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The customer effect in agile system development projects. A process tracing case study

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Abstract

The success of an agile system development project is dependent on many factors, including the customer organization's ability to collaborate with and support the development team. This support consists not only of a single project owner or an on-site customer, but involves several stakeholders in the customer company, and the attitude and focus of the whole customer organization towards the project will influence project success. In this case study a customer organization's involvement in an agile system development project and the consequences of the customer and the development teams' collective behavior are analyzed. A process tracing research method is applied, aiming to identify causal chains in the project's progress towards a partly unsuccessful final delivery combined with an accepting customer. The analysis shows that in this case, main causes for low delivery rate are an unprepared customer and a large initial project scope. On the other hand, the agile project organization and good communication ensure an involved customer that still has expectations for the project.

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Keywords: information system development; agile project management; customer involvement; process tracing; case study

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1. Introduction

The customer has a prominent role in agile system development projects, with customer participation ensured through many prescribed practices, techniques, and tools. The main perspective is that unclear and volatile requirements are managed by frequent or continuous involvement of the customer in the system development process. Martin et al. have shown that many information systems development (ISD) customer representatives enjoy working agile, and customers have developed a variety of practices and roles that enables them to do the job in a productive manner[1]. However, Hoda et al. have found that many agile development teams meet customers who are not able to participate in agile teamwork in the prescribed manner[2]. Ramesh et al. find that low stakeholder ability and concurrence is a main problem in agile requirements engineering[3].

There is a distinction between customer and user in ISD projects, but user participation is more studied than customer participation[4,5,6]. However, customer participation as it is understood in agile is often related to user participation or user involvement (see for instance the list of agile methods in Dybå et al.[7]). Thus, many of the findings on user participation transfer to customer participation in agile methods. It is verified in meta-studies that the user participation actually increases system success[8,9], and that much of is this is due to user involvement (the user's level of engagement in the project)[9]. Note that these meta-studies include reports with the agile customer as a kind of user.

Although we have knowledge about overarching variables relating user and customer participation to system success, there is still a gap in our deeper understanding of how agile methods and the customer's and/or user's participation influence ISD projects, as we need to identify the mechanisms that lie behind these variables, and how these mechanisms contribute to the final outcome. This problem is the main focus in the case study presented here, where we study a Norwegian company aiming to develop new computerized support for its field workers.

In the next section, we present a description of research on customers and users in system development in general and agile methods in particular. Then in section three an introduction to process tracing, a qualitative case research method, is given. A description of the case is provided, before we delve into the process of establishing and testing hypotheses using qualitative data. The discussion section summarize the results, reflects on the research approach, and presents ethical considerations taken.

2. Customers and Agile Software Development

Customer participation in agile development projects is not studied extensively if we search beyond Ramesh[3], Martin et al's1, and Hoda et al's work[2]. However, there is a significant number of studies focusing on the user's ability to influence ISD. A couple of recent meta-studies[8,9] verify that user/customer participation and/or involvement have positive impact on system success. One of the studies also include a collection of user or customer participation practices found in software engineering projects, documenting a large variation on how user participation is managed[8]. Cavaye also analyzed a collection of user participation studies[4]. She defined dimensions of user participation, and further identified contingencies that influence the contribution of user participation to system success. She organized contingency factors in three groups: organization variables, project-related factors, and project complexity. Her argument is that effects of user participation is not a direct bivariate, but highly dependent on these contingency factors, and that understanding their effect is essential.

Bano & Zowghi's meta-study also identifies main factors that influence the value of user participation[9]. This understanding is further deepened in a longitudinal case study where focus is on how user satisfaction, indicating system success, evolves as the contingencies of the project are changing[10]. The mentioned case study indicate causes of system success by identifying events and project features that contribute to user satisfaction.

It is the aim of this work to develop Bano et al.'s[10] ideas further by focusing on how the actual instantiations of theoretical concepts interact to give a final project outcome. What do these theoretical concepts actually mean in a real project? How do they actually influence the project flow, and contribute to create the outcome? In this work, contingencies would be the main study object, and how they cause situations and effects that contribute to system success would be the outcomes.

3. The Process Tracing Method

Process tracing is a research method aiming to understand the causal flow of events in a process, originating in

psychology[11] and political science[12,13]. The aim often is to be able to understand how theoretical concepts explain events, but also often to contribute to theory building by suggesting causalities. It is a single case study method emphasizing the analysis of qualitative data and how these data support of hypotheses regarding causal relationships. The goal is to conclude about the probable causal sequences of events, identifying mechanisms at work. Bennett argues that process tracing has a resemblance to Bayesian reasoning as it emphasizes the ability to draw conclusions in a systematic manner from limited amounts of evidence combined with domain and theoretical knowledge[14].

