Fraunhofer
IESE

A Preliminary Survey on Subjective Measurements and Personal Insights into Factors of Perceived Future Project Success

Authors:
Sabine Nunnenmacher
Jessica Jung
Golriz Chehrazi
Alexander Klaus
Constanza Lampasona
Christian Webel
Marcus Ciolkowski

IESE-Report No. 030.12/E
Version 1.0
August 2012

A publication by Fraunhofer IESE

Fraunhofer IESE is an institute of the Fraunhofer Gesellschaft.
The institute transfers innovative software development techniques, methods and tools into industrial practice, assists companies in building software competencies customized to their needs, and helps them to establish a competitive market position.

Fraunhofer IESE is directed by
Prof. Dr. Dieter Rombach (Executive Director)
Prof. Dr. Peter Liggesmeyer (Director)
Fraunhofer-Platz 1
67663 Kaiserslautern

Abstract

Within the framework of a project, a variety of known and unknown problems and difficulties in collaboration may occur, which affect how the success of a project is perceived. The goal of our research is to identify factors that influence the perceived success of a project in order to be able to take early countermeasures if project success is threatened. In this paper, we present preliminary results of a study for perceived project success. The study measures perceived project success quantitatively and qualitatively; in addition, our goal was to analyze correlations between perceived project success and aspects of collaboration, communication and individual experiences by using path analysis. The study was conducted in the context of a large-scale research and development project, where multiple partners from research and industry with a heterogeneous background work together to develop new methods and technologies in the field of "internet of things". After the first half of the project, we conducted an explorative survey with 45 persons to evaluate how the current status and project success are perceived by the partners after 1.5 years of collaborative work. As key result, we identified factors that significantly influence the perceived future project success.

Keywords: subjective measurement; project success; quantitative data; qualitative data; path analysis

Table of Contents

1 Introduction

Project success is frequently associated with projects being completed on time, on budget, within the required quality and functionality. One important aspect of project management is to detect as early as possible whether the project success is endangered, and to take appropriate corrective measures if necessary. In order to do that, it is important to measure indicators for project success before the project is completed. A multitude of metrics have been proposed to this end (e.g., earned-value methods, effort consumption, schedule completion, or code quality metrics). These metrics have in common that they require insight into process and product data. However, in particular for research and development (R&D) projects or global software development, these data are usually not available. Our experiences have shown that either the concept of a product status and its associated value are difficult to define, or insight into product and process data is missing because the projects span across organizational boundaries. Besides, the objective in R&D projects funded by the German government is not to develop products but to develop innovative ideas and technologies that create added value and foster future prosperity. To our knowledge, there is no literature about assessing project success in early project phases; therefore corrections in running projects are not yet well investigated.

In this paper, we address early measurement of project success that can be applied in any type of project, since its measurement depends on subjective impressions of project participants. Additionally, we analyze the influence of variables such as communication and collaboration within the project, as well as individual work experience on subjective perceived current project status and on subjective perceived future project success. An interesting finding is that against our assumptions of allover positive influences, professional work experience shows a negative influence in the model.

2 Background

Project success can be measured in many different ways. One possibility is to measure the success at the end of a project, or, as we recommend, an early evaluation of project success opens room for improvement. In this section an overview of studies on measuring project success within the Software Engineering (SE) context is presented, followed by a description of the specific project context, in which this study took place.

2.1 Overview of Studies Measuring Project Success in SE

A number of studies investigate project success and potential influences in SE. However, all our surveyed studies are post-hoc; i.e., they are performed after the project has already finished, and not, as in our case, while the project is still running. In the literature, mostly the technical side of project success is in the focus.

For example, together with other researchers, Verner conducted several studies concerning project success [1][2][3][4]. Procaccino et al. [1] and Verner et al. used in [2] questionnaires covering several categories, such as quality of requirements definition, goodness of project management, or customer's expectations, while in [3], the authors used an online-questionnaire with fourteen independent variables. The number of respondents (=N) were 66 [1], 153 [2], 76 [3], and 143 [4], described as software professionals from various disciplines.

Key findings of [1][2][3] describe success factors considered as most important for practitioners and project managers, i.e., customer or user requirements are met by the system, or the system meets their needs and is easy to use. Furthermore, well defined and accepted requirements that involved users and managers provide feedback and further intrinsic factors, e.g., having a sense of achievement and doing a qualitatively good job.

According to an investigation done by Egorova et al. [9] in 2009 (N=72), the most important project success factors are satisfied customers, great quality, "meet business objective, goal, and user requirements" as well as "complete on time and within budget".

