Extending the Rational Unified Process with a User Experience Discipline: a Case Study

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Abstract. The Rational Unified process is widely used as a process framework for software development. The introduction and use of the RUP is not straightforward. Experience and research have shown that some sort of tailoring of RUP to the software development organization and the software development projects is necessary to be able to use the framework in a productive way in the projects. In this paper we describe software development in an organization with high focus on the user experience aspects and user interface design in their projects. This organization did tailor RUP to its types of projects by adding a user experience discipline. An evaluation of two development projects using this tailored RUP was done by the means of Post Mortem analyses conducted by external researchers. The main conclusion is that RUP needs to be tailored to be able to support the design of user experience oriented issues, and that the RUP structure is suited for doing so.

Introduction

The Rational Unified Process, RUP, is a comprehensive process framework for software development projects. RUP defines a software development project as a set of disciplines, e.g. requirements handling, implementation etc., running from start to end through a set of project phases. A project is performed by a group of actors, each having one or more well defined roles. Each role participates in one or more activities producing one or more artefacts. A discipline can run in iterations, that is, repetitions within a phase. Activities, roles and artefacts are the basic process elements of RUP.

Given the complexity and richness of RUP it needs to be tailored to the context of use as stated by Jacobson, Booch and Rumbaugh [1] p. 416: "It has to be tailored to a number of variables: the size of the system in work, the domain in which that system is to function, the complexity of the system and the experience, skill or process level of the project organization and its people." In this paper we report some experiences from a software company that has adopted a tailored version of RUP that particularly support development of graphically rich and user friendly solutions. RUP – out of the box – is by the most designed to support development of solutions with rich functionality. However, developing appealing solutions with an advanced look and feel cover additional challenges than purely technical solutions. How should requirements be captured and documented? How should the design be expressed and communicated? How to test? The software company being studied in this case did
specialize on this type of solutions and our study covers two projects taking the new discipline named User Experience Discipline into use for the first time. The study is based on PostMortem analyses [2] of the projects that covers both positive and negative experiences. Our findings indicate that the new specialized discipline did help the company to produce good solutions but that it is a challenge to coordinate and balance the technical and design-oriented parts of a development project.

The tailored RUP – tRUP

The Rational Unified Process is funded on three core principles:

1. Use-case driven; requirements are documented in the form of Use-cases (as defined by UML [3]). A Use-case diagram is a graphical representation explaining users performing actions. A user may also be an integrated system. Use-cases are suited for documenting functional requirements.

2. It is architecture-centric. As Use-cases define the function of the system, the architecture defines the form. Functionality and form (the system architecture) must be balanced and mutual supporting.

3. It is iterative and incremental. Being iterative means that the disciplines (design, implementation etc.) are performed as a series of iterations, each involving all or most disciplines. Incremental means that the solution is built in piece-by-piece where each piece adds to the previous.

Tailoring RUP may involve the inclusion and exclusion of low-level process elements such as roles, activities and artefacts but will always preserve the three core principles. In our case the tailored RUP (named tRUP) had replaced the entire Requirements-discipline with a new discipline named User Experience Discipline which includes a new set of roles, activities and artefacts designated for design and development of user experience features of a solution. The international branch of the company, located in US, did make the tRUP. The Norwegian branch then tried to adopt it without making any tailoring itself. The new discipline is shown in Figure 1, and summarized in Table 1.

