

Software Practitioner's Perception of Project Success: A Pilot Study

J. Drew Procaccino

Adjunct Assistant Professor
Rider University
College of Business Administration
2183 Lawrenceville Road
Lawrenceville, New Jersey 08648 USA
E-mail:jdproc@aol.com

June M. Verner

Professor
Drexel University
College of Information Science &
Technology
3141 Chestnut Street
Philadelphia, Pennsylvania 19104 USA
E-mail:June.Verner@cis.drexel.edu

Abstract

The success of a software development project is generally defined in terms of budget, schedule and customer requirements. However, it is not clear that all project stakeholders hold the same views of success. In this research, we investigate, by means of a questionnaire, those factors that influence software practitioners' view of project success. Our survey shows that the practitioner view comprises two categories, namely personal factors associated with the work and customer/user factors. The personal factor category includes a sense of achievement while working on a project, a good job was done (i.e. a quality was delivered), the project working was satisfying and resulted in professional growth. The customer/user category includes the customer/users were involved, they had realistic expectations and the project met all their requirements.

1. Introduction

The purpose of this research is to investigate those factors that influence software practitioners' perceptions of project success. In this context, the term "practitioner" includes programmers, systems analysts, programmer analysts, network engineers, database administrators, project managers/leaders and team leaders. The factors that influence practitioners' perceptions of project success are important because before we can discover if a project has been a success, and what factors contributed to that success, we need a definition of success. There is, however, no agreement on what software project success is, particularly among the various project stakeholders, which include senior management, project managers, developers and customer/users.

A general definition of a successful software project is one that "meets its budget, delivery and business objectives",

while a failed project is one that has been cancelled or does not meet its objectives [Lindberg 1999]. Other definitions, some of which are from a project manager's viewpoint, include the degree to which the project achieved its goals, cost, schedule, functionality/scope, user satisfaction, effective project teamwork, professional satisfaction on the part of the project manager, on-time and within budget, reliable, maintainable and met the goals and requirements of users [Hagerty 2000, Linberg 1999]. Many studies have shown that project success and failure is a question of perception and that the criteria could vary from project to project [Pinto and Mandel 1990, Wateridge 1995, 1998]. The only criteria with strong agreement among all the involved parties (in a study of several projects), were: "meets user requirements, achieves purpose, meets timescale, meets budget, happy users, and meets quality". To achieve success, project managers need to ensure that commonly agreed upon success criteria are established at the start of a project [Wateridge 1995, 1998]. A project that has been perceived to be a failure by one stakeholder may be perceived as a success by another [Bennatan 1996]. In a Lindberg study, practitioners declared a project to be one of the most successful they ever worked on, while others stakeholders considered the same project to be a failure. This particular project was over budget by 419%, over schedule by 193% and over size estimates by 120%. By all the traditional measures, one would consider this project at least troubled, if not a failure. When asked to explain what factors lead to project failure, practitioners mentioned schedule pressure, poor schedule estimate, poor understanding of the resources needed, and poor understanding of the problem to be solved. Glass [1999] also noted a profound difference of opinion between managers and team members concerning software project success and failure. It has been suggested that success

has to do with practitioners learning experience on the project. This provides skills that developers can use on other projects [Glass, 1999].

Practitioner's view of success (and failure) is important to the process of developing software due to practitioner's critical role in the process, and their unique view among project stakeholders. Practitioners are on the front line in the design and construction of software, both in terms of what they do and with whom they interact. These interactions are both between their management, and customers and users of the system being developed. We expect to confirm previous research that suggests that interactions with these stakeholders will play a major role in shaping the typical practitioner's perception of project success and failure [McConnell, 1996].

People, in general, are the single, most critical component of any software development project. "Good people, with good skills and good judgment, are what make projects work" [Boehm, 1991]. Further, "personnel attributes and human relations activities provide by far the largest source of opportunity for improving software productivity" [Boehm, 1981]. However, people are the major cost item for software development projects [Howard, 2001]. Because of the resources at possible risk (time, talent and money), managers of software development need an understanding of the aspects of the development process that practitioners consider important, and by extension, serve as motivating forces for the practitioners. Such understanding will assist in meeting practitioners' needs, which will, in turn, contribute to meeting the needs of the customer and users, as well as the developing organization.

