"Do I Want to Have Losers In My Team?" – A Quantitative Study of Learning from IT Project Failure

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Abstract

This paper is motivated by a lack of research on the learning from failed IT projects of IT professionals. It remains unclear whether they learn from failed projects and conduct more successful projects in the future. We investigate this research gap with a large quantitative dataset from a German IT service provider. We find that IT professionals learn from failed projects and can leverage this knowledge in the future. Therefore, they should not be seen as "losers", but as a valuable human resource. Our research contributes to the limited research of learning from failure in IT literature. We show that results that have been obtained in other domains are transferable to the IT domain. Our research is limited by the circumstance, that our dataset comes from only one IT company. This is the first paper that analyzes learning from failure of IT professionals and their performance in future projects.

1. Introduction

IT projects have a quite high failure rate. According to studies by The Standish Group [1], the failure rate of IT projects is higher than 60%. Although the IT market has increased its maturity [2, 3], the failure rate has not significantly decreased over the past decade [1]. It is estimated that the cost of failed IT project is about $3 to $6 billion every year [4, 5].

Due to the high failure rate, IT employees experience project failures quite often. Failed projects not only have a financial impact, but also create negative emotions among the employees [6]. Despite these negative effects, failed IT projects might also have a positive effect. IT employees might learn from failed projects and leverage the gained knowledge in future projects. Learning from failed IT projects on the organizational level has already been examined for instance by Ewusi-Mensah and Przasnyski [7], but they focused on organizational learning and not on the learning of individual project members. There are studies in management literature that focused on learning from failure on the individual level [6, 8-11]. For instance, Shepherd, Patzelt [10] analyzed learning from failed research project.

However, it remains unclear whether these results are transferable to the IT domain. In order to learn from a failure, it is necessary that a certain attention is drawn to the failed project [12]. The failure rate of IT projects is much higher than in most other domains. Therefore, it is possible that IT employees do not pay a lot of attention to failed projects, because they are a common thing.

Additionally, it remains unclear whether IT employees can leverage the gained knowledge in future IT projects. It is possible that they have learned from a failed project, but as IT is in constant change and new technologies and trends arise quickly [13], they cannot leverage the gained knowledge in future projects.

In order to address this research gap, we aim to answer the following research question: *Do IT professionals learn from failed projects and perform better in future projects?*

We answer this question with a unique data set from an IT service provider, which is called ALPHA due to confidentiality reasons. They granted us access to data from their internal project controlling and human resource management systems. We gained extensive data on all 36,413 projects conducted by ALPHA between January 1995 and April 2014 and

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information on more than 8,000 IT employees that worked on these projects during that period.

This paper is structured as followed. First, we present background information on learning from failure and on the success of IT projects. This is followed by the development of the hypotheses that are subsequently examined. Then, we outline the dataset, the variables and the chosen research method. In the next section, we present the results of our data analysis. Finally, the theoretical and practical implications as well as limitations and possible future research are discussed. The paper ends with a short conclusion.

2. Theoretical Background

2.1 Learning from Failure

There are many different definitions of learning which focus on various aspects like change, detecting and correcting errors, improvement, knowledge or understanding [14, 15]. For this paper we adopt the definition that learning is the development of insights, knowledge, and associations between past actions and the effectiveness of those on future actions [15]. This definition focuses on the relationship between the past, present and future and defines learning as a process and not as a single event. Learning does not occur instantly, but over time [16]. During a learning process, experience or provided information is converted into knowledge [14].

It is possible to distinguish two different forms of learning, namely learning through teaching and learning by experience. Teaching is an organized from of learning and based on controlled settings [17, 18]. It can occur in many forms, such as training, mentoring or coaching and normally occurs separated from the normal working place [18, 19]. Learning by experience occurs during normal working tasks [19, 20]. Studies argue that employees only learn abstract knowledge from training, but lack the practical experience [17, 21].