Process tracing as method involves analysis of chunks of qualitative evidence from the data named causal process observations (CPOs)[12,13]. The data could be simple quotes from an interview, but also several connected statements from a relevant person in an interview. It could also include observations of events in a process, or extracts from process documentation. Interesting CPOs have a relevance to a particular hypothesis explaining causality in a process, and either supports or weakens a hypothesis. The qualitative analysis of a hypothesis in relation to a CPO constitutes a test, which comes in four categories with varying levels of support/disconfirmation. The test categories are:

- Straw-in-the-wind tests: supports or weakens a hypothesis but does not exclude it
- Smoking-gun tests: confirms that the hypothesis is correct, does not exclude other causalities
- Hoop tests: rejects a hypothesis, does not influence other hypotheses
- Double-decisive tests: confirms a single hypothesis, disconfirms the other hypotheses

Identifying the right hypotheses is a challenge here, and is depending on theoretical and practical knowledge of the domain under investigation. For example, there could be traces of evidence that relates to a particular explanation from theory, and this would be a starting point for making hypotheses. Mechanisms explicitly stated or strongly suggested in the data are also candidates. It is considered good practice that one after having established a hypothesis one should identify what kinds of data one would expect in order to confirm or disconfirm a hypothesis[12,13].

Beach et al distinguish between three categories of process tracing, theory-testing, theory-building, and explaining-outcome[13]. Explaining-outcome process tracing is the one approach found in this paper, and it has a pragmatic perspective aiming to establish the cause (or conglomerate of causes) of a particular process outcome.

4. The Project Story

The customer organization of this study has existed for more than 100 years. The last 20 the company has changed from being mainly involved with services within one particular business domain to be engaged in two related business domains. The old domain (domain O) is rather static, and there are few changes in the domain, whereas the new domain (domain N) is still growing and new approaches and solutions to the business are still developing. The company has a central office in a main, Norwegian city C1, as well as regional offices all around the country. To avoid identification of the organization, respondents and other stakeholders, this description is kept at an abstract level, but maintaining essential features of the project itself.

The service provided is complex and needs planning before delivery. The company some years ago identified a need for better computer support for their field personnel. The field workers wanted faster access to information, a standardized way of behaving towards customers, and automated documentation of the services provided. Other aims were to present themselves to the market with a uniform behavior and being able to collect better statistics about the customers and the market. An internal process for specifying needs was conducted, and an external consultant (A1) was engaged in process modeling for activities to be supported by the final tool. The resulting document was an informal requirements analysis.

During spring 2015, tenders were invited for a 20 months long, 3.0 million Euro software development project. The customer wanted an agile contract, which was, at the time, a new thing for the company. The customer has a significant, internal IT department, but they do not have the capacity to run such ISD projects. A small/medium-sized software development company won the contract. The schedule suggested three production deliveries, applying a Scrum process with intermediate test releases throughout the project. The contractor has its main site in another Norwegian city C2, and a second site in a third city (C3). Both sites were involved in the project. Consequently, we got a distributed project with development teams at two sites, and the customer at a third geographical site.

The project started in September 2015, focusing on functionality for domain N. In the first sprints, focus was on going from the specified needs and process models to describe epics and user stories for the domain N in parallel with

initial software development. A1 had a significant role in this work together with functional designers at site C3.

During the first six months it became clear that the management for domain N was not satisfied with the solutions for service delivery planning, and the manager took over for the deputy that had participated in the project owner group. Simultaneously, A1 was released from the project, and consultant A2 was hired by the customer. A2 had experience with agile project practices, and took the product owner role. The project also started the development of epics and user stories for domain O during spring 2016. A2 initiated changes to the delivery practice into a continuous, Kanban-like delivery process. Production release should be delivered every month, as well as weakly releases for testing.

10 months into the project, they had spent most of the funding for the domain N, but solutions for service delivery planning (main functionality of the system) was not accepted. The intention was now to focus on domain O, but resources were also in the continuation spent on completing domain N. The project was extended with a few months.