As noted earlier, this research investigates those factors that influence

software practitioners' perceptions of project success and failure. The research question associated with this study is:

- *What software project development factors contribute to software practitioner's perception of project success?*

The results of this research project will assist software project managers in understanding how to better motivate their staff. When practitioners explicitly indicate what factors contribute to their perception of success for a given software project, they are identifying what aspects of their jobs they most value and take pleasure in. This information, in turn, can be used by management of software development teams to increase practitioner productivity, which then can help alleviate some of the risk that is associated with project personnel. How well practitioners are managed (this includes factors related to motivation) and how well the tasks they undertake are managed (this includes factors related requirements management) affect practitioners motivation. In the end, practitioner's motivation is critical to the achievement of the generally accepted management and organizational view of successful software development; namely, that the product be delivered on schedule, within budget and meets stated business objectives. [McConnell, 1996; www.standishgroup.com/visitor/chaos].

2. Methodology

Thirty one software practitioners responded to a survey between March and May 2001. The questions were developed through literature review and semi-structured interviews with practitioners. These responses were primarily via e-mail. Respondents represented a convenience

sample, which was appropriate given the exploratory nature of our work. In addition to demographic data, we asked 29 questions related to various aspects of project success from the perspective of practitioners. Each question began with the wording, "It is important to your perception of project success that...". Respondents answered through a five-point Likert scale, and they were instructed that there were equal distances between the five responses in order to create an interval scale. (After data collection, we assigned a value of 5 to "Strongly Agree", 4 to "Agree", 3 to "Neutral", 2 to "Disagree" and 1 to "Strongly Disagree".) We refer to these as our "success factors".

3. Findings

The demographics of our respondents were as follows: 77% were males, 52% held a bachelors degree, 29% either held a graduate degree or were in a graduate program, 16% held doctorate degrees and 3% had done some college-level work. Respondent years' of experience in software development ranged from less than one year to 35 years, with a mean of 12 years. Respondents reported age ranges, which are shown in Table 1, demonstrate that the majority of our respondents were less than thirty years of age.

Table 1: Respondents by age range

Age Range	Pct
20-29	35%
30-39	26%
40-49	23%
50-59	16%

Respondents' reported level of software development expertise is shown in Table 2.

Table 2: respondents by programming expertise

Level of Expertise	Pct
Expert	23%
Proficient	35%
Average	19%
Somewhat inexperienced	16%
Very inexperienced	7%

We calculated means and standard errors for the responses to the 29 factors in the questionnaire, and then ranked them firstly by means, i.e. their importance (Table

3), and then secondly by standard error, i.e., stability or consensus (Table 4). Tables 3 and 4 list all the questions asked in the questionnaire. Generally, our findings support previous research regarding practitioner motivation [McConnell, 1996; Herzberg, 1959]. Many of the higher rated factors involve personal satisfaction, growth and achievement. It is also interesting to note that those factors of relatively less importance to the respondents include increasing salary level, opportunity for career advancement and increasing professional status.

Table 3: Success factors sorted by descending means

Rank	Variable [It is important to developer's perception of success that...]	Valid N	Mean	Standard Deviation
1	Q2.03 you had a sense of achievement while working on a project.	31	4.48	0.51
2	Q2.28 you did a good job (i.e. delivered quality) while working on a project.	31	4.45	0.68
3	Q2.25 project's customer/users have realistic expectations.	30	4.40	0.93
4	Q2.23 project meets all customer/users requirements.	31	4.26	0.82
5	Q2.24 project's customer/users are involved.	31	4.26	0.68
6	Q2.05 you find working on a project to be satisfying.	31	4.03	0.95
7	Q2.04 project results in your professional growth.	31	4.00	1.00
8	Q2.21 project finishes on schedule (that time estimation was accurate).	31	3.94	0.85
9	Q2.14 working on a project increases your recognition as a competent IT professional.	31	3.87	1.12
10	Q2.09 you enjoy working with the other members of the development team.	31	3.87	1.02
11	Q2.02 you are provided with enough freedom to work creatively on a project.	31	3.87	0.88
12	Q2.01 work you do on a project is in line with your interests as an IT professional.	27	3.81	1.11
13	Q2.22 project finishes within budget.	31	3.81	0.91
14	Q2.27 project success that you learn something new while working on a project.	31	3.71	1.01
15	Q2.18 you experience good overall working conditions while working on a project.	31	3.68	0.98
16	Q2.26 project's system requirements are stable during the development process.	31	3.65	0.98
17	Q2.10 you enjoyed working with the manager(s) of the development team.	30	3.63	1.03
18	Q2.20 company policies & administration have a positive influence while you work on a project.	30	3.63	1.00
19	Q2.15 working on a project increases your current or future salary level.	31	3.61	1.12
20	Q2.08 project offers you an opportunity for career advancement.	31	3.58	1.12
21	Q2.16 working on a project increases your current or future level of professional responsibility.	31	3.58	1.06
22	Q2.12 working on a project increases your interpersonal relationships with your manager(s).	31	3.48	1.00
23	Q2.29 you are able to use new technical tools while working on a project.	31	3.45	1.03

