

clearly a failure, but from the supplier's perspective the situation was not so straightforward. The supplier managed to produce the software on time, within budget, and according to the scope agreed with the customer, and received payment. Thus, the key question is whether it is possible to consider the project a failure also from the supplier's perspective. Hence, project success is a more complicated concept than meeting time, cost, functionality, and quality goals (Pinto and Slevin, 1988).

To avoid analyzing something that has already been studied in detail, we conducted the systematic literature review presented in this paper. Our aim was to summarize the existing research on the definition of project success and failure from the supplier's perspective, and establish in which journals the articles selected for this study were published.

The structure of the article is as follows. In Section 2 we define basic concepts, Section 3 presents the research questions and the review process, and in Section 4 we analyze the selected articles and summarize the results. In Section 5 we consider the validity of the research, Section 6 is the discussion, which includes the lessons learned, and Section 7 is the conclusion.

2. Basic concepts

When we carried out pilot searches for the systematic literature review, we found that the topic of the definition of software project success and failure from the supplier's perspective is complex and that there is confusion and inaccuracy in the terms used. We aimed at construct validity, i.e. at ensuring that our study investigates what we claim to investigate, as Gibbert et al. (2008) recommend. Therefore, these concepts had to be clarified before we could commence the study:

1. Sub-contracting³ software development project versus in-house software development projects,
2. Project versus continuous services,
3. Bespoke software development⁴ versus software product development,
4. Success criteria and success factors, and
5. Project success/failure and PM success/failure.

The first concept is the distinction between sub-contracting software development projects and in-house software development projects. When there is a sub-contracting relationship, there are two parties, a customer and a supplier⁵: the customer is acquiring software and the supplier is developing software for the customer. In these situations the customer and the supplier are from different organizations, and they have made a contract regarding a software development project. According to the

contract, the supplier has agreed to develop software and deliver the outcome of the software development project to the customer. In-house projects are undertaken for other units in the same organization, and there is no business relationship between these organizations. When software is developed for an external customer, business elements are added to every software development project undertaken by the supplier, and therefore project success from the supplier's perspective may be different from success from the customer's perspective. As there is no business relation between units in the same organization, in-house software development projects are excluded from this systematic literature review.

The second concept concerns the distinction between a software development project and continuous services. According to the ISO/IEC 12207 Systems and software engineering — Software life cycle processes standard, a project is “an endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements” (ISO/IEC, 12207, 2008, p. 5). Newton defines a project describing attributes for work done during a project thus: “In a project the work is unique, complex, non-routine, on-time effort limited by time, budget, resources, and performance specifications designed to meet customer needs” (Newton, 2009, p. 16). Our focus in this review is on software development, including embedded software development, carried out through projects by external suppliers, and therefore continuous services such as database administrative support and network support are excluded from this review. Software maintenance is included only when it is done through projects and without a yearly billing contract. Especially in the case of outsourcing, we make a distinction between software development and different support activities, and a distinction between outsourced software project and yearly billed software maintenance work. An example of the difficulties in discerning whether software development is made on a continuous basis or through projects is revealed in the study of Levina and Ross (2003). The term ‘project’ was used although the outsourced type of operations was not actual software development projects but was services provided by one supplier with a long-term contract. In studies which do not define the concepts clearly, it is difficult to tell whether they are actually about projects.

The third concept distinguishes bespoke software from software products. Software products are produced for mass markets whereas bespoke software is developed only for one customer. Bespoke software may be developed from scratch and may contain different software components, but these are developed and built for a certain customer. The differences between bespoke software development and software product development are discussed in several studies (e.g. Cusumano, 2004; Nambisan, 2001). In this review, we consider a project to be a software development project if it includes a significant software development effort intended for a single customer. Hence, in our analysis, projects which consist of major tailoring of existing software products are in the same category as normal bespoke software development projects.

³ The relationship between customer and supplier is commonly captured by the ‘outsourcing’ concept. Since our interest is in the supplier's perspective, we use here concept ‘sub-contracting’ instead of ‘outsourcing’.