During fall 2016, a client for the field workers in domain N was tested in production with positive responses on the users' behalf, even though domain N's main office was dissatisfied. Initial functionality was delivered for domain O, as well as documentation of epics and user stories for prioritized functions in that domain. Expectations on the customer's side were reduced, but they still trusted that there would be a significant amount of useful functionality at the project's end date. In November 2016, a report stating that with current development speed less than half of the first priority features of the system could be delivered within the project time. The customer in general did not seem to a serious extent to be critical to the project process and the contractor, and still had fairly high expectations.

5. Hypotheses and Outcomes

What makes this project particularly interesting was that the customer was informed that they would get less than 50% of the first priority features, and at the same time was not very critical to the contractor's work. Instead of a situation where the parties would play a blame game, the parties seemed to be in agreement to make the best out of the situation. So we have a conjunctive outcome o that we want to explain here, formulated as $o = o_1 \wedge o_2$ where o_1 = "< 50% delivery" and o_2 = "accepting customer".

5.1. The data

The data used in this analysis are mainly a collection of interviews with project participants both from the customer and the contractor. Three project members from the contractor have been interviewed, from both sites, and with different responsibilities. On the customer site, four leaders and user representatives in both domains were interviewed, two product owners/managers, the CIO, and two developers in the ICT department. The interviews were in three rounds, the first in March/April 2016, the second in August/September 2016, and the third in December 16/January 17. Access was also given to minutes from retrospectives, and project progress reports to the customer organization's management.

5.2. The variables

Establishing which hypotheses one wants to test in process tracing is one of the challenges of the method. In this work, candidate hypotheses originate from statements in the interviews. These are assessed in light of theoretical knowledge about variables that influence system success in ISD projects, constructing explanations based on variable values (contingencies). For each of five variables, events that explain how particular mechanisms creates an outcome were looked into. Top-level variables that is relevant to this analysis are *initial scope size*, *customer maturity*, *contractor maturity*, *communication levels*, and *appropriateness of project management approach*

Scope size: The most visible evidence that scope size has had an impact on income comes from the re-estimation report produced towards the end of 2016. This report itself is a CPO on outcome o_1, indicating that the hypothesis h_1="Initial project overscoping caused o_1" needs to be tested. An argument for overscoping is that the project consisted of two equally sized parts. At the time of the re-estimation report there had been progress for domain O, and almost half of the project period still was left. Then, if adequately scoped initially, at least 50% of the total scope, i.e., all of domain O, and in addition the accepted functionality for domain N, would be delivered. This is considered a smoking

gun evidence that confirms h_1. We have no explanations as to why the project was initially overscoped, but lack of understanding of technological and organizational complexity could be one, in combination with inadequate funding to the project.

Bjarnason et al. identify several sources of overscoping in projects in a case study15, the most prominent cause being the continuously changing requirements. Agile cross-functional teams, continuous prioritization, and gradual detailing of requirements were applied in that case, and was shown to be helpful strategies for managing overscoping. The reported case is similar to Bjarnason et al.'s, and a particularly important event is A2's insistence on a more agile project management approach. From this observation, we can suggest the hypothesis h2 = "The agile project management approach facilitates outcome o2 in the context of overscoping". Some customer respondents have statements that are straw-in-the-wind support for this hypothesis. For example this statement from a user representative: *"They continuously force us to be precise in our requirements. And we were not really aware of our needs beforehand, so that is positive."*

Customer maturity: The customer or user's ability to provide sufficient support to the development team in a system development project has been critical in many instances, and lack of participation and engagement in the project reduces system success[16]. In this case, there is lots of evidence pointing towards insufficient customer participation, which again may be attributed to immaturity or lack of experience in the organization when relating to system development projects. This leads to the proposal of hypothesis h_3 = "Low customer maturity caused o_1". A statement from a contractor interviewee is clearly indicating this: "*...one thing to talk about is process competence - process and maturity with regard to develop IT systems. I would say that they are rather immature with regard to developing IT systems. They don't seem to have good heuristics about how behave as customer in relation to a contractor, for instance on being able to deliver the domain knowledge, to ensure that one has resources available for long enough time, and that your willing to organize a set up for participation that facilitates the process to run together with us."*

To prove this relation it is important to search in data for CPOs and events that gives a causal chain from low customer maturity to o_1. CPO-s that could support this chain, would report on low management support, conflicting priorities, unengaged users, missing understanding of the project goals, etc.