Learning from failure is a special form of learning by experience. In general, learning is possible from failure as well as from success [22]. Success tells what to do and failure what not to do [23]. However, learning from success has a drawback. A continuous series of successes motivates a firm to become specialized in these successful operations, but this makes the firm inflexible [24, 25]. Therefore, learning from repeated successes makes failure in the future more likely [24]. A failure forces the involved individuals to critically examine the actions which lead to the failure and therefore enhance a broader understanding of the underlying relationships that have led to the failure [9, 26]. This gained knowledge leads to a change of behavior in similar situations in the future, which might help to prevent a failure [26, 27].

Many studies suggest that failure is a better source for learning than success [9, 27, 28]. Due to this, failure should be seen as an opportunity not as something to be embarrassed of [6, 7, 26]. If the errors are not hidden, but carefully analyzed by the involved individuals, it is possible to prevent future mistakes [7]. To make this possible, it is important that a positive learning environment with psychological safety should be established in order to enable learning from the failure [29].

Previous research on learning from failure can be categorized whether learning is considered at the organizational level or at the individual level.

On the organizational level, for instance, Baumard and Starbuck [24] analyzed 14 failures in a large European telecommunication company. They found that companies, in general, learn little from failures. Either learning does not take place or the wrong things are learned. Research on learning from failure of IT projects is limited. A rare example is Ewusi-Mensah and Przasnyski [7] that analyzed whether companies learn from failed information systems development projects. They found that most companies do not learn from their failed projects. Another example is Kasi, Keil [30] who analyze the usage of post mortem evaluations after project failures. They find that post mortem evaluations are only seldom conducted due to limited learning capabilities in most IT organizations.

On the individual level, to the best of our knowledge, no study analyzes whether IT professionals learn from failed projects and leverage their knowledge in the future. There is one paper, but it analyzes learning o IT professionals from failure only on a conceptual level [31]. There are several studies in management literature that focus on learning from failure [6, 8-10]. These studies analyze professionals from scientific research [9, 10] as well as entrepreneurs [6]. For instance, they focus on how individuals cope with failure and learn from them [10] or on the influence of the speed of project termination [9]. However, none of these studies analyzes whether employees can leverage the gained knowledge in future projects or possible failure situations in the future.

This brief overview on the theoretical background of learning from failure shows that there is little research on learning from failure within the IT domain, especially on learning from failure on the individual level. The IT domain is different from other domains. It is characterized by quickly changing developments [32]. Additionally, due to the high failure rate, IT employees quite often face project failure. Therefore, it remains unclear, if project failure still evokes negative emotions and therefore leads to learning or if it is just taken as normal and not considered further. Furthermore, it shows that current literature on learning from failure has not yet analyzed whether it is possible to leverage the gained knowledge in future projects.

Due to these points, it remains unclear whether the results that have been obtained in other domains are transferable to the IT domain and whether the gained knowledge can be leveraged in the future to improve the success of IT projects.

2.2 Success of IT projects

There are various dimensions of IT project success. For instance, in software development projects, it is possible to use the number of defects, the deviation from the expected effort or whether the schedule was met [33]. Thomas and Fernández [34] identify three categories of IT project success: project management (On-time, On-budget, Sponsor satisfaction, Steering group satisfaction, Project team satisfaction, Customer/user satisfaction, Stakeholder satisfaction), technical (System implementation, Met requirements, System quality, System use) and business (Business continuity, Met business objectives, Delivery of benefits).

If an external IT vendor is conducting the project, the success of the IT project is mostly determined by the financial performance of the IT project. Previous studies have used the absolute profits of each project [35-37], the price of the contract [38] and the profitability of the project [39, 40].

The success of IT projects is a complex construct and is influenced by many different factors [34, 41]. One important factor that influence the success of the IT project is the team and its members [33, 42, 43]. Each team member has different attributes, such as work history, knowledge, gender or beliefs [33, 42, 43]. The composition of the team influences the performance of the team [33, 42, 43].

