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ABSTRACT

Agile process models are aimed to improve the track record of software development projects – but in literature and in daily project work there is a broad debate of the usage of agile project management methods. Despite initial positive results in practice, the conditions, possibilities and effects of agile process models are discussed controversial. In this paper, the adoption of agile project management models has been investigated in terms of an exploratory case study for a business intelligence development project in the ICT industry. In this case study the adoption of SCRUM as agile project management method was analyzed and evaluated. The results and experience gained from the method adoption are discussed. General and SCRUM-specific implementation proposals for the practical application were derived. These recommendations serve as a support in the introduction of agile process models in other similar projects situations.

Keywords

Agile project management, SCRUM, exploratory case study, ICT Industry

INTRODUCTION

Companies in general and especially in the field of information and communication industry (ICT) are faced with the challenge of adequate project management. In their dynamic environment, companies must be able to handle changing goals, markets and requirements (Hoffmann, 2008; Gloger, 2010). Traditional process models come with regard to the frequently changing conditions to their limits. Agile project management models offer improvements in this situation, however, they are rarely applicable "out of the box" (Standish Group, 2010; Schatten, 2010). Therefore an understanding is needed which influence factors lead to a positive effect in the adoption of selected agile project management models. In the existing literature there are several case studies on the adoption of agile project management methods (e.g. Segal, 2005; Germain, 2005; Chow and Cao, 2008). But taking a closer look at the conducted case study, the focus of the research is on the adoption of XP (Extreme Programming), whereas the adoption of SCRUM can only be found in one single case study (Dyba and Dingsoyr, 2008). The aim of this paper is to enhance the body of knowledge in the adoption of SCRUM by conducting a case study of this agile project management method in the ICT industry. The presented experiences are based on an exploratory case study. They give practical recommendations for the introduction of the SCRUM in a specific project environment. Practitioners are guided when implementing an agile project management the first time and what they can adopt for their specific project setting.

AGILE PROJECT MANAGEMENT

Since 2001, when the agile manifesto was published (Beck et al., 2011), agile methods became more and more popular. Agile process models such as SCRUM are used in practice increasingly (Schwaber, 2007) and the literature speaks of a paradigm shift (Balzert, 2008; Coyle and Conboy, 2009).

Introduction of Agile Project Management

Agile project management such as SCRUM can be successful, if adequate preparation of the organization and selectively controlled introduction of the new method is done (Hu et al., 2009). Although there are many posts about agile project management and their individual methods in the scientific community, including practices (e.g. SCRUM, XP, pair programming, etc.) (Maurer and Melnik, 2006; Highsmith, 2010; Krzanik et al., 2010), only few papers deal with a successful and above all, effective introduction to a company. In addition, these contributions are only of limited use. For example, radical organizational changes such as the reorganizing of complete organizational structures are required (Gonçalves and Heda, 2010). This means that in company practice a considerable organizational and monetary effort needs to be invested in advance. An alternative proposal for the introduction of an agile methodology is to conduct an own agile project (Bunse and von Knethen, 2008), which should prove to be only in rare cases as practicable. Critics of agile practices

claim that the introduction of agile methods in a company is linked with a significant effort at the beginning of a project (Augustine et al., 2005).

Agile Project Management in ICT-Industry

Projects in general and especially in the ICT Industry face the challenge to deal adequately with a dynamic environment, changing goals, markets and requirements. In addition, finally success is only achieved if the project result is aligned with the requirements and expectations of stakeholders (Hu et al., 2009). Many IT projects are out of balance or fail completely (Standish Group, 2010). The poor record of success can be partly explained by the fact that project management methods reach its limits in highly dynamic environments. In addition, there are special characteristics of IT projects (Krzanik et al., 2010). Agile project management methods, which are intensively discussed both in science and practice, however, dispute this promise an improvement. For this reason, they will become increasingly important in the ICT industry.

Project Scopes for Agile Project Management

Most projects in ICT industry deal directly or indirectly with the development of software (Balzert, 2008). Software development and customization represents a share of 65% percent and is therefore a cornerstone in this area. In the group of software projects for companies business intelligence projects become increasingly important (Dasgupta and Vankayala, 2008). Many companies have already implemented ERP, SCM and CRM systems successfully. The next step is to use the acquired data to generate decision-relevant information. It is all about making information available efficiently and optimal graphically prepared for the management of a company. This should make it possible to transform "data cemeteries" into actionable information to increase competitive advantages for the company (Baars et al., 2009).