⁴ Other terms meaning ‘bespoke software development’ are ‘custom software development’ or ‘tailored software development’.

⁵ Other terms meaning ‘supplier’ include vendor, contractor, and seller, and other terms meaning ‘customer’ include client, buyer, and acquirer (ISO/IEC, 12207, 2008; ISO/IEC, 15288, 2008; ISO/IEC, 16326, 2009; PMBOK, 2008).

The fourth concept highlights the importance of understanding the difference between project success criteria and project success factors. Project failure/success factors are understood to be elements which can be influenced to increase the likelihood of failure/success (Collins and Baccarini, 2004; de Wit, 1988; Müller and Turner, 2007; Pinto and Slevin, 1987), and a combination of many factors makes failure/success more likely (Belassi and Tukel, 1996). Project failure/success criteria are used when making an evaluation of project failure/success (Collins and Baccarini, 2004; Müller and Turner, 2007), and in this study we are concerned with the failure/success criteria used when an evaluation of software development project failure/success is made.

The fifth concept emphasizes the importance of defining and understanding the difference between software development project failure/success and PM failure/success. If this difference is not understood, one may make oversimplifications. An example of this can be found in the study of Sumner et al. (2006). They explored the linkage between the characteristics of IT project leaders and project success, but adhered to one project management criterion defining project success as “... *planned versus actual project completion time is valid measure of project success that essentially encompasses project cost*” (Sumner et al., 2006, p. 46). Finishing a project within budget may mean not that it has been successful, but only that the management of costs has been successful. A more influential but similarly simplistic study is the periodically updated Chaos Report by the Standish Group.⁶ They use PM criteria in assessing IT project success/failure, which is one reason why these reports maintain the claim that software development projects often fail. Moreover, based on the description of sampling, the projects in Chaos Reports are in-house projects or IT projects acquired by customers, so they are not relevant to this article. Furthermore, these reports have been criticized for failing to describe the research methods used (Eveleens and Verhoef, 2010; Glass, 2005, 2006; Jørgensen and Moløkken-Østvold, 2006).

It was important for us to have defined and understood these concepts before deciding whether particular articles should be included in or excluded from the review. Additionally, understanding these concepts allowed us to interpret and analyze the articles included in the study, while also looking for a definition for software project success and failure from the supplier's perspective.

3. Research questions and review process

For this review we formulated the two research questions presented in Subsection 3.1. The other subsections describe the step-by-step process we followed in order to get answers to our research questions. When planning and conducting this review, we applied the guidelines presented in Kitchenham and Charters (2007).⁷

3.1. Research questions

During pilot searches we observed that a lot of research has been carried out on software development project success/failure, but it is not common to distinguish project success from PM success in these studies. Moreover, there seem to be hardly any studies which consider project success/failure from the supplier's perspective.

In order to find out how software development project success and failure are defined in the literature, we formulated the first research question thus:

RQ1: How does the literature define software development project success or failure from the supplier's perspective?

Because we concentrated on formulating a definition of software development project success, we made a distinction between project success and PM success when analyzing articles, rather than at this early stage.

In order to find out where results have been published, we formulated our second research question thus:

RQ2: In which journals were the articles selected for this study published?

3.2. Data sources and search strategy

Before the actual search for the articles, we performed several ad-hoc queries using the databases and their search engines provided by the publishers. In addition, we performed some general searches using Google Scholar. These searches made it clear that relevant articles have been published in a variety of journals. We expected to find articles in such journals as *Communications of the ACM*, *IEEE Software*, *IEEE Transactions on Software Engineering*, *Information and Software Technology*, and *Software Quality Journal*. Instead, we found that the *Project Management Journal*, *International Journal of Project Management*, *Technovation*, *R&D Management*, *British Journal of Management*, and *Research Policy*, for example, have published articles that might be relevant to the first research question. Hence, we decided not to concentrate on particular journals but to search all the databases available to us, which were:

- ACM Digital Library (portal.acm.org/dl.cfm);
- EBSCOhost (web.ebscohost.com);
- Elsevier Science Direct (www.sciencedirect.com);
- Emerald (www.emeraldinsight.com);
- IEEE Electronic Library (ieeexplore.ieee.org);
- SpringerLink (www.springerlink.com); and
- Wiley Interscience (www.interscience.wiley.com).