As another example, Cerpa et al. conducted a survey in 2010 [4] and employed a Principal Component Analysis to extract those variables contributing significantly to a factor explaining the variation in project success. Key findings are 3 factors consisting of 3, 4 and 1 variables for predicting project outcome. The first two factors extracted indicate a success factor, namely "project manager

capability" (51.8% variation explained), and "realistic project plans" (11.9% variation explained). The third factor, indicating a project's failure, "add staff late to meet schedules", confirms findings in [2].

2.2 Project Context

Our study was conducted in a large applied research project called Alliance Digital Product Flow (ADiWa) [7] funded by the German Ministry for Education and Research. Within the project twelve partner organizations from industry and academia are currently investigating new concepts for the Internet of Things (IoT) integration in business applications, to foster innovative system implementations reflecting real-world awareness. As such, the main goal of the project is to leverage the information provided by the IoT with respect to business process management.

3 Study

In this section we describe our research questions, followed by an explanation of the quantitative study design and execution of the survey. Furthermore, by the use of open questions, i.e., qualitative analysis, we like to get a deeper understanding of the project members' perceptions and opinions with regard to project success. Therefore, we examine: Do the qualitative results comply with presented findings with regard to project success or disclose further insights? Finally, the results are explained.

3.1 Research Questions

RQ1: How do project members perceive the current project status and the future project success?

RQ2: Which factors (i.e., independent variables) influence perceived project success? We hypothesize that perceived future project success (PFPS) is influenced by communication (COM), collaboration (COL) and perceived project status (PPS), while PPS itself is also influenced by COM and COL. Additionally, there is a relationship between COM and COL. Furthermore we postulate that work experience (WE) directly influences PFPS and indirectly PFPS via PPS (Figure 1).

The rationale behind this is that we assume that both communication and collaboration contribute to a project's status. Also a current project status influences the future project status and not the other way round. It is also obvious that an individual's work experience contributes to the success of a project.

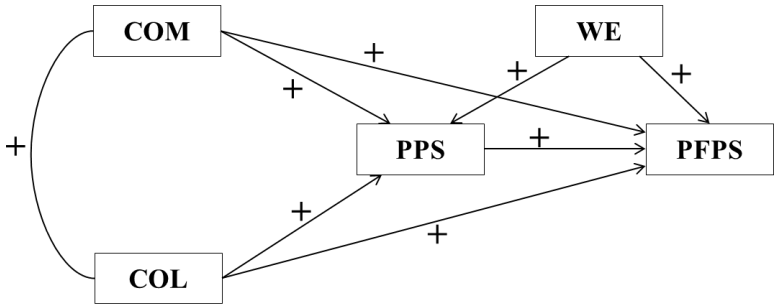

Figure 1: Model assumption

3.2 Study Design and Execution

From research idea to final interpretation of the results, the work can be described in 5 steps.

(1) First, we identified an initial set of variables that potentially influence perceived project success.

(2) In the following step, the potential influencing variables were transferred into an online distributed questionnaire. All variables except WE were operationalized into items measured on a 5-point-Likert-scale. The resulting items (Table I) were then combined to develop a standardized online questionnaire. A cross-sectional design was selected to survey all project members. All questions of the questionnaire were optional to answer.

(3) In the third step, the questionnaire was tested in a pilot study. According to the feedback of the pilot test participants, minor changes in wording and in the sequence of the questions were implemented.

(4) In the subsequent step, the questionnaire was released and the actual execution of the study took place. The questionnaire was online for four weeks. To increase the response rate, two reminders for participation in the online questionnaire were sent to the project partners.

(5) In the last step of our study the data analysis and interpretation were performed.

3.3 Analysis of Results and Discussion

In this section we will first illustrate the given sample of our study. Related to our research questions, we then describe the quantitative analysis and results of the qualitative analysis.

Variable **Item**	**Operationalization**	**Mean**	**SD**	**Correlation**				
				COL	**COM**	**WE**	**PPS**	**PFPS**
Collaboration (COL) Collaboration within the project works.	1=fully disagree – 5=fully agree	3.71	.96	**1.0**				
Communication (COM) Communication within the project works.	1=fully disagree – 5=fully agree	3.07	.99	**.15**	**1.0**			
Work experience (WE) For how many years do you approx. work in your profession?	Years in whole numbers	9.97	6.79	-.09	.08	**1.0**		
Perceived project status (PPS) How do you evaluate the current project status?	1=not satisfying at all – 5=very satisfying	2.95	.87	.32*	**.31***	-.09	**1.0**	
Perceived future project success (PFPS) The project will achieve its goals at the end of project.	1=fully disagree – 5=fully agree	3.29	1.07	**.48****	**.52****	-.03	**.59****	**1.0**

a. N=45. SD=Standard Deviation. * $p < .05$ (two-tailed); ** $p < .01$ (two-tailed).
b.