As RUP is tightly connected to the Unified Modelling Language, UML one implication is that RUP is weak at handling the non-functional aspects of the information system to be developed. The new discipline addresses this weakness by offering described artefacts suited for describing user experience issues.
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Fig. 1. The User Experience Discipline
Content of the new discipline

The table shows the main content of the new user experience discipline:

<table>
<thead>
<tr>
<th>Activities</th>
<th>Artefacts</th>
<th>Roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Understand context of use</td>
<td>- User Research Report</td>
<td>- Requirements Analysts</td>
</tr>
<tr>
<td>- Establish System Scope</td>
<td>- Actor Catalogue</td>
<td>- Usability Evaluator</td>
</tr>
<tr>
<td>- Specify System Interactions &amp; Presentations</td>
<td>- Use Case Model</td>
<td>- Subject Matter Expert</td>
</tr>
<tr>
<td>- Plan &amp; Manage Content</td>
<td>- Software Architecture Document</td>
<td>- Business Strategist</td>
</tr>
<tr>
<td>- Develop Creative Approach</td>
<td>- Creative Concept</td>
<td>- Creative Concept</td>
</tr>
<tr>
<td>- Define requirements</td>
<td>- Content Inventory</td>
<td>Director</td>
</tr>
<tr>
<td>- Develop Information Architecture</td>
<td>- Content Development Guide</td>
<td>- Content Analyst</td>
</tr>
<tr>
<td>- Prototype and Evaluate User Interface</td>
<td>- Visual Development Guide</td>
<td>- Brand Strategist</td>
</tr>
<tr>
<td>- Site Map</td>
<td>- Wire frames</td>
<td></td>
</tr>
<tr>
<td>- Usability Test Report</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. The content of User Experience Discipline in rRUP

The activities explained

**Understand context of use** focuses on the characteristics of the users, the tasks to be performed by the users and the organizational and physical environment of the system. The context is formed by these elements.

**Establish System Scope** uses the Use Case model and refines it. The activity is to be done in close cooperation with the users and other stakeholders of the system. Interaction and integration with other systems are also documented. The baseline for the system scope is usually created in this activity.

**Specify System Interactions & Presentations** focuses on the interactions which the system will have with the users as well with other systems. The activity will also deal with the presentation aspects of the system to be developed.

A main task in this activity is to develop the information architecture. Both the groupings of content, data and functionality will be described in this architecture.
Plan and manage content focuses on the content of the web site. This includes the evaluation of strategies for the business and the brand. The visual aspects of the content are closely related to the organization of the content, and are an issue in this activity.

Develop Creative Approach serves as the kick-off when it comes to work with the creative development of the system. The conceptual and aesthetic aspects of the system are created during this activity. The development of the creative hypotheses is an important task in this activity.

Develop Information Architecture focuses on the structuring of information content with the intended use of the application in mind.

Prototype and Evaluate User Interface supports development of the user interface prototype, based on the requirements, and evaluates this prototype. This is a very iterative process, and must be accomplished in close relationship with the end users of the system.

RUP in this company
At the time of this research, RUP was documented by the means of electronic documents. The documents were available through a rather simple web interface. There was no electronic process guide in place.

The introduction of RUP in this company was mainly motivated by this new discipline since the company had its main focus on web development, with the emphasis on the user and the user’s experience of the web sites. The original disciplines in RUP were offered to the development projects, mainly by the project manager, but the use of these disciplines was not mandatory. The project managers and the software developers were not trained in RUP.

Method
During the research on the tailoring and use of RUP in organizations, the authors have been identifying and evaluated approximately 100 research papers presented either in journals or in conference proceedings. The papers evaluated were either indexed by Compendex¹, ISI Web of Knowledge² or ACM³. Many of the papers are proposing a tailoring of RUP and how to implement and use the tailored RUP. However, most of them lack studies based on empirical data from the actual tailoring and use. The Norwegian tradition in software process improvement research is to collect and analyse empirical data taken from the companies developing software. This is also the case in this study. The researchers have performed the research in conformity with given guidelines for empirical research [4, 5].

¹ www.engineeringvillage2.org
² www.isiknowledge.com
³ www.acm.org
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This research presented in this paper is planned and accomplished as a case study. Case study research is described by Yin [6].

**Study context**

The company in this case study was a Norwegian branch of an international company developing web based information systems with a special emphasis on interactive and user-friendly solutions. The projects were organized as typical software development projects managed by a project manager.