We are well aware that some databases which may contain relevant articles, or different search engines, are not included in our selection. However, this could not be avoided: we used every database to which we had access. Moreover, we had no access to some journals included in the listed databases.

⁶ www.standishgroup.com.

⁷ A more detailed description of the review process is available from the corresponding author.

After the analysis of the hits produced by the pilot searches, we used the following restrictions in our searches:

1. Only journals were considered, so we excluded conference proceedings.
2. The fields relevant to our review were project management, computer science (including software engineering), information systems, engineering, management, and business research. This stipulation was needed in order to concentrate on articles concerning software development projects when performing searches in databases.

We did not use manual search techniques.

Our first list of terms or concepts used for the selection of articles was very limited and based on software engineering standards such as ISO/IEC 12207 (ISO/IEC, 12207, 2008). The first terms were ‘supplier’, ‘customer’, ‘project’, ‘success’, and ‘failure’.

It seems to be the case that, although the terms ‘customer’ and ‘supplier’ are used in the standards (e.g. ISO/IEC, 12207, 2008; ISO/IEC, 15288, 2008), the terminology used in published studies does not follow that used in the standards. Hence, the use of synonyms was considered necessary. When we conducted our systematic literature review, we used the following terms and synonyms:

- supplier–vendor, contractor, seller;
- customer–client, buyer, acquirer;
- project;
- software;
- success; and
- failure.

The search strings were formulated using logical expressions created from the terms. The total number of logically different expressions was 52. The logically different search strings are listed in the [Appendix](#).

The logical structure of each search string was written separately for each search engine provided by each database. In order to achieve comparable results, it was necessary to carefully fine-tune the search expression for each database. Moreover, handwritten database-specific queries ensured that searches were as reliable and repeatable as was possible. The federated search engine provided by the library of our university was not able to provide results that included every article that could be found via the publishers’ database-specific search engine. We assume that the federated search engine was not able to translate the search expressions into sufficiently exact forms for the search engines of the publishers’ databases. The inconsistency of the search engines has been earlier noted by [Brereton et al. \(2007\)](#). In order to include journals only from the specified disciplines, we wrote each string and the inclusion of journals individually into the search engines of the databases.

We used common search terms because earlier studies have shown that many articles use unclear and nonstandard terminology ([Jørgensen and Shepperd, 2007](#)). More limited terms and their combinations may not have been able to find the relevant articles. The more open searches did, however, provide

a very large number of hits from the searches. While performing searches in databases with search strings, it was possible to get over 150,000 hits even with some limitations to the search. If a search produced more than 1500 hits, we looked at the first 500, relying on the relevance ordering produced by the publisher’s database.

We added one term later to the search terms. We realized that some studies used the term ‘performance’ to denote all variations between a failure and a success, e.g. studies by [Nidumolu \(1995, 1996a, 1996b\)](#) and [Pinto and Mantel \(1990\)](#). The terms ‘failure’ and ‘success’ were replaced by the term ‘performance’, and the set of searches was re-run with those changes.

The searches were created so that the first year to be searched was the earliest one provided by the database, and the last year was 2009. The searches were completed before the end of April 2010. The studies published on-line after the end of 2009 which are included in the review were selected after performing searches for ‘2010 only’ during June 2010.

3.3. Article selection

The articles were selected for further analysis mainly on the basis of the title and the abstract. The abstract was read if the title did not explicitly exclude the possibility that the article might contain a definition of project success or failure. However, the abstract did not always provide enough information to decide whether the article included relevant information or not. Often, the only way to decide whether an article was useful was to open it and go through it manually, which meant reading the article. Thus, articles were finally selected because of the title and abstract, but, in the worst case, articles might be later excluded because of the content.

Articles were selected if they discussed

1. Either project success/failure and PM success/failure or both;
2. Success or failure of information system, information technology or software development project;
3. Project success/failure or PM success/failure from the supplier’s perspective.