Table 1: Overview of used items in the questionnaire, descriptives and correlations

3.3.1 Sample

In total, 49 out of 82 invited project members answered the survey, 4 persons had to be removed because of unfinished questionnaires. This results in a sample consisting of 45 finished questionnaires and a response rate of approximately 55%. The question regarding gender was answered by 33 persons (2 female, 31 male). 36 persons gave information about their scientific background: 18 project members have experience in computer science, and 6 each in engineering science (e.g., automation) or in natural science (e.g., chemistry). The remaining 6 participants who answered this question have experience in other disciplines; for example, logistics or business administration.

Analog to the diversity of the scientific background, the work experience in the given sample is heterogeneous, with an average work experience (WE) of 9.97 years and a standard deviation of 6.79 years. People with a minimum of one year of professional experience and people with more than 30 years of professional experience work together.

3.3.2 Quantitative Analysis

We first give a descriptive overview for COL, COM, PPS and PFPS (see Table I). As can be seen, PPS is the variable with the lowest value (mean=2.95; SD=.87), while collaboration is evaluated with the highest score (mean=3.71, SD=.96). That is, the participants agree that the collaboration within the project is positive, whereas for the other three variables, the rating is more or less neutral (i.e., around 3.0). This means, that the project members think that a) the communication subjectively neither works nor does it not work (mean=3.07; SD=.99), b) that the current project status is neither satisfying nor is it dissatisfying (mean=2.95; SD=.87), and c) the project members are undecided whether the project will achieve its goals at the end (mean=3.29; SD=1.07). All variables have a normal distribution checked with Q-Q plots [8].

Table I also shows the correlation matrix for the five variables. Correlation coefficients can take values between -1 and +1, with -1 showing a negative and +1 a positive relationship between two variables. We calculated the Pearson correlation coefficients r with ±.1 representing a small effect, ±.3 is a medium and ±.5 is a large effect [8].

Our analysis illustrates that three correlations with perceived future project success are relevant: COL, COM and PPS show a large and statistically significant correlation with PFPS. Thus, we can say that the better people perceive collaboration, communication, and the current project status, the better they perceive future project success. Interestingly, we were not able to find an influence of work experience on PFPS (r = -.03).

Looking at the perceived project status (PPS), we can see that the correlations with communication ($r = .31$, $p < .05$) as well with collaboration ($r = .32$, $p < .05$) are significant but WE ($r = -.09$) has no considerable relationship with PPS. Interestingly, the correlation between COL and COM is rather low ($r = .15$).

RQ1: How do project members perceive project status and future project success?

Our analyses show that PPS is rated on an average value. The project members are neither satisfied nor unsatisfied with the current status. A nearly identical picture shows PFPS: for PFPS, the assessment is also close to the scale's middle.

RQ2: Which factors (i.e., independent variables) influence perceived project success?

As shown above, COL, COM, and PPS have a strong influence on perceived future project success. Additionally, there is a relationship between COM and COL. Furthermore, we postulate that WE directly influence PFPS and indirectly PFPS via PPS.

To investigate these influences, we used path analysis [5]. This is a statistical method to investigate the explanatory relationships between observed variables. Unlike structural equation models, in path analysis no latent variables are considered (further reading, e.g., [6]).

All assumptions and pre-conditions for path analysis (e.g., normal distribution) were met. For the path analysis, all influences were transformed to standardized regression coefficients (needed because WE is measured in years, all other variables are operationalized in a 5-point-Likert scale). Standardized regression coefficients can take values from -1 to +1. Values between 0 and ±0.3 can be described as a weak influence from one variable on another, values between ±0.3 and ±0.5 as moderate and values greater than ±0.5 represent a strong influence [5].

Figure 2 shows the resulting model, which is able to explain 56% (R^2) of variance. This means that the dependent variable (PFPS) is sufficiently well explained with the resulting model. There are two statistically influences: COM and COL have a moderate and statistically significant influence on PFPS. All other influences can be classified as weak.

Overall, the model confirms our initial expectations (see Figure 1), except for the almost nonexistent influence of COL and COM on PPS, and the influence of WE. For WE, we expected a stronger influence on PPS and PFPS, and a positive one. However, it seems that, with growing work experience, participants tend to perceive the project status and the likelihood of future project success more

negatively. However, because of the low number of data points (path analyses usually require several hundreds of data points), conclusions can only be preliminary and have to be interpreted with care.

