Extreme Programming and Rational Unified Process – Contrasts or Synonyms?

Per Runeson and Peter Greberg
Lund University, Sweden
per.runeson@telecom.lth.se

Abstract

The agile movement has received much attention in software engineering recently. Established methodologies try to surf on the wave and present their methodologies as being agile, among those Rational Unified Process (RUP). In order to evaluate the statements we evaluate the RUP against eXtreme Programming (XP) to find out to what extent they are similar and where they are different. We use a qualitative approach, utilizing a framework for comparison. We conclude from the analysis that the business concepts of the two – commercial for RUP and freeware for XP – is a main source of the differences. RUP is a top-down solution and XP is a bottom-up approach. Which of the two is really best in different situations has to be investigated in new empirical studies.

Keywords

Agile, XP, RUP, comparison, framework analysis

1 Introduction

The agile movement has appeared the last years as an alternative direction for software engineering [1]. Among the agile methodologies, eXtreme Programming (XP) is the most well known [3][5]. In the current agile boom, many established software engineering methodologies try to present themselves as being agile. The Rational Unified Processes (RUP) [18] is among those, providing “plug-ins” to RUP for eXtreme Programming¹. Thereby they offer a downsized version of RUP, which is stated to be lightweight, agile style.

Both methodologies share some common characteristics; they are iterative, deliver incremental releases, customer-oriented and role-based [2]. RUP is generally not considered agile; rather it is criticized for being too extensive and heavyweight. RUP comprises 80 artifacts, when fully instantiated, while XP stresses a few key artifacts; the code, unit tests, user stories and similarly. RUP has 40 roles while XP has five.

These issues lead us to the main research question in this paper: Do RUP and XP match together? Are they synonyms, or are they contrasts? There are existing comparisons, e.g. by IBM [12] and Ambler², [2], which compare the technical content and purpose of the two. Our research approach to investigate the question is a qualitative framework analysis. Using a modified version of a standard question framework, we investigate similarities and differences between RUP and XP.

² http://www.agiledata.org/essays/differentStrategies.html
We assume that RUP [13][18] and XP [3] are fairly well known to the reader. An updated version of XP was published recently [5]. We stick to the original presentation, as it is well established, and there are few principal differences between the two, although practices are differently formulated.

The paper is outlined as follows. Section 2 introduces the research methodology, including the framework used in the analysis. Section 3 contains the analysis of XP and RUP, based on the analysis framework. Finally, in Section 4 we present the conclusions of the study.

2 Research methodology

2.1 Approach chosen

Comparing two methodologies requires some form of empirical studies. Using a quantitative approach [23][24][20] would require the setup of two parallel projects in an experiment, or launching a case study to investigate certain aspects of one or another of the methodologies. Either option is rather costly, for an initial study of a phenomenon. As a lower cost alternative, a qualitative approach using frameworks [8] is launched to achieve a first indication of similarities and differences between the methodologies.

A framework provides a simple and structured means for comparisons in a qualitative context. The framework consists of a set of general questions, which are extended with domain-specific questions, in an iterative flexible design fashion. Frameworks have been developed for software engineering by Lindland et al [19] and used by Kitchenham et al to evaluate novel tools [17].

2.2 Research context

The study is conducted to provide a Swedish consultancy company, Sigma Exallon AB, with a feasibility study for introducing XP in their development projects. The company has both in-house projects and external jobs and operates mainly in different branches of the telecom domain, although also more administrative systems are developed. The focus here is to evaluate methodologies for the in-house projects, while the preparedness for various processes used by the clients is an expected bi-effect.

The framework analysis is conducted by one of the authors, while the other acts as a peer reviewer. The former has a detailed level knowledge of both methodologies, while the latter has a broader, more overview knowledge. The latter researcher is also part of other software engineering research, and particularly research on the use of agile methods in a stage-gate context [16].

2.3 Framework for the study

The framework used is a combination of two established frameworks, Zachman’s and Checkland’s [8]. Zachman’s framework consists of the six categories what, how, where, who, when and why. Checkland’s framework is called CATWOE and has six other categories:

- Client: the stakeholder of the activity
- Actor: the person conducting the task
- Transformation: changes taking place
- World view: what is the outside view of the phenomenon
- Owner: the sponsor of the activity
- Environment: the wider context in which the activity takes place.
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Zachman’s framework is stronger regarding functions and processes (how, when) while Checkland’s framework is richer on the individuals (client, actor, owner). We combine the frameworks into one in order to utilize the strengths of both, see Table 1.