2.3 Hypotheses

We argue that project failure triggers learning among IT employees. They develop knowledge about the causes of the failure and about how to react in the future in similar situations. IT employees are normally part of a larger project team. They can leverage the gained knowledge in two ways: first, directly by leveraging the gained knowledge during their work and, second, indirectly by sharing the gained knowledge and experience with other team members. In general, due to knowledge sharing within the team [44], the whole project profits from knowledge that has been gained by one person that has experienced a failure in the past. Therefore, we formulate the following first hypothesis:

H1: An IT professional that has experienced a failure contributes positively to the success of projects in the future.

If there are more team members who have experienced a failure in the past, we can expect that the performance of the project increase more compared to a team with only a small ratio of team members that experienced a failure. First, it is likely that the reason for failure has been different from team member to team member. Therefore, there should be a broader variety of knowledge within the team. Second, not a single team member that has to pass on the gained knowledge, but several ones can share their experiences. Therefore, there is no bottleneck. Due to this, we formulate the following second hypothesis:

H2: An increased ratio of IT professionals that experienced a failure in the past increases the success of projects.

3. Research Method

3.1 Data set

The quantitative data, which is the basis for our analysis, was collected from a German IT service provider. This company generates a large proportion of its revenue with consulting projects and to a minor extent by offering other ITO services such as standard software development and hosting. Due to reasons of confidentiality this company will be named ALPHA. ALPHA granted us full access to their project controlling system, where we were able to extract 36,413 projects that were conducted between January 1995 and April 2014 with detailed metadata, like project revenue, profit, contract type, information on the customer and so forth. Since this data is extracted directly from the system and also used for billing purposes, the quality of the dataset is particularly high and not subject to recall bias, which is sometimes mentioned regarding surveys, interviews and case studies [38]. Additionally, we were able to gather data of more than 8,000 employees from the internal human resource management system, which enabled us to identify and keep track of employees that were working on these projects. This linkage was especially necessary for observing the individual learning curve of the involved IT professionals.

We filtered the raw data to eliminate internal projects and discarded projects with incomplete data. To remove outliers, we performed a 5% trimming algorithm according to Eriksson [45] on the variable project performance, which is a common approach in empirical ITO vendor studies [39, 46]. The final dataset comprised 19,004 projects. To additionally account for the effect of outliers we log-transformed some of our variables [47].

3.2 Variables

The dependent variable of our analysis is the performance of the project. The clients' project performance can be measured according to the adherence of costs and time estimates, as well as on the quality of project output and realized benefits [33]. External service provides measure their performance with a different approach. Studies on vendor's project performance therefore focus on financial measures, like the price of the contract [38] or the absolute project profits [35-37]. The metric that we have adapted is *project profitability* [39, 40] due to its relative characteristics that allows the comparison of different sized projects. Due to confidentiality reasons, it has been multiplied with a constant factor. This is a common approach to anonymize profitability [39, 40].

The independent variables in our analysis captures whether there has been experience with failure in the past. We use two different variables for this purpose.

Member with failure experience. We use a binary variable for measuring whether a member of the project has experienced a major failure in the past. The extent of failure needs to be great in order for negative emotions to be generated that will trigger the learning process [8, 9]. We defined major failure based on two criteria. First, the project profitability has to be minus 20% or below. Even if the rate of return may be very low this might not be classified as a failure, if only a small amount of money is involved. Therefore, we chose a minimum loss of 10.000 € as the second criteria. This amount is roughly the revenue an employee generates in one month. Since the values of these conditions are arbitrarily chosen, we conducted robustness checks that confirm our results.

Ratio of Failure Experience. It measures the ratio of project members that have experienced a major failure in the past. The definition of major failure remains unchanged. Accordingly, if the ratio is zero this corresponds to a team where nobody has ever experienced a failure before.

We employ the following control variables in our analysis.

Client Experience within Team. Previous studies have found that client experience has a significant influence on project performance [35, 37, 40, 48]. In general, client experience can be approximated in several ways. It can be measured as a binary variable, where the variable indicates whether there has been prior interaction [35, 37], as the number of prior projects [40] or as the volume of prior projects [49]. We used the sum of hours worked for that customer within the team.