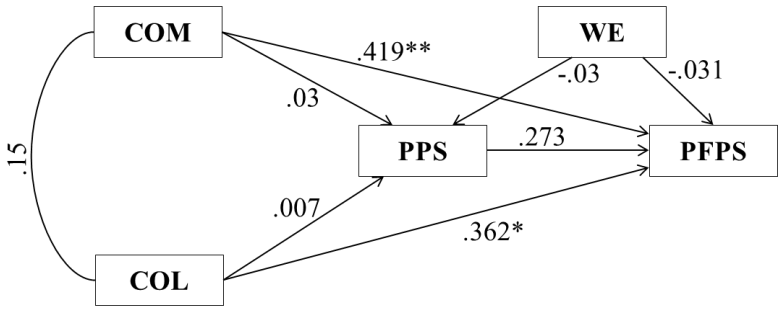

Figure 2: Result of path analysis

3.3.3 Success Criteria

To understand potential criteria for perceived project success, we asked the participants to explain under which conditions they would perceive the project as successful.

The existence of a demonstrator as a proof of concept was most often mentioned (19 out of 26 responses). Since the objective of the project is to develop technologies and to demonstrate their usefulness in a demonstrator, the participants' answers can be interpreted as "achievement of project objectives", an answer given directly by six participants. This is similar to the results of Egorova et al., who extracted a factor for project success called "meet business objective, goal, and user requirements" as one of the most important factors [9]. Obviously, when this objective is fulfilled, the participants will have a sense of achievement, similar to that mentioned in [1][2][3].

Our results can also be seen as reassurement of "functionality" as an important success factor [10], although this was not mentioned literally, since a useful or evaluated demonstrator comprises effective functionality.

4 Summary and future work

Perceived project success is one option to identify whether corrective measures are necessary. This is particularly true for situations where a project's output and progress is difficult to quantify; for example, if the goal is to develop innovative technologies.

In this paper we reported results of a survey in a large scale R&D project. One main finding is that professional work experience shows a negative influence on perceived project status and perceived future project success. One potential explanation is that the expectations towards a project outcome differ between persons with high and low work experience, therefore influencing the assessment of the project success.

This is subject to further research. Furthermore, customer involvement and meeting business objective, goal, and user requirements are among the most important success factors. This confirms findings in the literature.

An extended version of our study will be conducted at the end of the project. First, we want to correlate the perceived future project success with the real project success examined at the end of the project. Second, we want to expand our study to incorporate further factors into the model, such as intrinsic motivation and the educational background.

Moreover, through replications of our study in other R&D projects we want to investigate to which degree our findings can be generalized.

5 Acknowledgments

We thank all ADiWa members who participated in the survey. This publication is funded by the German Federal Ministry of Education and Research under grant 01IA08006 (ADiWa).

References

[1] J.D. Procaccino, J.M. Verner, K.M. Shelfer, and D. Gefen, "What do software practitioners really think about project success: an exploratory study". JSS, Vol. 78(2), 2005, pp. 194-203.

[2] J.M. Verner, W.M. Evanco, and N. Cerpa, "State of the practice: An exploratory analysis of schedule estimation and software project success prediction", Inf. Softw. Technol., Vol. 49(2), 2007, pp. 181-193.

[3] J.D. Procaccino, J.M. Verner, "Software project managers and project success: An exploratory study", JSS, Vol. 79(11), 2006, pp. 1541-1551.

[4] N. Cerpa, M. Bardeen, B. Kitchenham, and J. Verner, "Evaluating logistic regression models to estimate software project outcomes", Inf. Softw. Technol., Vol. 52(9), 2010, pp. 934-944.

[5] M. Olobatuyi, "A user's guide to path analysis". Lanmham, ML: University Press of America, 2006.

[6] T. Raykov, G.A. Marcoulides, "A first course in structural equation modeling". Mahwah, NJ: Lawrence Erlbaum Associates, 2006.

[7] Alliance Digital Product Flow (ADiWa), http://www.adiwa.net [retrieved: 08-01-2011]

[8] D.C. Howell, "Statistical methods for psychology". Belmont, CA: Wadsworth, 2010.

[9] E. Egorova, M. Torchiano, M. Morisio, C. Wohlin, A. Aurum, and R. Berntsson Svensson, "Stakeholders' perception of success: An empirical investigation", 35th Euromicro (SEAA '09), IEEE Computer Society, Washington, DC, USA, pp.210-216.

[10] N. Agarwal, U. Rathod, "Defining 'success' for software projects: An exploratory revelation", International Journal of Project Management, Volume 24(4), May 2006, pp. 358-370.

Document Information

Title:	A Preliminary Survey on Subjective Measurements and Personal Insights into Factors of Perceived Future Project Success
Date:	August 2012
Status:	Final
Distribution:	Public Unlimited