The first selection was performed by one author and randomly checked by another. The selection of software development articles from the selected 141 articles was made by two authors, who discussed the borderline cases. The second selection left 71 articles for further analysis. The selection of the articles that consider the supplier’s perspective was made by same two authors who accepted only seven articles for final analysis.

3.4. Data extraction and synthesis

In order to provide answers to our research questions, we extracted the following data from the selected articles into [Table 1](#):

1. Perspective: if the article discusses only the supplier, the perspective was the supplier’s; if it also discusses the customer, it was classified as presenting both perspectives.

Table 1
The software development project success criteria.

Article	Supplier		Customer		Project success criteria from the supplier's perspective	Journal
	PM	P	PM	P		
<i>Supplier only</i>						
Agarwal and Rathod (2006)	X				Supplier's profit Customer satisfaction Future business	International Journal of Project Management Information & Management
Mao et al. (2008)	X	X				
Na et al. (2007)	X					
Taylor (2007)	X	X			Supplier's short-term business success Supplier's long-term business success	Journal of Systems and Software Journal of Global Information Management
<i>Supplier and customer</i>						
Haried and Ramamurthy (2009)		X		X	Future business Good relations with the customer	Project Management Journal
Heiskanen et al. (2008)	X	X	X	X	Supplier's short-term business success Supplier's long-term business success	The Journal of Strategic Information Systems
Natovich (2003)	X	X	X	X	Profitable project Long term benefits for the supplier	Technology Analysis & Strategic Management

2. PM or P: we classified articles according to whether they discuss PM success/failure, project success/failure, or a combination of these.
3. Success criteria: as we found no explicit definitions for success/failure, we extracted criteria for project success/failure from the supplier's perspective.
4. Publication information: name of the journal in which the article was published.

It must be noted that, except for the publication information, in most cases the data extraction described above required interpretation. Moreover, only in one article the main focus was on software development project success from the supplier's perspective, and furthermore, it was limited to PM success. In other articles the main focus was on risks, or trust and control, for example. Because the criteria were not expressed in an exact manner in some of the articles, the extracted criteria may be worded a bit differently than in the original article.

A summary of each article is presented in the next section. The first four articles in Table 1 discuss project success/failure only from the supplier's perspective. The remaining three articles discuss project success/failure from both the supplier's and the customer's perspective. All these seven articles discuss information system or software development projects.

4. Analysis of the studies and success criteria

4.1. Analysis of the articles

The first article listed in Table 1 was written by Agarwal and Rathod (2006). They focused on practitioners, in this case programmers, project managers, and customer account managers, and obtained success criteria through an exploratory questionnaire directed to some Indian software engineering firms. They decided to concentrate only on the internal characteristics (time, cost, scope) of the project organization, reasoning that software development organizations are more

internally focused, and used as examples the studies of Wateridge (1998) and Linberg (1999). However, we argue that because in-house projects (Wateridge's study) and Research & Development projects (Linberg's study) are carried out in units which are parts of larger organizations, these units may be more internally focused, but we do not yet know what criteria are perceived to be important by the software contract industry (the study of Agarwal and Rathod). Due to their generalization in the research planning phase, Agarwal and Rathod did not consider other than PM success criteria for their study although they had an almost unique research setting.

The supplier's perspective on projects includes a diversity of subjects to be studied. A study by Mao et al. (2008) analyzes suppliers' perspectives on trust and control in China. In addition, they mention the importance of completing the project in time and within budget in order to have a profitable project especially from the supplier's perspective. They also mention future business, profit, and customer satisfaction.

The study reported by Na et al. (2007) analyzed software development risk and project performance measurement in Korea. The article uses the concepts of project performance and product performance developed by Nidumolu (1995, 1996a, 1996b) mainly for software organizations which develop software products. Na et al. (2007) say that their findings are relevant to both software development organizations and software acquisition organizations. A questionnaire was sent to large software development firms that we assume to be supplier firms, but this is not explicitly stated in their paper. The actual types of projects are not clear: they may be bespoke or Research & Development. After a careful analysis of the criteria used it has to be concluded that only PM success has been analyzed.