There is evidence that actually supports h_3, but mainly for domain N. Domain O defined their goals clearly, for instance, by having described established business processes that they will support. They also have given very high priority to the project, by assigning qualified personnel to work 100% as customer representatives. The customer's ICT department also has a role in this project. They seem to have delivered the needed supporting technologies, and expressed their constraints to the project. Consequently, their participation has been adequate.

For domain N, there are several properties and events that contributed to a causal sequence that led to low delivery rate. Three main observations we find in the data is that the domain N department has lack of resources to participate well in the process, there are conflicting priorities, and the business processes are not yet settled for the domain.

Unsettled business processes lead to a situation where consultant A1 and the contractor's requirements team focused on the field workers' current practices. This emphasize on user needs obviously have support in the literature on information systems development. However, it was in conflict with the intention of the main office's wish to establish new business processes and to support those instead. Lack of internal resources lead to inability to define new business processes in time, and because of conflicting priorities, representatives for the new business domain did not participate in or was not prepared in planning meetings. Dissatisfaction with this was repeatedly expressed in minutes from retrospective meetings. The prioritized requirements thus were in conflict with the main office's wishes, and postponement of prioritization lead to little work to do for the system developers, making them unproductive. An event that shows this mechanism in action was a superior manager's prioritization of a business report, causing the domain N representative to be unprepared for planning meetings (if at all participating). Many interviewees support this story, including statements from the middle-level manager of domain N, for example: *"So we may also be criticized for not having invested enough in SAGA, that we did not have enough personnel to ensure quality."* This manager's statements have smoking gun strength in relation to h_3, due to the self-criticism implicit in this. The project thus has not delivered functionality that was in line with the wishes of the main office, contributing strongly to o_1.

Contractor maturity: The maturity of the contractor is known to be a main factor in system success. This is for instance the perspective taken in the Capability Maturity Model (CMM)[17], and in models that suggest approaches to lift an agile team's maturity[18]. There were some traces of dissatisfaction with the contractor in the later interviews. For example, the consultant A2 expressed that they are not working in an agile manner. They also continued work with user stories and epics of parts of the system that were supposed to be postponed. The contractor did probably not have the most mature agile team, but there is found no evidence of events which due to lack of contractor maturity caused o_1. On the other hand, the contractor seemed to have processes that to some extent match processes for developing own maturity[18], suggesting awareness of the organization's need to improve.

Communication level: Keil[19] and Gallivan & Keil[20] describe communication in terms of breadth (number of users with access to communication), depth (the richness of communication), and whether communication is both ways or not. They show that user/developer communication not always implies success, as its practice also influences a lot.

It was not found a significant amount of evidence to indicate that communication practice was not sufficient in this case. Instead, the project had several practices facilitating rich communication. Early in the project, it was agreed to have monthly demo meetings. Anybody from the main office could participate, as well as field workers through video channels. These demo meetings have been a success, although not without problems. The first months these meetings often became a forum for complaints and disagreement, particularly from the ICT department and domain N. After a few months stricter constraints about what to discuss at these meetings was enforced, and since then the value of these meetings has been higher. Other successful developer/user communication events were visits with field workers at work in both domains.

The contractor has continuously communicated at planning and retrospective meetings that the customer need to work better with requirements, and this has made the customer more aware of own accountability for system success. As a result, during fall 2016 both domain O and domain N appointed experts who were single contact points regarding further requirements, and communication with particularly the representative from domain O, has been successful. The domain O single contact point said: *"I have very good collaboration with them, and I must say I'm surprised about how fast the grasp my domain and understand how it works, so I'm very impressed. So I think this collaboration works fantastic."* A developer in C3 expressed: *"The other thing we did to make things work, is that [the single contact point] has been here weekly on fixed days, and we have been in C1 and worked together. We have a very close collaboration, because we have been a lot together. We have done social things together, so it has been very good."*

To conclude, the data verify h_4="High communication levels caused o_2 in the context of low customer maturity".

Appropriateness of project management approach: Initially the project had a hybrid fixed price/agile contract. The customer should participate in planning on a monthly basis, but only run real life testing each 6 months. At the same time as A2 joined early spring 2016, there was initiated a change to a more continuous delivery (two weeks iterations), potentially improving input from the customer, enabling responsiveness to changing and more precise expectations, and in the end making the customer more accountable towards the outcome.

