Agile Software Development of Embedded Systems

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Information System for Remote Control and Data Analysis: Agile Industrial Trial Experience Report

Abstract
The purpose of this document is to present experiences and results of industrial trial conducted in Nemetschek using agile methods, tools and practices. The trial is a project for creation of system for remote control of devices and data analysis.

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1 Introduction

The purpose of this document is to describe the progression and the key results of a Nemetschek Agile trial project called "Information System for Remote Control and Data Analysis" (ISRCDA), which was conducted under project called AGILE ITEA. The aim of the trial was to find the best agile practices for Nemetschek context and to support Nemetschek agile product development model. Another purpose was to compare the efficiency of the traditional and agile software developments in the company as well as to establish how the agile practices could be utilized also under the traditional development model used in the company and to evaluate the adherence to standards.
The document is organized as follows: section 2 presents background information, trial environment and deployment approach. Section 3 describes the methods piloted and the tools evaluated. Section 4 presents the data collection approach. Section 5 describes the trial plan and execution. Section 6 presents the results of the trial and the recommendations for future use of the approach. The last section concludes the document by summarizing the key findings.

2 Background Information

2.1 Description of the Company

The trial was conducted by Nemetschek OOD, a software vendor in various domains – document management, CAD applications, web based b2b applications, SCM and CRM solutions, etc. The company has some background in the usage of agile methodologies, mainly XP, from previous projects. The company has ISO 9001:2000 certification and is going towards CMMI certifications and is especially interested how agile software development would affect this. Another key interest of the company is how agile methodologies can be applied for the development of software for embedded devices since a lot of its customers in the last years are using such devices and require software for them. Last but not least, the company has high focus on the tools that can support agile development and data collection (since date collection is a key aspect needed by some CMMI practices and is usually not easy to implement into software development teams).

2.2 Trial Environment

The trial conducted is in the field of a specialized domain – systems control and data analysis. The system architecture includes various hardware components, interacting with each other using different protocols. A high level diagram of the system can be found in the following figure:

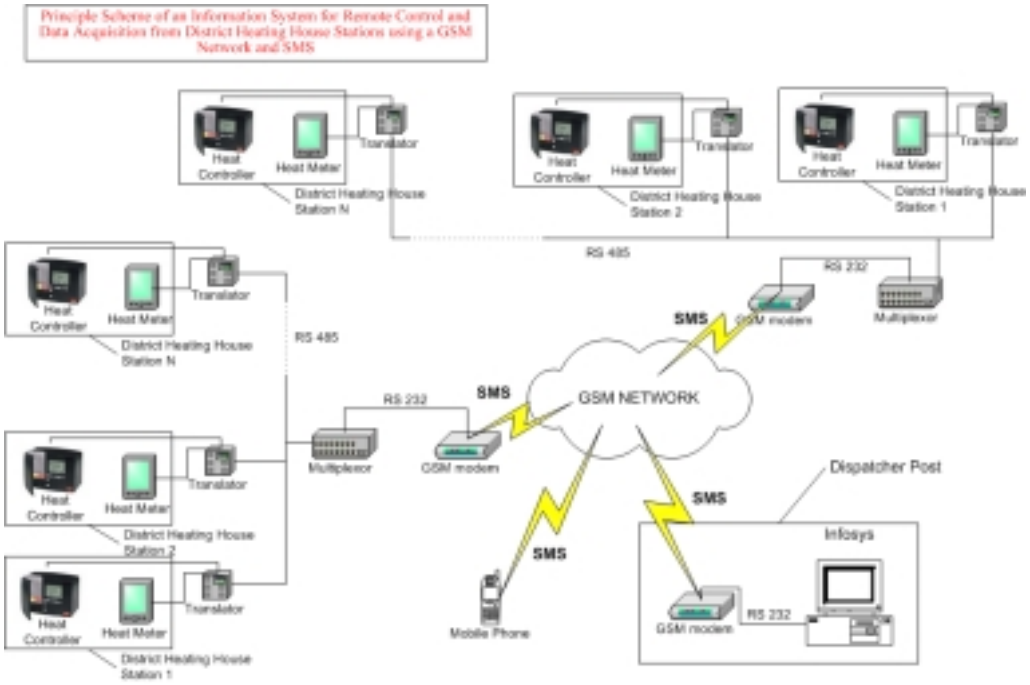

Figure 1

The trial is implemented in the context of this project as it has high embedded focus, the development team is small, the customer can be easily involved and fast release cycles can be used. The Boehm/Turner [2] diagram representing the initial agility assessment of the project is represented in Figure 2 below. The project team consists of three members who have good experience in the development of applications using the platform for this project (.NET) and have had initial training on the used agile methodology. The project scope is the trial of agile development of in several iterations using XP for planning the iterations and tracing requirement changes and effort.

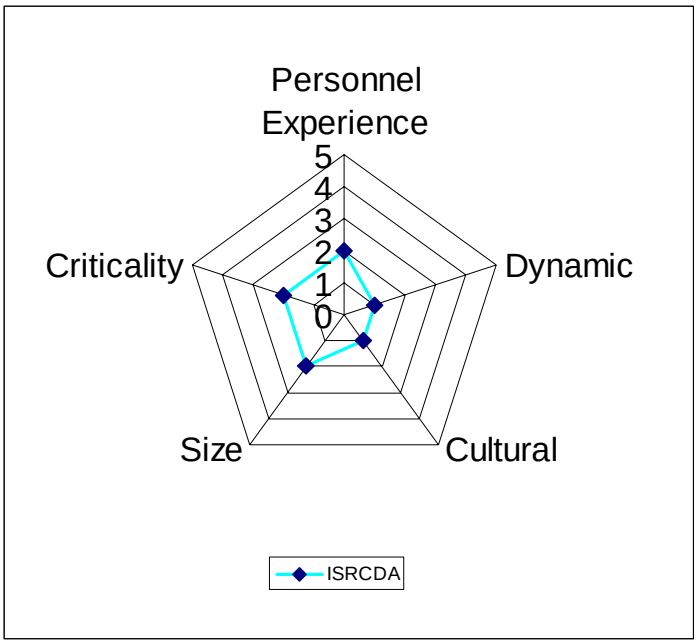

Figure 2

As can be seen from the diagram, the initial agility of the project is moderate (curve close to the center implies the usage of agile methodology).

3 Piloted method/ practice/ tool

The agile methodology used for the trial pilot is based on XP practices proposed by Kent Beck. XP was chosen since its development oriented practices have already proven their value for the company, but the planning and customer communication practices still need performance tuning. Therefore, the trial emphasizes on the planning tasks, schedule adherence and effort logging. As a supporting tool to evaluate the methodology implementation was chosen XPlanner for its free license and planning oriented capabilities. The general deployment approach consists of several 1 month iterations, each one producing additional functionality for the system. For each iteration, a list of user stories will be kept, the iteration plan will be created by developers estimating the stories and effort will be logged and tracked through the tool to verify the correct estimations and provide consistent feedback on the project progress to both customer and team.

4 Objectives and Metrics of the Trial

The objectives of the trial are to evaluate the applicability of the agile methodology in the project environment, to follow the planning practices and evaluate their effectiveness in precisely predicting and tracking project progress, to enable data collection using tools (XPlanner), to evaluate the approach and empower the team to self organize its work and draw conclusions from the results. The data will be collected by using XPlanner on daily basis (see Figure 3) to log the requirements and tasks, the effort spent and the changes to the requirements. Other objective metrics like LOCs will also be collected for comparison purposes.
Qualitative data will also be collected from the team on iteration workshops. It will show the success and failure factors that affect the development and the key benefits from the application of the selected methodology.

Figure 3

During the analysis phase, the collected data will be compared to data from other projects and data from literature and conclusions about the approach applicability in certain areas will be presented. Also any needed modifications and improvements to the method will be summarized.