CASE STUDY RESEARCH DESIGN

Research Methodology

As a research method in this paper the case study is used. Case studies give researchers the possibility to study objects in their natural context (Yin, 2002). Gaining knowledge through case studies is an accepted method in areas where only few previous studies have been conducted (Lee, 1989). A single case study is suitable to identify new findings and research issues (Yin, 2002). To pay attention to known problems of case study research (Benbasat, et al. 1987), a clear case study design was developed. We used multiple data sources to strengthen the findings (Eisenhardt, 1989). Aim of the case study was to get new insights in the adoption of SCRUM in an ICT environment. To achieve this, the case study was designed as exploratory case study according to the purpose classification from Robson (Robson, 2002). To increase the precision of the conducted research, triangulation was used. Following (Stake, 1995) two different types of triangulation were used:

• Data triangulation: We used data from direct observations and quantitative data from generated and compiled project information.

• Methodological triangulation: Qualitative data was collected through observations and interviews, quantitative data was collected from extracted information from project information in applied information systems.

The design of the case study can be obtained by figure 1:
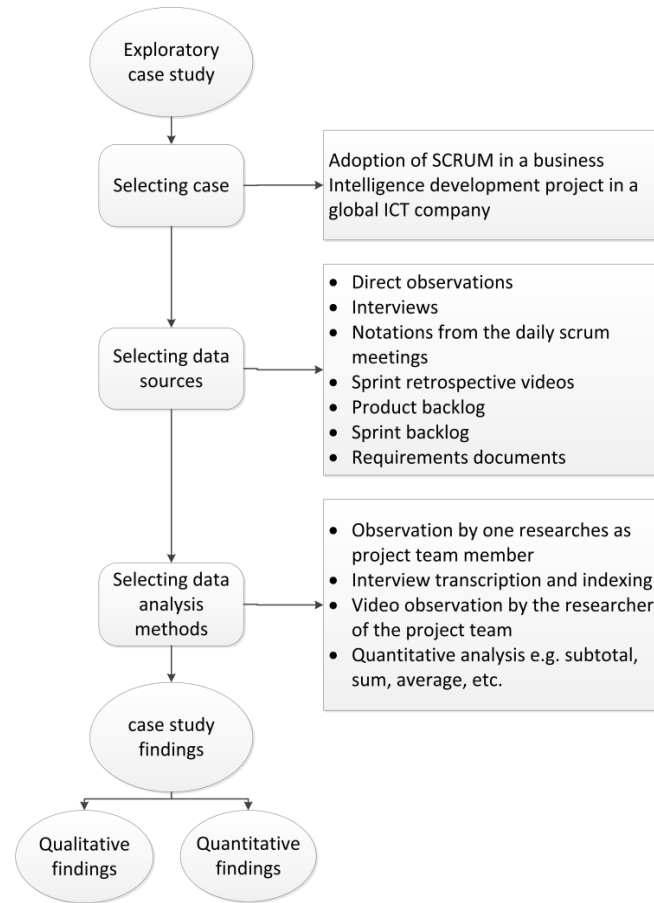
Figure 1. Case Study Design

Project Case Selection and Background

For the case study a company which is located in the field of information and communication industry (ICT) and which is a global provider of products and support services was selected. The company is a multi-national company operating in 70 countries and employees 180.000 people. Offerings of this company are IT products, IT platforms, IT services and Cloud Computing solutions. The case for the case study was a real-life project in its whole unit. Selecting this type of case allows a holistic view of the research objective. Furthermore the application of agile project management should be done for the first time.