Project Size. According to Barki, Rivard [50] the size of a project has a considerable influence on the risk of the project. Previous studies have found that it significantly increases the project performance [35, 37, 39, 40]. In this analysis, project size is approximated by the revenue of the project.

Project Duration. Longer projects are harder to specify and to forecast [35, 38]. It is also more likely that there are changes during the project [38, 50]. Therefore, the performance of long running projects should be lower [41]. Project duration has also been included as a variable in other project performance studies [35, 37-40]. In this study, project duration is approximated by the number of days that the project ran.

Team Size. A large project team increases the risk of underperformance because of coordination problems [35] and therefore it might have a negative influence on the profitability of the project. However, it could also be the case that team size has a positive influence on profitability, if the team is too small and overworked [35]. Due to its influence, team size has also been used by other studies on project performance

Table 1. Descriptive Statistics

	Mean	SD	1)	2)	3)	4)	5)	6)	7)	8)
1) Project Profitability	0.31	0.58	1.00							
2) Member With Failure Experience	0.68	0.47	0.01	1.00						
3) Ratio of Failure Experience	0.52	0.42	-0.03	0.85	1.00					
4) Client Experience	15,361	25,132	-0.01	0.41	0.36	1.00				
5) Project Size	96,942	713,951	0.16	0.10	-0.06	0.14	1.00			
6) Project Duration	211	248	0.06	0.20	0.10	0.21	0.59	1.00		
7) Team Size	4.29	6.10	0.11	0.39	0.15	0.39	0.47	0.42	1.00	
8) Contract Type	0.41	0.49	-0.04	0.21	0.24	0.26	-0.15	-0.06	0.13	1.00

[35, 37, 39, 40]. In our analysis, team size is defined as the number of different employees that have worked on the project.

Contract type. There are two basic types of IT outsourcing contracts: fixed price (FP) and time & material (TM) [37, 51]. In FP contracts, the ITO vendor agrees to deliver a predefined result and gets compensated with a certain fee [35]. TM contracts are different, because the billing is based on the agreed hourly rate and the working hours that the ITO vendor invested [35]. The contract type has been used as a control variable by several studies [35-37, 39, 40]. It is coded as a binary variable, where 0 stands for a TM contract and 1 for a FP contract.

Year of project start. A dummy variable for the year of the project start has been included in the analysis. This variable captures year specific effects such as exchange rate fluctuations, inflation and business fluctuations [35, 39].

3.3 Data Analysis

Table 1 shows the mean and the standard deviation (SD) of numerical variables and the correlation matrix. In order to reduce skewness, we log-transformed client experience, project size, project duration and team size [47].

To detect multi-collinearity, we employed the variance inflation factor (VIF) [52, 53]. The values of the VIF lie between 1 and infinity and values between 5 and 10 can be used as a threshold to decide whether a problematic amount of multi-collinearity is present or not [52]. We obtained values clearly below 2 and therefore multi-collinearity should not be an issue.

The correlation coefficients between *Client Experience within Team* and the two independent variables as well as between *Member with failure experience* and *Team Size* are moderate, but due to low VIFs should not cause problems.

To test the hypotheses, we construct multiple linear regression models. The first model only contains the control variables. The second model will analyze the first of our two proxies for influence of failure experience, namely *Member with Failure Experience*. The third model analyze the second proxy, *Ratio of Failure Experience*. We have used this approach with two different variables because of robustness reasons.

As our data set contains several projects for the same customer, we have to correct for panel data [54, 55]. We conducted the Hausman tests for each model to choose between a fixed-effect models and a random-effect model [56]. The test shows that a fixed-effect model should be used in all three models, as the p-values are clearly below 0.05.

4. Results

The results of the multiple regression models are presented in table 2. First, there is a base model that only contains the control variables.