Taylor (2007) concentrates on the risks identified in package implementation projects in Hong Kong. We consider Taylor's work to be an example where the basis started with a software product, but a significant amount of work is about tailoring and adapting existing software for one external customer at a time.

She does not provide definitions, although project outcome success can be interpreted to mean PM success. Project process success and commercial environment success can be considered to include short-term and long-term project success criterion, respectively. The main observation of the paper is that the supplier's project managers must manage not only the risks that impact directly on the project outcome success, but also long-term risks that arise from the project performance and can threaten the supplier's future business.

Haried and Ramamurthy (2009) evaluated success during international sourcing of information technology projects in India. They noted that most of the definitions of failure or success do not consider the supplier's point of view, and that studies taking both the customer and the supplier into account are relatively rare. The study shows that one of the main aims of the supplier is to get additional business in the future, and therefore one of the main criteria of the success of the current activities from the supplier's point of view is the outlook for future deals with the customer. However, in their study only three projects were software development projects. Other projects concerned testing or application installation, and three cases were about providing support. Although they included other projects and continuous services in their study, we did not exclude their study from our analysis. The reason for this was that they have understood the different perspectives throughout their study and they had identified three software development projects. Unfortunately it was difficult to find success criteria.

Heiskanen et al. (2008) studied control, trust, power, and the dynamics of an information system outsourcing relationship in Finland. They describe a case where the focus is the cooperation between a university, the customer, and a supplier. Although they restricted their perspective to the customer's viewpoint, they express an opinion on both parties' "optimal" outcome. One of the important issues taken into account by Heiskanen et al. (2008) is that the customer is buying and the supplier is selling. Hence, the customer tries to maximize the benefits from his own point of view, while the supplier is trying to maximize the profit either in the short or long term, i.e. the supplier tries to achieve short-term or long-term business success.

The project analyzed by Natovich (2003) was a development of a billing system for the telecommunication company Bezeq. In this case the supplier was the international software company AMS. This is one of the rare cases in which the commitment of the supplier is explicitly mentioned. A project that is going to lose money for the supplier makes the supplier to lose interest in it if there are no strong business reasons to continue with it. Natovich discusses the traditional criteria (PM success) and the role of the project's outcome in the customer's business (project success). In addition to the customer-related issues, he outlines the impact of PM success and project success on the supplier. Project success involves, however, only the economic outcome of the project.

4.2. Success criteria from the supplier's perspective (Answer to RQ1)

The aim of research question 1 was to understand how the literature defines software development project success or

failure from the supplier's perspective. We accepted seven articles for further analysis and extracted success criteria from each article to Table 1. We continued our analysis, combined criteria for software development project success in Table 1, and established three classes of software development project success:

- Customer satisfaction (mentioned in one article),
- Short-term business success for the supplier (supplier's profit (in one article), supplier's short-term business success (in two articles), profitable project (in one article)), and
- Long-term business success for the supplier (future business (in two articles), supplier's long-term business success (in two articles), good relations with the customer (in one article), long term benefits for the supplier (in one article)).

We found 'Customer satisfaction' only in one article (Mao et al., 2008). The criterion 'Short-term business success for the supplier' was found in four articles (Heiskanen et al., 2008; Mao et al., 2008; Natovich, 2003; Taylor, 2007). The criterion 'Long-term business success for the supplier' was found in five articles (Haried and Ramamurthy, 2009; Heiskanen et al., 2008; Mao et al., 2008; Natovich, 2003; Taylor, 2007).

PM success criteria were mentioned in six articles out of seven. Two articles (Agarwal and Rathod, 2006; Na et al., 2007) mentioned only PM success criteria, and there was only one article which did not discuss PM success from the supplier's perspective at all (Haried and Ramamurthy, 2009).

We did not find any clear definition of software development project success from the supplier's perspective. We were, however, able to identify three success criteria for software development projects from the supplier's perspective. The criteria of project success presented in the literature concern the business success of the supplier, either short-term or long-term business benefits. These are very likely to have a strong impact on the behavior of the supplier and the project in question.