The project case selected was the software development project "Design and Implementation of a Management Cockpit for Finance and Controlling with SAP Strategic Enterprise Management". The Management Cockpit is part of the Business Intelligence Group applications which assisted executive managers by using Data Warehouse Systems. The solution was designed to support executive functions and considers organizational intelligence as well as logics, special functions and mindset of its users. This type of personalized management cockpits illustrates KPIs (Key Performance Indicators) in a visual mode. From a conceptual point of view, the cockpit to be implemented is segmented into four walls; each of those walls consists of six logical views. Each logical view in turn consists of six frames. For a short insight how the project results will look like see figure 2.
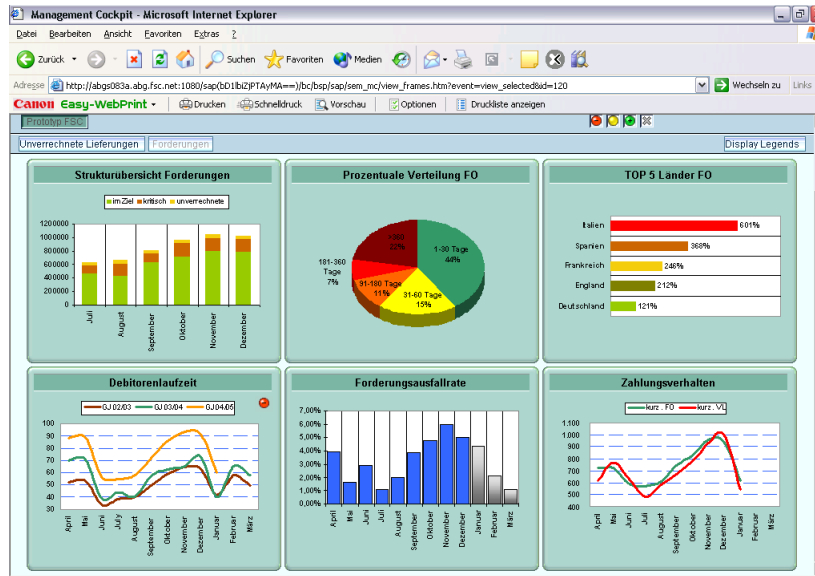
Figure 2. Management Cockpit as the Project Result

A summary of the project scope may be obtained from table 1.

Context Factor	Case Study
ERP System	SAP ECC 6.0
Data Warehouse System	SAP Business Intelligence 7.0
Data Base	Oracle Database
Management Cockpit Software	SAP Strategic Enterprise Management (SEM)
Key Performance Indicators	71
Cockpits Walls	4
Logical Views	24
Frames	144
Nature of Project	New Project
Constraints	Date constrained, scope constrained, semi-resource constraint
Person Days	720
Elapsed Days	157
Documentation	Microsoft Office 2003

Table 1. Technology and Project-specific Factors

In the involved areas of the project, an organization-specific project manual was used for years, which regulated the practice in project management. This process model was built like a waterfall, and there were no further feedback iterations planned between the different phases. The former approach provided unsatisfactory results particular with regards to the project outcome. Hence the decision was made to evaluate agile process models in the company and to test in practice. An overview of the project's context can be obtained from table 2.

Team Size	8 people
Team Distribution	SEM-Developers: 3
	KPI-Specialists: 2
	BI-Experts: 2
	Testers: 1

	Plus SCRUM Master
Highest Degree Obtained	None: 0 Bachelors: 3 Masters: 2 Diploma: 3
Experience Level of Team	6-10 years: 5 <5 years: 3
Agile Experience	Low
Team Location	Co-located
Domain Expertise	Medium
Language Expertise	Medium
Experience of Prof. Mgr.	Low
Specialist Available	BI-Experts KPI-Experts SEM-Experts
Number of Stakeholders	Approx. 15
Stakeholder Location	Different locations, multi-national, several time zones

Table 2. Sociological and Geographical Context of the Case Study

Depending on the project scope, the first issue was to ensure that SCRUM might serve as appropriate agile project management method. A detailed analysis of the project objectives has been made and due to the lack of a clear structured comparison of agile project management approaches, an evaluation of software project management experts' opinions was done. As a result, SCRUM was selected as an appropriate method for the project.