Table 2. Results Of The Regression Analysis

Dependent variable: Project profitability (anonymized)			
Variable	**Base Model**	**Model 1**	**Model 2**
Member with Failure Experience		0.040 *** (0.012)	
Ratio of Failure Experience			0.029 * (0.012)
log(Client Experience)	0.010 *** (0.002)	0.009 *** (0.002)	0.009 *** (0.002)
log(Project Size)	0.066 *** (0.004)	0.066 *** (0.004)	0.066 *** (0.004)
log(Project Duration)	-0.062 *** (0.005)	-0.062 *** (0.005)	-0.062 *** (0.005)
log(Team Size)	-0.151 *** (0.007)	-0.157 *** (0.007)	-0.151 *** (0.007)
Factor(Contract Type)	0.062 *** (0.010)	0.060 *** (0.010)	0.060 *** (0.010)
Factor(Year)	significant	significant	significant
Adj. R-squared	4.68%	4.74%	4.71%
F-value	46.82 ***	45.19 ***	44.87 ***
Hausman test: *Chisq* (*p-value*)	126.60 (< 2.2e-16)	138.07 (< 2.2e-16)	139.87 (< 2.2e-16)
Standard errors are reported in brackets Significance: *** = significant at the 0.1% level; **= significant at the 1% level; *= significant at the 5% level,			

Model 1 analyzes the first hypothesis *H1: IT professionals that experienced a failure contribute positively to the success of projects in the future.* We find that *Member with Failure Experience* has a positive significant influence on project profitability, which supports the first hypothesis H1.

Model 2 analyzes the second hypothesis *H2: An increased ratio of IT professionals that experienced a failure in the past increases the success of projects.* We find that *Ratio of Failure Experience* has a positive significant influence on project profitability, which supports the first hypothesis H2.

When comparing the coefficients of the control variables between the three models, we find that adding *Member with Failure Experience* and *Ratio of Failure Experience* does not significantly change them. This indicates robust models.

5. Discussion

5.1 Limitations

All research is subject to limitations. In the following, we discuss possible limitations of our results.

First, our dataset comes from only one IT company, which might limit the generalizability of our results. This a general problem when dealing with archival datasets [33, 38, 39]. Our results could be influenced by to the way ALPHA deals with project failures. However, discussions with representatives of ALPHA revealed that they have no special way of dealing with project failures in comparison with other IT companies.

Second, our definition of failure (a project with less than -20% profitability and a loss of more than 10.000 €) seems arbitrary. We performed robustness checks, where we varied these figures. The drawn conclusion did not differ from the presented ones. Another issue with the employed definition of failure is that it might not be generally possible to tie failure to such numbers. A project that is not complex might already be seen as a failure, if it does not have a positive profitability. However, due to the large number of projects that have been analyzed, such influences should be cancelled out.

Third, although we find significant relationships, the two variables *Member with Failure Experience* and *Ratio of Failure Experience* only slightly increase the adjusted R-squared in comparison to the base model. To address this issue we employed F tests to analyze whether model 1 and model 2 have a significant higher explanatory power in comparison to the base model. We found that both variables (*Member with Failure Experience* and *Ratio of Failure Experience*) significantly increase the explanatory power.

5.2 Theoretical and Practical Contribution

We contribute to theory in several ways. First, we reject the results of Ewusi-Mensah and Przasnyski [7] and Kasi, Keil [30], which are one of the rare studies of learning from failure in the IT domain. Ewusi-Mensah and Przasnyski [7] analyzed the learning from failed information systems development projects and found that organizations do not learn from them. Kasi, Keil [30] analyzed the usage of post mortem evaluations after project failures and found that post mortem evaluations are only seldom conducted due to limited learning capabilities in most IT organizations. However, we found that IT employees learn from failed project and tend to perform projects that are more successful in the future. A possible explanation for these opposing results could be the different levels of analysis. We analyzed learning on the individual level, but Ewusi-Mensah and Przasnyski [7] and Kasi, Keil [30] analyzed it on the organizational level. Another possible explanation could be that Ewusi-Mensah and Przasnyski [7] and Kasi, Keil [30] based their conclusions on the retrospective actions that companies conducted after a failed project. Such actions might be a good way to learn from a failed project, but learning from failure also occurs in an unstructured and informal way among the involved team members.