5 Trial Implementation

As described in the Industrial trial plan, the project consisted of eight 1 month iterations, with total project length of 10 months. Each iteration was planned during iteration workshop where the client stories were prioritized and evaluated by the client and the development team. The iteration schedule was then created and both client and team committed to it. Once the iteration has started, changes of the requirements (stories) being implemented were not allowed. This was key factor to avoid delays and compromising of the schedule. During the development phase sub practices from XP like pair programming, continuous integration, collective code ownership, simple design, etc. were used, but they were not put in the focus of the trial analysis. The deployment approach in focus included using XPlanner and XP practices like User Stories, Customer Involvement, Iteration Planning, Empowering the team for the management of customer requirements, iteration tasks definition and estimation, planning before each iteration and reflection workshops to gather experiences and identify improvement needs. The data collected was analyzed after each iteration to identify the trends and to perform corrective actions on the approach.

6 Preliminary Results and Analysis of the Trial

6.1 Results of the Trial

The data collected showed that the effort spent for logging is significantly smaller than expected. The developers used only 10 minutes per day for effort logging, which makes the use of a tool like XPlanner very effective. Another finding is that the developers' estimations of iteration tasks were initially smaller than really needed. This is due to the fact that the estimations have not been left to the developers in the past and they do not have the culture needed to do that. They tended to underestimate the tasks, not having in mind all possible obstacles and overhead that go on with the development effort for embedded systems. It is exactly the nature of the project – development of software for embedded systems, which caused most problems with the correct effort estimation in the beginning. With the latter iterations when the developers gained more experience in estimating and in developing for these systems, the estimations precision became much better. All this lead to schedule slips in the first iterations but was successfully addressed during the latter iterations, so as is evident from Figure 4, the last iterations had all tasks achieved on time. The team velocity was expected to be bigger, but as evidence showed that this is not realistic to expect such figures, the plans were adjusted to match the velocity in the latter iterations.

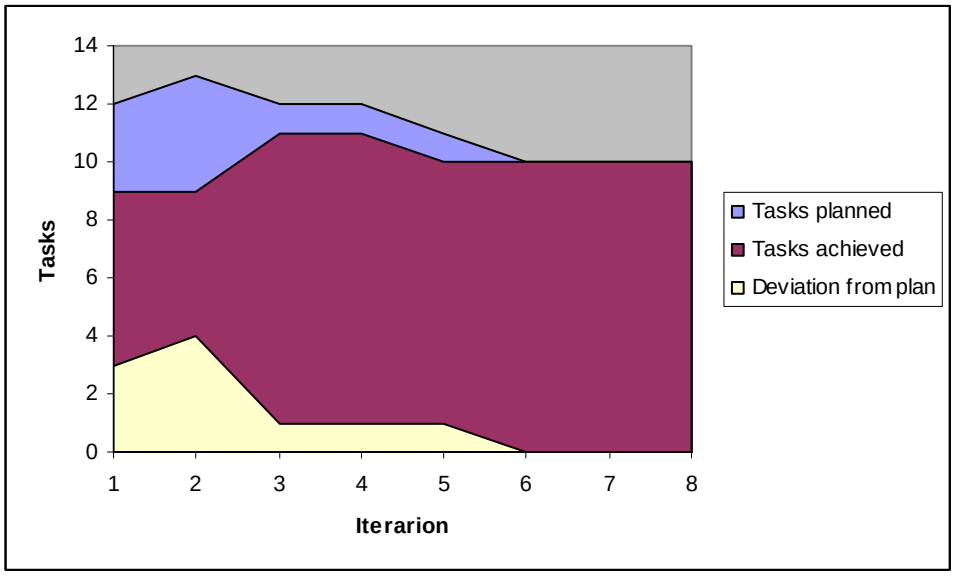

Figure 4

Requirements changes (Figure 5) were easily traced down to tasks due to the convenience of the tool usage. The changes to the requirements were not immediately addressed, but were left for the next iterations. In this way the iterations schedule was not compromised by requirements instability. The user stories were easily maintained and tasks distribution was easily handled. The overall effort for requirements management was very low, almost seamless. This was due to the good customer collaboration and the light practices for user story definition, estimation and tasks breaking up.