Table 1. Mapping between the Zachman and Checkland frameworks

<table>
<thead>
<tr>
<th>Zachman</th>
<th>Checkland</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>Transformation</td>
</tr>
<tr>
<td>Why?</td>
<td>World view</td>
</tr>
<tr>
<td>When and Where?</td>
<td>Environment</td>
</tr>
<tr>
<td>How?</td>
<td></td>
</tr>
<tr>
<td>Who?</td>
<td>Client, Actor, Owner</td>
</tr>
</tbody>
</table>

This combined framework is used as a starting point and is iteratively extended with domain-specific questions on RUP and XP, resulting in the framework with questions, presented in Table 2.

These questions are used to analyze the two development methodologies, which is presented in the next section. The scope of the study is a comparison based on the documentation of the two methods. It is limited to the information gained from the documentation. Evaluating the dynamics of each of the method would require empirical studies in real projects, which has to follow after a framework-based study like this.

Table 2. Framework and tailored questions

<table>
<thead>
<tr>
<th>Framework</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What? (Transformation)</td>
<td>Which underlying philosophy is the basis for XP and RUP? How types of projects are RUP and XP suitable for?</td>
</tr>
<tr>
<td>Why? (World view)</td>
<td>Which are the technical pros and cons for XP and RUP?</td>
</tr>
<tr>
<td></td>
<td>Which are the financial pros and cons for XP and RUP?</td>
</tr>
<tr>
<td></td>
<td>Which are the social pros and cons for XP and RUP?</td>
</tr>
<tr>
<td>When and Where? (Environment)</td>
<td>Which are the time dimensions of RUP and XP?</td>
</tr>
<tr>
<td></td>
<td>Which are the geographical dimensions of RUP and XP?</td>
</tr>
<tr>
<td>How?</td>
<td>Which is the extent and complexity of RUP and XP?</td>
</tr>
<tr>
<td></td>
<td>How is the development methodology organized in RUP and XP?</td>
</tr>
<tr>
<td></td>
<td>Which types of tool support exist for RUP and XP?</td>
</tr>
<tr>
<td>Who? (Client, Actor, Owner)</td>
<td>What characterized the individual developers using RUP and XP?</td>
</tr>
<tr>
<td></td>
<td>What characterized the organizations using RUP and XP?</td>
</tr>
</tbody>
</table>

3 Analysis

3.1 What?

We begin with the history of the methodologies, and then move towards the underlying philosophies and the project types, for which the methodologies are suitable.

RUP is created by the well-known triple, Jacobson-Booch-Rumbaugh, launched in its first version 1998. Jacobson began the development of the use-case based approach at Ericsson in the 1980’s. RUP is based on the originators’ and others practical experience from software engineering, and has evolved further during the years, as well as the UML language. RUP is designed for large product development projects. Even though books are published on the methodology [22], the main distribution channel is though purchasing of licenses for the tool support for the RUP methodology, offered by Rational Software, which now is owned by IBM.

XP has its origins in practical applications in projects during the 1990’s. Beck and Cunningham have packaged their experiences into XP, originally from a project at Chrysler. It is a lightweight method for
small to medium sized software development teams. XP is intended to meet the demands of a context with unclear and volatile requirements. The methodology is not primarily commercial; instead there is a set of people – a community – who evolve and develop the methodology as such, as well as tool support (freeware), to advance and support XP development projects.

The origin of RUP and XP are similar. They are both based on experience from software engineering. Both are evolved during the same decade, although RUP has its roots earlier.

There are two different underlying philosophies behind RUP and XP. RUP takes to a large extent a technical management perspective while XP focuses on the development staff. RUP is originally designed to support large projects, while XP is originally designed for small to medium sized projects, for which type of projects several experience reports are published, see e.g. [10][14][21]. The distribution of the methodologies is different; RUP is primarily commercial and XP is primarily freeware, although RUP can be accessed through books, and XP is commercialized by consulting companies.

3.2 Why?

We analyze advantages and disadvantages for the two methods from three perspectives, technical, financial and social points of view.

**Technical perspective.** On the technical side, RUP is provided together with a large package of development tools and documents. It is delivered online via the web, and updated in new releases. It can be tailored and extended to suit the individual organization’s needs. One major sales argument for RUP is the integrated tool-suite, although it is debated how well they integrate.

XP on the other hand strives towards simplicity. It comes with more loosely connected tools, which are developed in the XP community, to support specific practices, e.g. Junit for unit testing.

RUP is a large collection of processes, artifacts and roles. This must be scaled down for most projects except for the very largest ones. XP starts in the other direction, with a minimal core of values and practices, which has to be scaled up to fit larger contexts.