Second, we extend research on the learning of individuals after a failure to the IT domain. These studies have been conducted in settings like research projects or entrepreneurial activities [6, 8-10]. The IT domain is different than other domains. It is characterized by quickly changing developments [32]. Furthermore, due to the high failure rate, IT employees quite often face project failure [1]. Therefore, it remains unclear, if project failure evokes negative emotions among IT employees, which are necessary to trigger the learning process [8, 9]. Our results suggest findings that haven been obtained in other domains [6, 8-10] are transferable to the IT domain.

Third, we show that knowledge that has been gained through learning from failed IT projects can be leveraged in future projects and significantly improves the performance. This has not been done in other studies on learning from failure on the individual level [6, 8-11]. This is an important aspect, because having gained knowledge through learning from a failure is one thing, but IT managers are more interested in the question whether future projects perform better because of the gained knowledge.

Fourth, our results show that it already has a positive effect, if only one member of the team has experienced a failure. This member seems to spread its knowledge to other team members which then are able to perform better in certain situations [44]. Additionally, our results show that the higher the ratio of team members with failure experience, the higher the performance of the project. This might be due to the two following reasons. First, it is likely that the reason for failure has been different from team member to team member. Therefore, there should be a broader variety of knowledge within the team. Second, not a single team member that has to pass on the gained knowledge, but several ones can share their experiences, which prevents a bottleneck of knowledge sharing.

We contribute to practice in several ways. First, our results suggest that IT employees that have experienced a failure in the past should be seen as a valuable resource and not as “losers”. They should not be devalued or generally blamed for a failure.

Second, IT managers should create an atmosphere for learning for the involved IT professionals after a failed project. Carmeli and Gittell [29] show that a positive learning environment with psychological safety intensifies learning from failure

Third, our results suggest that it is advisable to staff projects with individuals that have experienced failure in the past in order to increase the project success.

5.3 Future Research

We analyze learning from failure on the individual level only indirectly through the performance of future projects. Future research could analyze learning from failure directly based on individual performance indicators.

Another possible direction for future research could be the consideration of the time since the failure occurred. According to Argote, Beckman [57] acquired knowledge gets outdated quickly in organization setting. Therefore, it is likely that the influence of failure experience decreases with time.

Our results show, that it has a positive effect on the project performance, if one team member has experienced a failure in the past. Furthermore, they show that the performance increases, if more team member have a failure experience. Future research could analyze the influence of different configurations of team members with failure experience and team members with no failure experience. We find that the ratio of team members that have experienced a failure in the past significantly increases the performance of a project. Our analysis assumes a linear relationship. Future research could relax this assumption and perform a non-linear analysis. It is possible that the relationship has an inverted U-shape or reaches a plateau after a certain ratio.

Another possible direction for future research could be to analyze whether different types of personalities cope differently with the failure and therefore differ regarding learning from failure [58].

Finally, future research could analyze if persons within the social network of an employee that experienced a failure also learn from this failure. Kim and Miner [59] have analyzed whether organizations learn from failures of other organizations. They found that learning occurs and that it is increased if accessibility to the failure and applicability of the failure to the own business are given.

6. Conclusion

This research was motivated by a lack of research on learning from failure of IT employees. We employed a unique dataset from a German IT consulting company and found that IT employees learn from failed IT projects and leverage this gained knowledge in future projects. We contribute to theory by extending previous research on learning of individuals in other domains to the IT domain. Furthermore, we contribute to practice by showing that IT employees that have experienced a failure in the past are a valuable resource and should not be blamed or devalued or be seen as “losers”. IT managers should even think about staffing IT projects with employees that have experience with failure.

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