Subsequently, the roles "Product Owner", "SCRUM Master" and "team" were occupied. For the role of a Certified SCRUM Master, external staff was engaged because of the lack of knowledge within the internal project team. After choosing the model the relevant objects aligned to the chosen model were realized (according to Mountaingoat Software, see figure 3). In addition to this, at the beginning next to the product backlog a continuously adapted release plan was established and a sprint info page which was accessible to all team members was created.
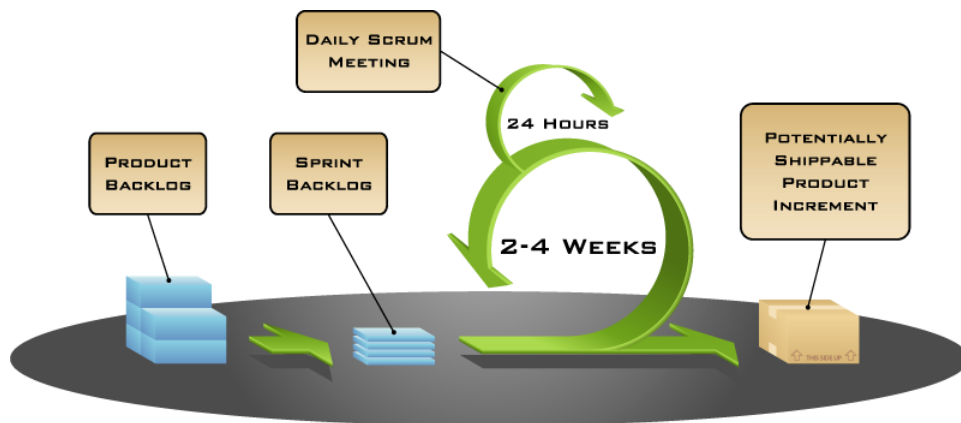
Figure 3. Sprint-based Project Life Cycle (Mountaingoat Software, 2010)

To use SCRUM for the first time in the project effectively, a preparation of the organization and affected employees was necessary. In the project framework, available options were limited. Neither it was possible to make significant changes in the large-scale organizational structure of the company nor was it possible to carry out SCRUM as stand-alone project to

introduce it in the organization like it is proposed as necessary method when implementing SCRUM (Schröder, 2004). Concerning the existing limitation the following preparation tasks were carried out (see table 3):

Introduction Tasks	Preparation (Days)	Training Duration (Days)	# Participants	Total (Days)
Show need for change using case study	2	0,50	10	10 * 0,5 + 2 = 7
Introduce agile project management using a practical example	3	0,25	10	10 * 0,5 + 3 = 5,5
Ensure management attention by showing opportunities	1	0,25	3	3 * 0,25 + 1= 1,75
Introduce chosen pilot project using project brief	3	0,25	10	10 * 0,25 + 3 = 5,5
Intensive training of team members	2	3,00	8	8 * 3 + 2 =26
Total MD	11 MD	4,25 MD		45,75 MD

Table 3. Introduction Tasks and Effort

Data Collection

We used different sources of information to gather data for this case study. Using different data sources limits the effect of over-interpreting the data just from a single source (Runeson and Höst, 2009). Following Lethbridge et.al. (Lethbridge et al., 2005) we used the following data collection techniques:

- First degree methods
  As researcher we are in direct contact with the subject and collect data in real time. For that we used interviews and observations with "think aloud protocols".
- Second degree methods
  With these indirect methods we directly collect raw data without actually interaction with the subjects during the data collection. For that the daily scrum meeting and the sprint retrospective was video recorded.
- Third degree methods
  By third degree methods, we get an independent analysis of work artifacts where already available and sometimes compiled data were used. For example we analyzed the product backlog, sprint backlog and the requirements documents.

In this case study data is mainly collected through interviews, i.e. first degree method. To evaluate the work of the daily scrum meeting, review and retrospective meeting it was recorded. All studies also included one or several feedback steps where the organizations gave feedback on the results. These data were complemented with analyzing the product backlog, sprint backlog and requirements documents.

Data Analysis

In this case study the main analysis was conducted with quantitative methods, but this was combined with a limited qualitative analysis. The observations have been done by one of the researcher acting as member of the project team. The interviews which have been conducted have been transcribed and were initially analyzed by one of the researchers. The transcribed documents were indexed to identify frequent terms and issues. The sprint retrospective videos were manually analyzed by the researcher being a project team member. The analysis of the interviews and videos would probably lead to possibilities to corroborate findings or develop new results from the qualitative analysis. Quantitative data was analyzed by quantitative methods like sum, subtotal and averaging (see e.g. table 4).

RESULTS OF THE CASE STUDY

In the following we describe the results of the case study structured by the data source type.