We are not able to provide definitions for software development project failure because none of the reviewed articles provided any definitions of failure: they discussed only project or PM success. It may be that we simply failed to find such articles, although it seems that there are no articles to be found. It is possible that there is a common publication bias favoring the analysis of success over that of failure. Another reason may be that firms are not willing to provide failure data for research purposes.

4.3. Answer to RQ2

In order to establish where studies of software development project success and failure from the supplier's perspective are published, we formulated research question 2: In which journals were the articles selected for this study published? The publication forum for each article is presented in Table 1. All seven articles are journal articles and all of them were published in different peer-reviewed journals since 2003: 2003 — 1, 2006 — 1, 2007 — 2, 2008 — 2, and 2009 — 1.

5. The validity of the literature review

5.1. The construct validity of the review

Our review is based on the constructs presented in Section 2. The validity of our review is based on the assumption that we and the authors of the articles share a common understanding of the concepts.

5.2. Internal validity of the review

The internal validity of the review is guaranteed by the documented procedure used for the search, selection, and analysis of the articles. The main threat to the validity of the reasoning used in the analysis arises from the subjective evaluation of the contents of the articles: the results of the evaluation depend on the evaluator. However, the evaluation procedure was predefined and approved by at least two of the authors in order to make the reasoning more valid and repeatable. The internal validity of the review has been ensured by the documentation of the review procedure and random checking of the analysis. Therefore, there are no threats to the internal validity.

5.3. Repeatability of the review

The main threat to our literature review is that it is based on the results provided by the search engines incorporated into the publishers' databases.

Although the search for articles was performed systematically and can be easily repeated, the results of repeated searches may not be exactly the same, mainly because of the expanding nature of the databases. The publishers add new articles to the database, and in some cases may be adding old articles to it. Hence, these new articles would be included in the future reviews.

It is also possible that the searches may have missed relevant articles. However, we included synonyms in the search strings, and two of the authors checked the results, thus reducing this possibility to a minimum.

The publishers may also update the search engines from time to time. The search engines may fail to find relevant articles and therefore a manual search may be necessary. This phenomenon has been noted in earlier reviews, e.g. Brereton et al. (2007), Jørgensen and Shepperd (2007), and Kitchenham et al. (2010).

5.4. Biased perception, article selection, and article analysis

The first selection of articles was not totally cross-checked. One of the authors performed the searches from a single database. He/she performed the searches and the selection of the articles from that specific database. Another author randomly checked the searches and the article selection. This procedure made it possible to avoid systematic errors in the searches and article selection. Two authors performed the final selection and analysis of the articles. We might have misunderstood the research described in the excluded articles, or perhaps the

authors of the excluded articles understand the basic concepts described in Section 2 differently from us. An example of difficulties is that we excluded the article made by Aundhe and Mathew (2009) but included the article made by Haried and Ramamurthy (2009). Projects were unclearly described in the first article but clearly expressed in the latter article (four cases out of eight were software development projects). Moreover, the articles that were read for this review but excluded from the actual analysis may have influenced our prior perceptions of success/failure criteria.

6. Discussion

By conducting a literature review and analysis of seven articles, we found three criteria which are used to evaluate software development project success from the supplier's perspective. All seven studies were empirical, and therefore, although in most cases criteria extraction required interpretation, our findings are preliminary criteria which are used in supplier firms to evaluate software development project success.

PM success criteria – meeting time, cost, functionality, and quality goals – were mentioned in six articles out of seven. In addition to PM success, there is an emphasis on meeting business goals. These are presented in terms of having short-term or long-term business success for the supplier. Customer satisfaction was mentioned in one article (Mao et al., 2008), but we can assume that if the customer is dissatisfied, it is unlikely that he will make future deals, and long-term business success is thus threatened.

Although the role of supplier firms that sell software development projects to their customers has increased during recent decades as a result of outsourcing (Dibbern et al., 2004; Lacity et al., 2009) it is not common to consider different business aspects when researching software development projects (Anda et al., 2009) and their success. This is inconsistent with our results, which highlight the importance of business aspects: either short-term or long-term business success for the supplier was mentioned as a success criterion in five articles out of seven.