By the time of this study, the Norwegian branch had approximately 70 employees. Most of the projects were small, both in calendar time and in man hours, lasting for some weeks. Projects with duration over 4-6 months were considered as “large projects”. The customers were both commercial companies and public organizations. The company did develop both systems mainly serving information, as well as integrated systems with e-commerce functionality built in using integrated third-party solutions.

Traditionally in the company, the software developers and the user interface and user experience developers were working in parallel, not really cooperating during the work. The project managers were mainly recruited from the software development part of the company. In some cases this resulted in a low mutual understanding between the two groups; the technical developers and the user experience developers. To improve this situation and establish a unified process tRUP was adopted.

This study draws upon observations and analysis of two projects following the new RUP-based process; Project F developed a White/Yellow-pages solution for a national phone-indexing service. The delivered solution was based on a third-party solution for indexing and searching and a rich and user-friendly front-end. Project J did a redesign of an existing web-site keeping most of the technical functionality.

**Data collection**

Post Mortem analysis has been used as the main tool for collecting data in this case study [7, 8]. The main use of PostMortem in the two case-projects was to document the positive and negative experiences with the newly introduced tRUP-process in general and with the added User Experience Discipline particularly. A PostMortem analysis is a group oriented technique, where brainstorming and the use of sticky notes are important. Each participant is asked to write their positive and negative experiences. The notes are then grouped and summarized [9] as a collective activity resulting in a set of experience-groups with defined names. The results are documented in the form of a PMA-report that shows experiences at a group level. During the PMA-sessions, the researchers took personal notes during the work sessions. These notes are also treated as data since they give valuable information about the Post Mortem analyses.
Data analysis

The data from the Post Mortem analyses has been structured and compared in a process similar to the principles of Constant Comparison [5]. The analysis is applied both at the written PMA reports as well as the notes taken by the researchers. The PMA reports in this case study follow a template which ensure that both positive and negative experiences from the project are documented [7]. The researchers used mind maps to take notes during the PMA work shops4. Findings from each case are compared and statements and experiences that resemble are grouped.

Results

When analyzing the data from the two Post Mortem analyses we find three main results regarding the design-team internal coordination of work, coordination with the technical side of the project and documentation of design-oriented requirements.

Design-team internal coordination

Project members report that the use of the new User Experience Discipline improves the coordination of design-related roles such as the usability specialist, the usability evaluator and the producer which act as a mentor across several projects. The User Experience discipline defines these, and other roles, and their designated activities and results.

As this type of work had been a part of the business for a long time, there was established a set of best practices, including roles. Through the use of the User Experience discipline the project members saw that it resembled with these established best practices, however they became more formalized and not at least visible to other parts of the development organization. Those working with user-experience type of tasks appreciated this visibility as it made their work more recognized amongst the others that focused more on the technical sides of the projects.

Cross team organization

When it comes to the actual outcome of this new discipline the results from the Post Mortem analyses clearly indicate that the discipline worked as intended; the defined artefacts was produced and contributed to the progress in the project. However, as it seems to have worked as a process guide for the user-experience oriented project members it seems quite clear that the design work was separated from the rest of the project, including the project manager. This division was intentional; however the

4 www.mindjet.com
drawbacks became pretty obvious when this was put into practice. There was a low level of coordination of the technical (traditionally functional) requirements and the user experience requirements. Accordingly this also affected the testing negatively. This lack of coordination is the most prominent learning from the two projects.

**Expressing design-oriented requirements**

One of the core features of RUP is the strong focus on use cases as a mean of documenting requirements. However, in this case the feedback from the two projects clearly tells that use cases are not suitable for documenting graphical- and design – related issues. Therefore the projects used forms such as mock-ups, pure textual descriptions and design sketches. This is an important contribution from the new User Experience discipline which defines this type of artefacts. All these three artefacts are used as input to the activity Prepare User Interface Design. The participants at the Post Mortem analyses reported that this type of artefacts worked as an important medium for communicating with the customer. Further on they also emphasized the importance of involving the customers during the course of the project – as the solution grew. Besides this, such artefacts were also reported to positively affect the communication with the technical side of the project.