Results from the Interviews and "Think Aloud Protocols"

Basically, the analysis of the interviews revealed that 100% of the participants agreed that the project conduction was successful. 90% of respondents believed that in particular the agile project management approach contributed significantly to the project success. The previous waterfall model-based project approach would have led in the opinion of the respondents to major problems. This was justified in particular, that the requirements were just developed and have changed several times during the project.

At first the team had problems to get familiar with the new and unusual way of working as the agile method demands. Despite of the apparently simple project flow, much self-discipline, decision-making and self-assembly of each individual was needed. But this was improved during the project, and the team honored the responsibility entrusted to him by a high-quality performance. In practice, living of the designed SCRUM roles was problematic sometimes. For example, the fact that the product owner did not have unlimited availability for the project was challenging for the project. This was particularly evident when voting requirements with other areas in certain phases arise, but he was not able to manage it in his timeframe. Finally, it should be mentioned in relation to the roles that an experienced SCRUM Master was selected for the project. This was, in retrospective, from the perspective of respondents, a good decision because he always competently answered questions as well as mentored and supported the team. The integration of an experienced SCRUM master is highly recommended for the first adoption of SCRUM. An experienced SCRUM Master acts for the team and the environment involved in critical situations as an indispensable guide. 80% of respondents were happy with the roles. 20% would have wanted more flexibility in the allocation of roles.

All respondents agreed that an introduction to agile practices before the initial application of an agile method is essential. They were of the opinion that the chosen approach was good to apply and suitable for practice.

Results from the Daily Scrum Meeting and the Sprint Retrospective

After studying the video conference records the following issues were identified. At the beginning it was problematic that some team members arrived late to the meeting. Therefore, it was introduced, being late to sanction with a contribution of five Euros to the team fund. This arrangement worked surprisingly well and lowered the delay time to a minimum.

In addition, team members often claimed not to know about their personal workload of the current day. The SCRUM Master solved these situations by offering those affected to wait along with the entire team until they were in mind about their daily tasks. With this method, he indirectly increased the pressure of the group, which meant that all parties worried about their future tasks in advance. At the end of each sprint, the results were presented. This result presentation developed during the project to an important and valuable event. Since the presentation of incomplete and erroneous results was quite embarrassing for the team, it also served as an incentive to reach really 100 % of the sprint goal.

At the beginning of the project, the team tended to let fail the sprint retrospective. To react on this, the SCRUM master counteracted strictly, which in the end turned out to be absolutely purposeful. It was possible to generate new ideas on the knowledge gained within the team and bring them into the next phases. It has to be mentioned positively that after a short initial phase all team members brought themselves in actively and discussed in a constructive way. This was not always the case in non-agile previous projects.

Results from Product Backlog, Sprint Backlog and the Requirements Documents

In the agile process, there are always a small number of written records, as documentation is attached less importance (Balzert, 2008). It was therefore only possible to analyze the product backlog, sprint backlog, and the contained documents relating to the requirements.

In the project duration of 18 week, segmented into eight sprints, a total workload of 720 days was realized. With this workload it was possible to implement 57 user stories, 71 KPIs and 144 frames. Details on the allocation of the results to the different sprints may be obtained in table 4.

Factor	Sprint 1	Sprint 2	Sprint 3	Sprint 4	Sprint 5	Sprint 6	Sprint 7	Sprint 8	Total
Calendar time (weeks)	4	2	1	2	2	3	2	2	18
Total work effort (man-days)	160	80	40	80	80	120	80	80	720

# user stories implemented	5	7	4	9	8	12	5	7	57
# user stories postponed for next sprint	1	0	2	0	1	0	1	0	5
# implemented KPIs in a sprint	18	15	4	4	4	17	7	2	71
Avg. time for one KPI (man-days)	8,89	5,33	10,00	20,00	20,00	7,06	11,43	40,00	15,34
# reworked KPIs in a sprint	0	4	7	7	3	2	1	2	26
# implemented frames in a sprint	8	21	13	25	22	32	16	7	144
Avg. time for one frame (man-days)	20,00	3,81	3,08	3,20	3,64	3,75	5,00	11,43	6,74
# reworked frames in a sprint	0	7	10	4	5	4	3	5	38

Table 4. Exploratory Data from the Sprints

One result that can be seen in the table is that the average time for implementing a KPI differs significantly and therefore the individual KPIs were of different complexity. Second it is to mention that several KPIs, as well as frames, were reworked in following sprints, which was possible without greater issues in the agile process and shows the benefit of the agile planning method.