24	Q2.19 working on a project increases your professional status.	31	3.42	1.09
25	Q2.13 working on a project increases your interpersonal relationships with your subordinate(s).	31	3.35	0.84
26	Q2.17 working on a project improves your level of job security (within the same organization).	31	3.32	1.11
27	Q2.11 working on a project increases your interpersonal relationships with your peers.	29	3.17	1.00
28	Q2.06 project does not interfere with your personal life.	31	3.10	1.14
29	Q2.07 project offers you the opportunity to supervise technical staff.	31	2.97	1.05

Table 4: Success factors sorted by ascending standard deviation

Rank	Variable [It is important to developer's perception of success that...]	Valid N	Mean	Standard Deviation
1	Q2.03 you had a sense of achievement while working on a project.	31	4.48	0.51
2	Q2.24 project's customer/users are involved.	31	4.26	0.68
3	Q2.28 you did a good job (i.e. delivered quality) while working on a project.	31	4.45	0.68
4	Q2.23 project meets all customer/users requirements.	31	4.26	0.82
5	Q2.13 working on a project increases your interpersonal relationships with your subordinate(s).	31	3.35	0.84
6	Q2.21 project finishes on schedule (that time estimation was accurate).	31	3.94	0.85
7	Q2.02 you are provided with enough freedom to work creatively on a project.	31	3.87	0.88
8	Q2.22 project finishes within budget.	31	3.81	0.91
9	Q2.25 project's customer/users have realistic expectations.	30	4.40	0.93
10	Q2.05 you find working on a project to be satisfying.	31	4.03	0.95
11	Q2.26 project's system requirements are stable during the development process.	31	3.65	0.98
12	Q2.18 you experience good overall working conditions while working on a project.	31	3.68	0.98
13	Q2.11 working on a project increases your interpersonal relationships with your peers.	29	3.17	1.00
14	Q2.12 working on a project increases your interpersonal relationships with your manager(s).	31	3.48	1.00
15	Q2.20 company policies & administration have a positive influence while you work on a project.	30	3.63	1.00
16	Q2.04 project results in your professional growth.	31	4.00	1.00
17	Q2.27 project success that you learn something new while working on a project.	31	3.71	1.01
18	Q2.09 you enjoy working with the other members of the development team.	31	3.87	1.02
19	Q2.29 you are able to use new technical tools while working on a project.	31	3.45	1.03
20	Q2.10 you enjoyed working with the manager(s) of the development team.	30	3.63	1.03
21	Q2.07 project offers you the opportunity to supervise technical staff.	31	2.97	1.05
22	Q2.16 working on a project increases your current or future level of professional responsibility.	31	3.58	1.06
23	Q2.19 working on a project increases your professional status.	31	3.42	1.09
24	Q2.17 working on a project improves your level of job security (within the same organization).	31	3.32	1.11
25	Q2.01 work you do on a project is in line with your interests as an IT professional.	27	3.81	1.11
26	Q2.08 project offers you an opportunity for career advancement.	31	3.58	1.12
27	Q2.15 working on a project increases your current or future salary level.	31	3.61	1.12
28	Q2.14 working on a project increases your recognition as a competent IT professional.	31	3.87	1.12
29	Q2.06 project does not interfere with your personal life.	31	3.10	1.14

We ran Chi-square tests in order to find evidence of any significant relationships between the 29 success factors and each of the demographic factors [gender, education, level of expertise, years of experience (collapsed into three classes, 10-19, 20-29, 30-39 years), and age range of the respondent]. However, due to our sample size, our contingency tables contained too many cells with expected values less than five, even after collapsing some of the responses into “agree” and “disagree”. We have, however, included the significant cross-tabulations below.