**Discussion**

Good communication is a basic prerequisite for succeeding in all types of software engineering processes, regardless of process flavour. In agile processes good communication is ensured by informal, tight, direct and frequent exchange of experience and opinions. In RUP the communication is more formally based on defined roles developing defined artefacts which are used as input by other roles. This means that the defined artefacts must be suitable for bringing information from one role to the next clearly and consistently. As RUP tends to focus on the development on technical functionality rich solutions most artefacts reflect this view. In this case we see that the new User Experience discipline which includes new types of (communication) artefacts such as User Research Report and Creative Concept clearly improved the communication at two levels. Firstly the internal communication within the design-team was reported to be improved, secondly these new design-oriented artefacts turned out to be working efficiently as a communication aid towards the customers and especially end-users.

While a standard Use Case diagram explains the functionality and order of actions in a system the new artefacts explained the look and feel of the system. This was not new to the design oriented developers; however the new process represented a more formalized view on their roles and function in the total project. As the PostMortem analyses showed us, this new discipline complied with existing best practice. In a comparison of five technology acceptance models, Riemenschneider et al [10] explains Compatibility as one factor for technology (process) uptake and success. They define this factor as "the degree to which an innovation is perceived as being
consistent with the existing values, needs, and past experiences of potential adopters”. It is likely to believe that the positive view and experiences by using the new discipline can be explained by this effect. The design-oriented developers expressed satisfaction as their function now became more visual to the rest of the projects, especially to the technical-oriented developers. Here we also find a explanatory technology acceptance factor; Subjective Norm [10] which is defined as “the degree to which people think that others who are important to them think they should perform the behaviour”. In our case the formalization of roles, responsibility and contribution to the total project most probably have contributed to an increased subjective norm.

As the new User Experience discipline are reported to have improved internal design-team and customer/end-user communication it did not affect the communication with the technical side of the project to that extent that it could have done. The two parts of the projects traditionally worked pretty much separated, a practice which was continued with the new discipline. This was the most prominent negative experience and correspondingly improvement issue from the PostMortem analyses. The developers clearly wanted the two teams to cooperate more in practice. Our two case-projects can be seen as pilots for the new experience, thus we believe that this is only a result of an easy first try and that new projects should integrate the technical and design-oriented sides to a much larger extent. As the new design artefacts was suitable for documenting user experience requirements and design the new discipline did not contain any guidelines for testing. As standard by RUP, testing is separated into the Test-discipline which did not encompass the new User Experience Discipline. We believe that there is a great potential for process improvement by extending the Test-discipline to involve end-users frequently to verify the design aspects of the solution. Agile processes [11] holds many practical guidelines for this that easily could be incorporated.

Conclusion

In total we see that for a development organization that emphasize the user experience, RUP should be extended to support new roles, artefacts and activities. However it is important to strongly integrate both the technical/functional parts of the work with the design-oriented parts. Given the situation, the development of a great look and feel may be at least as important as the technical and functional sides of the end product. The process should clearly reflect this.

This case study clearly shows that it is possible to create a discipline for user experience development using a traditional RUP structure.

Further research

The authors have been studying the tailoring and implementation of RUP in several case studies [12-15]. During the work it has become clear that there are few empirical
studies covering such tailoring and implementation reported [16, 17]. Most of the papers dealing with RUP are proposing a tailored RUP, but with no empirical data to confirm the usefulness of the tailoring. There are also a considerable numbers of “white papers” covering RUP, but the scientific quality of these is impossible to measure.

IBM Rational provides a comprehensive set of tools supporting RUP\(^5\). The new version of the tools provides functionality for selecting roles, artefacts and activities. The selection may be connected to types of projects.

One interesting issue would be to conduct empirical studies on companies implementing RUP using the new set of tools.

Acknowledgement

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\(^5\) www.rational.com
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