According to that an essential knowledge of the use of SCRUM was, that the sprint planning meeting is important and is not to underestimate. It contributed to the success of the sprints during the project essentially. So it was significant that whenever the meeting was not run optimally, the results of the sprint were not satisfactory.

In considering the requirements during the project period was apparent, that initially it was not possible to combine all the project requirements in a complete and reliable form. The requirements in the product backlog were completely revised several times. When viewing the documents on the requirements or user stories in the product backlog, it became clear that it is crucial that the essential characteristics of good requirements are fulfilled already in the formulation. The reason for this is that these are the basis for all further steps in SCRUM. The quality criteria for good requirements include, for example, uniqueness, necessity and traceability. In retrospect, this was not always the case. As to that, for example, often the requirements contained in the product backlog were not described clearly.

To counter this, in future a reliable method for the formulation of requests should be used. Therefore so called "Snow cards" can be used to document the typical attributes of a requirement, such as name, description or origin detained, and then to discuss them in the group.

DISCUSSION

The incertitude of the project was met well with SCRUM. Thus it was not initially possible to capture all the requirements completely and reliably. In addition to that there were mostly just vague or even contradictory ideas about the cockpit to be created. With similar conditions from the experience of recent projects, the previous waterfall model-based project approach would have led here to problems. The division of the project into several sprints, however, allowed to implement requirements gradually and to get early feedback from future users. In return, they could check the correct implementation of their demands promptly and bring additional requirements into the project on demand so far not taken into account. Thus, both sides benefited from the early and iterative presentation of the cockpit and the resulting possibility of productive use of already completed parts. In retrospect it would have helped also to divide the project into two smaller projects (such as Finance and Controlling separately), each with its own product owner.

Besides the advantages of the agile approach it also brought some challenges. Thus it was initially to overcome misconceptions in the organization of an agile project approach and resistance against it. This included arguments such as "An important project needs to be edited with the traditional and familiar methods" to undermine and counteract false hopes, like "Wow, finally, no rules, and status reports, more!" in bilateral talks.

In summary, SCRUM has been proven as an appropriate agile management method for the pilot study. The project was successfully completed and met the expectations of all stakeholders. However, it is not automatically the case that the application of agile project management guarantees project success. Rather, it depends on the appropriate use, where it is to check the accessible, specific conditions of each project. For example, the development of a multi-billion dollar satellite project with a maturity of ten years tends much to the traditional plan-driven approach. An agile, iterative approach would not likely lead to the goal. A project, whose outcome can be good, however divided into several packages, speaks for the application of an agile approach. As to that, for example, the introduced pilot project to develop a management cockpit suited well for an agile implementation. This was confirmed by the obtained project success.

SUMMARY UND OUTLOOK

Agile process models should help to increase the success of the project, where classical models are reaching their limits. Today, this is especially in the ICT industry of relevance. This paper provided the basis of experience from an exploratory case study in practical recommendations for the introduction of SCRUM as an agile process model in the ICT industry. In the context of this case study, a first-time introduction of agile methods for software development project was carried out.

The most important prerequisite for the successful application of agile project management is therefore a thorough preparation and a thorough assessment of the current situation. Only in this way, it is possible to act appropriately. This will require the appropriate skills, freedom of choice and willingness to take responsibility for that course. If it is possible to respect these principles, and to bring both opponents and supporters a little more together, it is possible to increase project success in a lot more projects than today with agile practices, to improve the quality of delivered products and to address the often difficult conditions especially in IT sector adequately.

Finally it can be concluded that under this pilot project, many valuable lessons for the future application of Scrum could be won in the company. Two things were this clear to all concerned: first, the application of an agile method requires the necessary discipline and consistency when it is to succeed. Second, the introduction of Scrum is not possible in a few weeks, but involves a continuous learning process that must be professionally supported.

More research is needed on getting insights in other industries, in combination with traditional process models and the introduction of an intercultural environment.

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