Evidence regarding the influence of the project management approach on o_1 point both ways. Except for the consultant A2, few respondents were critical to the initial project management approach. And even A2 indicated that the change to continuous delivery not necessarily was a large improvement. For example, realistic field testing in this case would need to be planned long time ahead. As A2 said*: "Then it takes two months from the delivery of functionality until the test can be done. If you have continuous delivery, you don't have a month delay."* The conclusion is that h_5 = "The project management approach caused o_1" is not supported, but also not discarded. For a discussion of the project management approach in relation to o_2, relate to discussion on **scope size** above.

6. Discussion

The case presented in this study has two interesting outcomes: o_1 = "< 50% delivery" and o_2 = "Accepting customer". Often o_1 would lead to the negation of o_2, with consequential discussion of blame, negotiations of economic responsibility, etc. As we have documented in the analysis, the causes for o_2 in the light of o_1 is the communication practices and a change towards a more pure agile project management approach. Figure 1 summarizes causalities in the project, focusing on the project contingencies. Events that have been particularly significant to obtain o2 are:

1. Change of project management approach towards agile and continuous delivery (spring 2016)
2. Hiring consultant A2 to work as a product owner (spring 2016)
3. Repeated requests from the contractor about better participation from customer (fall 2015/spring 2016)
4. Customer assigning local domain experts 100% to the project (early fall 2016)

The case study here verify observations on the value of developer-customer communication in ISD[19], but also indicate a more precise cause for why communication can be important, namely making the customer aware of the competences expected from themselves to make the project successful. It is also an example that duplicates Bjarnason et al.'s finding that agile methods contribute to a shared accountability for overscoping[15].

On the practitioner side, the presented story contributes to the understanding that both customers and contractors need to be aware of their own responsibilities in order for a project to be successful, at the same time as they need to be open about problems encountered in the cooperation. An interesting observation is that if there are obvious and early problems with the requirements in a fixed price ISD project, quickly changing to an agile approach may have the potential to reduce conflict levels and support a delivery that still can be considered successful.

The process tracing methodology applied here is an attempt to use qualitative data to establish truths about single cases. Like quantitative methods, it is not infallible, but in light of existing theories and previous empirical findings, most researchers' interpretation of the qualitative data most likely would support an explanation model like the one presented in Figure 1. Some links are not as strong as other, parallel to significance levels in numerical studies. In this case, a visible, but not so strong relation is found for instance between the agile project management method and o_2.

In a case study on a medium sized ISD project, where you analyze system success, data is personal and sensitive for the respondents. Project failure and success may be attributed to persons who have no wish to be public persons. The researcher may need to anonymize not only persons, but also the project, and even the domain of the project. This is a challenge also observed by Milne and Maiden in analysis of power relations in requirements engineering[21]. Here, even the business domain is anonymized, perhaps reducing the validity and usefulness of the study. Privacy has been prioritized, and the analysis has been presented at this abstraction level to ensure that the anonymity of respondents.

7. Conclusion

In this case study we have seen how particular contingencies in a ISD project have contributed to the outcome of the project. The process tracing method as applied gives us an insight into how one could use established theoretical knowledge and established empirical findings together with own empirical data to understand how the events and mechanisms in an ISD project actually influence the outcome. The result is a causal model for variables and outcomes in the particular case. For project management practice, this study suggests an approach to explaining project outcomes in light of initial contingencies, project events, and their interactions. In particular, we have observed that participation in an ISD is demanding for a customer, and the customer's maturity level and other competences should be in focus to ensure project success. This case study confirms that weak customer competence can be alleviated by rich communication channels enabling mutual understanding of the project among the stakeholders.

The project in case study is still not finished, and more and richer data could be collected and analyzed to give a better understanding of the processes, strengthening or weakening hypotheses already considered, or even bringing up new causal relations in the case.

Also, qualitative case studies are based on the single researchers' interpretation of data as well as being problematic to generalize. This suggests the need for additional case studies with agile customers aiming to investigate the generalizability of causal relations found in this case as well as quantitative approaches aiming to verify general theoretical formulations of customer effects in agile ISD.

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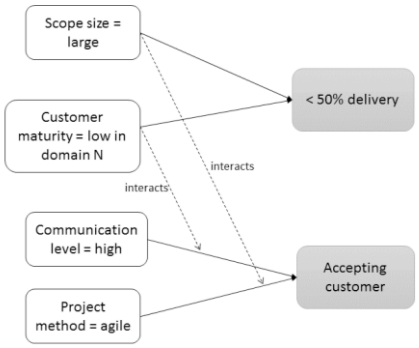

Figure 1 Causal relations between contingencies of case study (white boxes) and outcomes (grey boxes).

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