**Financial perspective.** The financial issues are different in the distribution and support of the methodologies, since RUP is a commercial product and XP is freeware as are most of the related tools. The financial power behind RUP is used for marketing giving more visibility to RUP. Rational Software is owned by IBM, which has good reputation in the software industry.

On the other hand, why should one pay for something that can be achieved for free? Effort must be spent on tailoring RUP, why should an organization then pay for it as well? XP offers the freeware solution, which is financially advantageous, but may cause social reactions. Both approaches require tailoring and transfer effort before established in an organization.

**Social perspective.** The social aspects of RUP and XP are also related to the commercial versus freeware discussion. Larger software development companies are used to buying software licenses, and hence buying licenses for methodology is quite natural. The freeware principle behind XP is met with skepticism. Can something that is for free be good? The situation is very much like the open source situation. Free software is offered from the open source community and software is licensed from commercial companies, e.g. the Linux operating system versus Microsoft Windows.

The choice is of course primarily technical and financial, but there is a significant social aspect. Smaller organizations and technical staff show a tendency to be more in favor of the freeware/open source approach, while large organization and management are in favor of the license approach. The good reputation and financial strength behind RUP are management arguments, while on the technical level, people know that both approaches need tailoring and hard work tend to choose the method which is least complex, and puts the technical work in focus.
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3.3 When and Where?

Regarding the time dimension, the development in RUP is organized in four sequential phases, inception, elaboration, construction and transition. Theses four phases constitute one development cycle, producing one release of the software. Within each phase, there are a number of iterations, and the four phases have their main focus on different activities, although all activities are run in parallel, see [13][18]. Inception stresses business and requirements, elaboration is architecture-focused, construction is mainly implementation and test and transition has its main focus on deployment and change.

XP has its main focus on the produced code, independently of the time aspect. In the beginning of a project, the focus is on the product core, and later on features, but it is a code focus all the time. The design evolves as the software evolves. The simplicity value and the simple design practice emphasize that the design shall be as simple as possible for the current needs, not for future possible needs. Like in RUP, design and analysis activities are not concentrated to the beginning of the project, but intertwined with the development in the planning activity.

Both RUP and XP stress short iterations, although iterations in XP are even shorter than in RUP. In XP, iterations range from seconds in the pair programming activity, via days in the stand-up meetings to months in a release plan, see [3][5]. The iterations in RUP are less frequent, in the magnitude of weeks or months.

Both methods strive towards short lead-time and efficient use of resources. The XP principle of developing only what is absolutely necessary, indicates that XP will be the most efficient method. On the other hand, only empirical studies will provide sufficient answers to the question.

The geographical dimensions are not explicitly addressed in either methodology, but are present implicitly in both. RUP originates from a context of large distributed development projects, and its approach with artifact-based communication is intended to support this kind of geographical situation. The philosophy behind XP is based on direct, oral communication, both internally in the project and externally towards customers, hence requiring a limited geographical distribution. In practice, XP teams must be located in the very same room to gain the most benefits of the methodology. Even being located at different floors in a building has caused communication problems [15].

3.4 How?

This section deals with the technical content of the two methodologies. We analyze the extent of the methodologies, the organization of the methodologies and the tools support. Regarding the organization, we analyze common aspects, and try to find similarities and differences between the two. The analyzed aspects are flexibility, project drivers, customer relation, releases and technical work.

Extent. RUP consists of a large collection of documents, role descriptions, activities etc. RUP stresses the need for tailoring to a specific organization, which in most projects equals downsizing of the methodology. RUP is considered and criticized for being "heavy-weight".

XP is very lightweight, both in its presentation and in the practical application. Everything that is provided to start using XP in a project is covered in each of the sequence of books published on the theme, e.g. [3][4][5][6][7].

An indication of the difference in extent of the two methods is illustrated in Table 3, where all the roles of an XP project are presented, with their counterparts in RUP, constituting a small subset of the RUP roles. In total, RUP comprises more than 80 major artifacts, 150 activities and 40 roles [18].