- *Gender & whether a project increases the respondent's professional status (0.028) (Table 5):*

Male responses were spread through the scale, while female responses clustered around “Neutral” and “Agree”. Females were more likely (71%) than males (38%) to agree or strongly agree that increasing their professional status was an important success factor. Perhaps this is related to females attempting to penetrate a traditional male-dominated profession of software development and/or their concern to get through the glass ceiling.

Table 5: Gender by importance of “project increases the respondent's professional status”

Response	GENDER		Difference
	Male	Female	
Strongly Disagree	4%	0%	4%
Disagree	21%	0%	21%
Neutral	38%	29%	9%
Agree	13%	71%	-59%
Strongly Agree	25%	0%	25%

- *Level of education & whether a project offers the respondent the opportunity to supervise technical staff (0.031) (Table 6):*

Respondents with a relatively lower level of education were more likely to

consider the opportunity to supervise technical staff as an important success factor. Possibly, they feel they need to make up for a lack of education when compared with their peers, or perhaps those who wish to go into management do not believe that they need an advanced degree.

Table 6: Education by importance of “opportunity to supervise technical staff”

Response	EDUCATION			
	Doctorate	Graduate	Bachelors	Some College
Strongly Disagree	40%	0%	0%	0%
Disagree	60%	11%	31%	0%
Neutral	0%	44%	38%	0%
Agree	0%	44%	19%	100%
Strongly Agree	0%	0%	13%	0%

- *Level of education & whether a project finishes within budget (0.040) (Table 7):*

In general, respondents with a relatively higher level of education placed more importance on a project finishing within budget.

Table 7: Education by importance of finishing with budget

Response	LEVEL OF EDUCATION			
	Doctorate	Graduate	Bachelors	Some College
Strongly Disagree	0%	0%	0%	0%
Disagree	0%	22%	6%	0%
Neutral	40%	22%	13%	100%
Agree	20%	11%	75%	0%
Strongly Agree	40%	44%	6%	0%

- *Years of experience (collapsed) & whether a project results in the respondent's professional growth (0.009) (Table 8):*

In general, respondents with more experience placed more importance on professional growth. Perhaps these people perceive themselves as having potential to ultimately experience such growth, particularly in the area of management.

Table 8: Education by importance of professional growth

Response	YEARS OF EXPERIENCE			
	0-9	10-19	20-29	30-39
Strongly Disagree	0%	14%	0%	0%
Disagree	0%	0%	20%	0%
Neutral	13%	0%	20%	100%
Agree	44%	29%	60%	0%
Strongly Agree	44%	57%	0%	0%

- *Years of experience (collapsed) and whether a project offers respondents the opportunity to supervise technical staff (0.010) (Table 9):*

In general, respondents with relatively fewer years of experience place more importance on supervising technical staff. Perhaps this is partially because those people who have more experience have had more opportunity to supervise staff members.

Table 9: Experience by importance of opportunity to supervise technical staff

Response	YEARS OF EXPERIENCE			
	0-9	10-19	20-29	30-39
Strongly Disagree	0%	0%	0%	67%
Disagree	38%	0%	40%	33%
Neutral	31%	57%	20%	0%
Agree	25%	29%	40%	0%
Strongly Agree	6%	14%	0%	0%

We asked our respondents two open-ended questions in order to expand on the 29 success questions. They are presented here in order to show additional factors to be incorporated into future revisions of our survey.

i. Think of projects that YOU (not management, customers or users) considered to be a success. Why do you consider it to be successful?

- Users needs (as stated BEFORE completion) are met.
- I can complete MY requirements in the manner I set out to early in the project.
- Stakeholders not on the project team are included in the decision making process.
- The requirements were accepted by the project team as being realistic and achievable, or agreed that they were too fuzzy and an accepted mechanism was put in place to address that issue.
- People liked using the product.
- Delivered useful software to the client.
- Product was used a long time by many people.
- Product required very few fixes after implementation.

ii. Think of projects that YOU (not management, customers or users) considered to be a failure. Why do you consider it to be a failure?

- Changes to requirements were not managed well and rarely documented.
- Changes made by different team member often conflicted with each other or caused severe downstream impacts, making the results of changes more costly and less predictable.