The reason for the lack of studies dealing with business aspects in research on software development projects and their success is almost self-explanatory. In the outsourcing literature it has been observed that there is a lack of studies on software development which consider the supplier's perspective (e.g. Dibbern et al., 2004; Goles and Chin, 2005; Levina and Ross, 2003; Taylor, 2007). The supplier's perspective inherently encompasses business aspects, and therefore studies that consider software development projects from the supplier's perspective have to take the business aspects into account. Most studies on software development projects have studied software development only, and for that reason the supplier's perspective has not been covered since it cannot be covered without paying attention to the business aspects.

However, business aspects are considered in the rigorous studies on data from defence projects carried out in Israel (e.g. Dvir, 2005; Dvir et al., 1998, 2003; Lipovetsky et al., 1997;

Sadeh et al., 2000). Because these were Research & Development projects (Dvir et al., 2003), about 25% of which were hardware projects (Dvir et al., 1998), we excluded the studies from our analysis. Similarly the key study on project success by Shenhar et al. (1997) has been excluded due to the type of the projects.

However, although we excluded these studies, there seem to be commonalities between the results of their studies on Research & Development projects and our results. The criteria for project success used in these studies are (Dvir et al., 2003, p. 91)

1. Meeting planning goals (success at the project manager level),
2. End-user benefits (success from the end-user point of view), and
3. Contractor benefits (success at the contractor's level, including the commercial success of the project and potential for future revenues).

The first is a project management level criterion and the second one is a criterion from the customer's perspective. The third one represents the supplier's perspective and includes two criteria we found in the literature, namely short-term and long-term business success for the supplier. Our third criterion – customer satisfaction – is quite close to the second criterion of Dvir et al. but is not the same. The customer may be satisfied even though end-user benefits are low. Hence, although the criteria found in these Israeli Research & Development projects are quite similar, they are not exactly the same as the ones we found in this literature review.

Comparing the success criteria used by Dvir et al. and those in our review reveals the importance of defining research settings, context, and perspectives precisely when studying software development project success, as is also suggested by Pinto and Covin (1989) and Pinto and Prescott (1990). We discuss the concepts that are important for this study in Section 2, and concentrate on sub-contracting bespoke software development project success/failure criteria from the supplier's perspective. Because there are differences between success criteria by project type (Müller and Turner, 2007), we do not suggest that these criteria are valid for projects which develop software products. Moreover, these criteria are not valid for in-house software development projects whose main goal is to deliver an information system that will support and strengthen the organization's own business (Taylor, 2007).

If research settings, context, concepts, and perspectives are defined precisely, there will be more valid research for the software industry. For example, if these concepts are well defined and understood it is possible to compare different software development models and their influence on project success in supplier firms. Molækken-Østfold and Jørgensen (2005) compared software project overruns between flexible and sequential development models. Their data consist of projects made by contractors who develop for customers, in-house departments of large companies, and software houses which develop products for mass markets, and these three

different organization types were clearly presented in their study. However, it is not possible to determine which results are valid for each organization type in that study, e.g. whether there are factors which should be taken into account in projects made by supplier firms but which are not valid in projects made by in-house departments. Similarly, only when success criteria are identified and understood for each project type will it be possible to determine whether different software development models have an influence on the project success.

During the review process we found that very few studies consider software development projects from the supplier's perspective. The lack of such studies is surprising given the importance of supplier firms and the fact that project-based supplier firms play a very important role in modern economies (Blindenbach-Driessen and Ende, 2006). However, research on global software development has examined different phenomena within supplier firms, e.g. Richardson et al. (2008) and Deshpande et al. (2010), as well as software process improvement in small and medium sized enterprises, e.g. Savolainen et al. (2007) and Valtanen and Sihvonen (2008). The focus of such studies is on global software development or software process improvement, not on the project success from the supplier's perspective in these contexts.