In summary, RUP is a much more extensive methodology than XP, for good and for bad.
Table 3. XP roles and their counterparts in RUP

<table>
<thead>
<tr>
<th>Team</th>
<th>XP roles</th>
<th>RUP roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer team</td>
<td>Customer</td>
<td>Requirements specifier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System analyst</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project manager</td>
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<tr>
<td>Tracker</td>
<td>Tracker</td>
<td>Test analyst</td>
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<tr>
<td></td>
<td></td>
<td>Tester</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test system administrator</td>
</tr>
<tr>
<td>Tester</td>
<td>Tester</td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System administrator</td>
</tr>
<tr>
<td>Development team</td>
<td>Programmer</td>
<td>Implementer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Designer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Integrator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>System administrator</td>
</tr>
<tr>
<td>Coach</td>
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</tr>
</tbody>
</table>

**Flexibility.** Both methodologies stress the word flexibility. In RUP, it primarily means tailoring to different needs in different contexts and its focus on iterations. In XP flexibility means continuous change, based on the feedback loops. The short feedback loops require continuous actions. The 12 practices can be implemented differently in different projects. The values are the stable core of XP, while everything else may change.

**Project drivers.** RUP is defined as being use case driven, i.e. descriptions of use of the system are implemented, and continuously integrated and tested. XP applies test-driven design, i.e. test case are derived and implemented before the code is written. XP has user stories to guide what to implement. These user stories are less extensive descriptions, compared to the RUP use cases, where the complete scenario for the interaction between the user and the system is defined.

Regarding planning, both methodologies agree on that a complete project cannot be planned in detail. RUP proclaims continuous changes in the plans, while XP advocates planning only the very near future in detail.

**Customer relation.** Regarding the customer relation both methodologies stress the importance of a close relation to the customer, but still this issue is very different.

XP assumes the customer be involved in person in the team to “answer questions, resolve conflicts and set small-scale priorities” [3]. This is later turned into “an XP project is controlled by an assigned person, defining requirements, setting priorities and answering questions from the programmers”. RUP is more flexible on the implementation of the customer relation. It is not always possible or even feasible that the customer is present in person.

**Releases.** RUP defines a release to be “a stable, executable version of a product and its necessary artifacts” [18], while XP defines it to be “a set of user stories creating a business value” [6]. The XP practice small releases and the RUP item develop software iteratively are very similar, assuming that a release can be both internal and external.

**Technical work.** XP involves two controversial practices, collective ownership and refactoring, which are tightly connected. They are also highly dependent on the continuous integration and testing practices, which constitute the quality assurance mechanisms. These practices are based on the principle of sharing responsibility. In RUP, which originates from larger systems, different project members are responsible for different subsystems, thus the underlying principle is division of responsibility.

**Tools.** The RUP process as such is guided by a tool, and there are suitable tools for e.g. modeling that interface with the methodology. As the methodology is so extensive, this is absolutely necessary, to guide the user. This is also a part of the commercial success of RUP.

XP does not proclaim any specific tools. There are tools offered by the community, e.g. Junit, but any kind of CASE tools and project management tools can be used in XP. However, it is worth noticing, that in its original form, whiteboards, paper cards and pens are the most mentioned tools in XP.
Who? What characterizes the developers and organizations using RUP and XP respectively? XP focuses on the individual developer, empowering the technical level in the organization. It is based on direct communication between stakeholders, and requires courage, as openness and honesty are important. This requires the staff and organizations acknowledge and maintain these kinds of characteristics and values. It requires team workers solving problems in teams, and not feeling discomfort for peer reviews.

RUP does not focus on the individual developer, but emphasizes the roles, which are tailored to specific projects. It prescribes documentation, which puts demands on the staff to be motivated to spend effort on preparing and maintaining the artifacts.

The origin of the methods are different, RUP originates from large projects and organizations, and XP from the small. This fact permeates the methodologies as such, as well as its advocates and critics. RUP is a top-down methodology, typically advocated by management while XP is a bottom-up methodology, typically advocated by the technical staff.

4 Conclusions

In this paper, we have analyzed the similarities and differences between RUP and XP methodologies, based on a qualitative framework. Although many keywords and key values are the same, the two methodologies are quite different. Common values are user/customer involvement, iterations, continuous testing and flexibility. The implementation of these values are however very different. RUP offers an extensive process description, comprising artifacts, roles, activities, integrated tool-suites etc. XP on the contrary stresses values and principles, rather than prescriptive instructions, and focuses freedom and simplicity. The distribution channels are different, RUP being a commercial product by a large company, and XP is freeware, maintained by a community of volunteers.

We conclude from this analysis that the two in many aspects are in contrast. The situation is very similar to the Windows vs. Linux case. One is commercial, the other is freeware. One tends to be advocated by managers, the other by engineers. Still both are operating systems for personal computers. It is important to be aware of this social aspect in the selection of RUP or XP. Which of the two is best suited for certain types of projects needs to be further investigated in empirical studies.

5 Literature

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