- The cost to bring additional people up to speed far exceeded their productivity.
- Stakeholders were not included in the decision making process.
- When the project is abandoned before completion
- Product did not work.
- Product had poor documentation and support.
- The team did not work closely together and was never able to integrate the various pieces of software well. Usually this was due to super egos on the team who thought they were better than they actually were.
- The team leader was too weak or too confrontational, and not able to communicate with customers and/or employees. If they come on too strong, they may frighten off key people. If they are too weak they unable to resolve conflicts in a timely manner and either schedule or software quality slips.
- The finished product was harder to use and had less functionality than the system that was replaced.
- Performance speed was unacceptable.

4. Discussion and Further Work

Our findings suggest that the most important factors shaping practitioners' perceptions of project success are made up of two factors; namely the importance of personal aspects of the work and customer/user involvement.

1. The factors associated with personal aspects of work:

- Q2.03 You had a sense of achievement while working on a project. (1 of 29)

- Q2.28 You did a good job (i.e. delivered quality) while working on a project. (2 of 29)
- Q2.05 You find working on a project to be satisfying. (6 of 29)
- Q2.04 The project results in your professional growth. (7 of 29)

Among these highly ranked personal aspect factors, only “the project results in your professional growth” and “you find working on a project to be satisfying” were significantly correlated ($R=0.46$ at 0.01)

2. All factors associated with customer/users resulted in relatively high mean scores, including:

- Q2.25 Project's customer/users have realistic expectations. (3 of 29)
- Q2.23 Project meets all customer/users requirements. (4 of 29)
- Q2.24 Project's customer/users are involved. (5 of 29)

These factors did not have any significant correlations with each other.

Interestingly, all of the factors associated with interpersonal relationships were ranked in the lower half of the 29 success variables when arranged by descending means (see Table 3). These included:

- Q2.12 working on a project increases your interpersonal relationships with your manager(s). (22 of 29)
- Q2.13 working on a project increases your interpersonal relationships with your subordinate (s). (25 of 29)
- Q2.11 working on a project increases your interpersonal

relationships with your peers. (27 of 29)

Among these lower ranked interpersonal relationship factors, significant correlations were found between all pairs of factors, i.e., interpersonal relations with peers and with manager, (0.68 at 0.00), interpersonal relationships with peers and subordinates (0.58 at 0.00) and interpersonal relationships with managers and subordinates (0.51 at 0.00).

We were surprised at the relatively low ranking of two of the factors. In particular, “project does not interfere with your personal life” ranked 28 of 29 and, “you are able to use new technical tools while working on a project” ranked 23 of 29 factors. For a different, and much larger set of respondents (in some of our earlier unpublished research which reviewed factors that lead to project failure), practitioners complained that the long hours they were working was interfering with their personal life for 25% of the projects discussed. We suspect that the rather small sample in this research is atypical of software practitioners in general.

We were not surprised with the relative low ranking of the salary level factor (19th) and the job security factor (26th) by our respondents. Prior research has suggested that making money is not a primary motivator of software practitioners. Regarding job security, we would speculate that practitioners are keenly aware of the current market demand for their services. In future studies, we will further investigate these factors.

While a commonly used definition of project success is on time, within budget and according to customer specifications [Bennatan, 2000], our research shows that a practitioner's view of project success is

somewhat different. It is made up of two factors; the first factor deals with the personal aspects of the work and includes “a sense of achievement, professional growth, satisfying, delivered quality”. Given the poor state of estimation and scheduling prevalent in the industry today [Verner, et al 1999, Verner and Evanco 2000], practitioners are unlikely to view most of the projects they work on as a success. Clearly, they value the creation of a quality product, but this implies that they need adequate time to do a good job. However, a realistic schedule is not always under the project manager's control, as are some aspects of customer/user involvement. Too frequently, project managers are not consulted about the schedule and are unable to negotiate the schedule instigated [Verner and Evanco 2000]. The second factor has a customer/user focus and can be described as “meets all customer/user requirements, customer/users are involved and have realistic expectations”.

Because software developers fill critical project functions as they interact with management and the system's customer/users. it is in the interest of all project stakeholders that the developers are inspired and motivated by their work.. A thorough understanding of practitioner motivational factors will help with the production of systems that are “on time, within budget and that meet customer expectations” even if the practitioner focus does not have a schedule or budget orientation

After revising our survey factors, we intend to collect additional data and conduct further statistical tests, including factor and cluster analysis, in order to arrive at a consensus definition of project success from the software practitioner perspective. Preliminary analysis has revealed that many of the success factors are related, and many may be measuring the same attribute. The

final definition can then be used within the context of a project management risk assessment and mitigation model, which we are currently researching.

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