7. Conclusion

We have examined software development project success and failure from the supplier's perspective. As far as we know this is the first literature review of this subject, although the importance of supplier firms that sell software development projects to their customers has increased during recent decades as a result of outsourcing (Dibbern et al., 2004; Lacity et al., 2009).

By means of a systematic literature review we obtained an overview of the relevant studies and extracted the criteria for project success from the supplier's perspective. We followed the division of criteria into project success and PM success used in other reviews on project success (Baccarini, 1999; Cooke-Davies, 2002; de Wit, 1988; Dvir et al., 1998, 2003; Ika, 2009; Jugdev and Müller, 2005; Lipovetsky et al., 1997; Munns and Bjeirmi, 1996; Papke-Shields et al., 2010; Sadeh et al., 2000; Shenhar et al., 1997).

Four articles discuss software development projects from the supplier's perspective, and three other ones take both perspectives into account. Based on these seven articles the criteria for software development project success from the supplier's perspective can be summarized thus: (1) customer satisfaction, (2) short-term business success for the supplier, and (3) long-term business success for the supplier. It is notable that six studies implicitly or explicitly mention project success criteria in addition to PM success criteria. We were not able to find definitions for software development project failure.

The results of our literature review show that the number of studies from the supplier's perspective does not reflect the importance of sub-contracting, or outsourced, software development projects. Limiting the research perspective to in-house projects or to the customer's perspective is not in line with the

reality of software development. Moreover, clinging to only PM success criteria may sustain the reputation that software development projects have for failing (de Bakker et al., 2010; Glass, 2001).

All the articles in our review were published in different journals, and this dispersal makes it difficult to increase knowledge on this topic. We recommend that further studies on software development projects from the supplier's perspective should be conducted — possibly a special issue of a journal could be considered. Furthermore, proper definitions of the perspective used in the research, and definitions of success and failure, are necessary for achieving the required rigor and relevance.

Acknowledgments

This research has been partly funded by the Finnish Funding Agency for Technology and Innovation (Tekes) with grant 70011/08, and has been supported, in part, by Science Foundation Ireland grant 03/CE2/I303.1 to Lero — The Irish Software Engineering Research Centre.

Appendix A

Logical search strings without the database-specific expressions

1. project AND success
2. project AND failure
3. project AND success AND software
4. project AND failure AND software
5. project AND success AND supplier
6. project AND success AND vendor
7. project AND success AND contractor
8. project AND success AND seller
9. project AND success AND customer
10. project AND success AND client
11. project AND success AND buyer
12. project AND success AND acquirer
13. project AND failure AND supplier
14. project AND failure AND vendor
15. project AND failure AND contractor
16. project AND failure AND seller
17. project AND failure AND customer
18. project AND failure AND client
19. project AND failure AND buyer
20. project AND failure AND acquirer
21. project AND success AND supplier AND customer
22. project AND success AND vendor AND customer
23. project AND success AND contractor AND customer
24. project AND success AND seller AND customer
25. project AND success AND supplier AND client
26. project AND success AND supplier AND buyer
27. project AND success AND supplier AND acquirer
28. project AND success AND vendor AND client
29. project AND success AND vendor AND buyer
30. project AND success AND vendor AND acquirer

31. project AND success AND contractor AND client
32. project AND success AND contractor AND buyer
33. project AND success AND contractor AND acquirer
34. project AND success AND seller AND client
35. project AND success AND seller AND buyer
36. project AND success AND seller AND acquirer
37. project AND success AND supplier AND customer
38. project AND success AND vendor AND customer
39. project AND success AND contractor AND customer
40. project AND success AND seller AND customer
41. project AND failure AND supplier AND client
42. project AND failure AND supplier AND buyer
43. project AND failure AND supplier AND acquirer
44. project AND failure AND vendor AND client
45. project AND failure AND vendor AND buyer
46. project AND failure AND vendor AND acquirer
47. project AND failure AND contractor AND client
48. project AND failure AND contractor AND buyer
49. project AND failure AND contractor AND acquirer
50. project AND failure AND seller AND client
51. project AND failure AND seller AND buyer
52. project AND failure AND seller AND acquirer

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