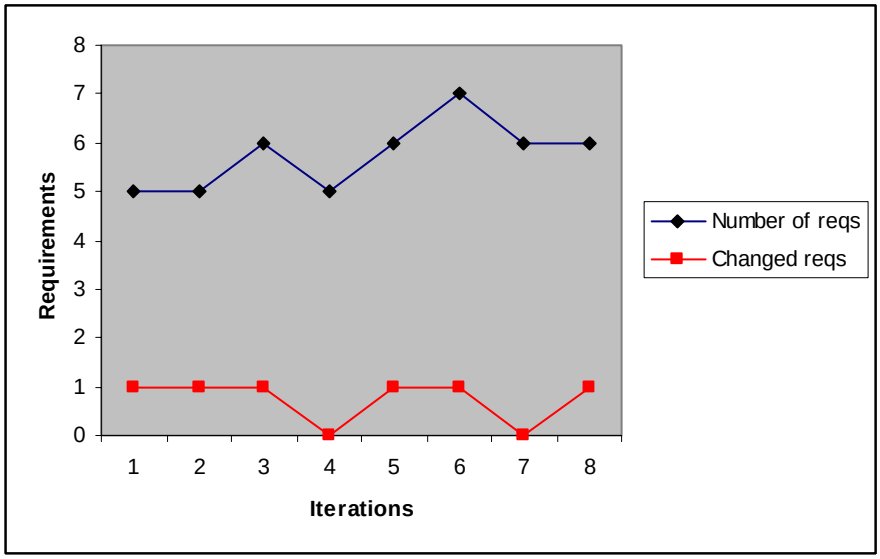

Figure 5

6.2 Empirical Evaluation

The empirical data collected from developers and customer shows important possible success and failure factors as shown in Table 1. The numbers in the table show the importance of the corresponding factor.

Success Factors	Weight
Tasks planning	2
Iterative releases	2
Developers culture	1
Customer involvement	3
Failure Factors in Scrum	
Developers technical excellence	2
Team size	1

Table 1

The identified success factors are in-line with the targets of the trial from Nemetschek point of view – increase the customer involvement and improve the planning capabilities on developers and team level. The high level of customer involvement is identified to be particularly important for the success of the agile methodology in practice. The specifics of the embedded system affected the planning precision and have to be taken into account. The developer's knowledge of the system and how software is developed for it greatly affects the tasks estimations.

6.3 Method/Tool/Practice Suitability to Pilot Environment

The results show that the method chosen is suitable for addressing the needs for planning improvement in term of effort and precision. The progress can be easily tracked through the iteration cycle and the overall effort can be easily addressed. The team sees the benefits of the short release planning and focused effort. It also enables the team to estimate their work as they see fit, which raises the overall confidence in the plan. The pilot environment, namely embedded system, did affect the precision of the

work planning. However, the agility of the chosen method lowered the risk of overall project failure due to these precision problems since they only affected the first iterations and were then addressed to allow the project to come to a successful ending.

The tool used (XPlanner) is easy and understandable, provides good planning facilities and understandable level of information on the current progress. The tool is also easily customizable, so some modifications needed were already addressed and work is in progress for implementing them. After customizing the tool, it might become standard tool for project management in the company on projects using agile methodologies.

6.4 Future work

As the method proved useful for the trial environment, the method will be used in more projects in the company. The results achieved will be added to the AGILE project results and disseminated. The method might be adopted as standard way of developing software in the company as soon as it proves to not compromise Nemetschek's CMMI certification activities.

References

1. Kent Beck with Cynthia Andres, *Extreme Programming Explained – Embrace Change*, 2004, ISBN 0-321-27865-8

2. Boehm, B. and R. Turner (2003). Balancing Agility and Discipline. Balancing Agility and Discipline -A Guide for the Perplexed, Addison Wesley.