

Requirements Engineering with Contextual Design and RUP

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Abstract: Models from methods like Contextual Design (CD) are a sound basis for requirements engineering. But current software engineering processes are not prepared to use such models. Together with tight schedule and budget project teams settle for the minimal work needed, which is writing use cases in case of the Rational Unified Process (RUP). HCI practitioners more and more need HCI methods effectively integrated into software engineering processes. As an example, integrating CD in RUP is outlined here.

Keywords: Requirements Engineering, Contextual Design, RUP, UML, Business Modeling

1 Introduction

HCI practitioners face the challenge to integrate user research, early prototypes and usability testing into a prescribed development process. This often violates the lived process and practitioners find themselves put into a box at the cost of effectiveness and efficiency. Emerging development processes like RUP (Kruchten, 2000) provide agile development and include HCI methods while being predictable.

In RUP, requirements engineers research the needs of stakeholders like executives, product managers, etc. and derive use cases and other requirements for developers and testers. But users are neglected for the sake of important persons and a thorough user research method is missing. CD (Beyer et al, 1998) in contrast, results in sound work models and a user-centred user interface design process, but delivers under-specified system models to developers and testers. HCI processes and methods do not easily integrate into existing development practices (Metzker 2002) and integrated HCI methods cover interface design but neglect user research, as can be seen with RUP.

Requirements engineering in RUP, RE (Leffingwell et al 2000) uses the Unified Modeling Language, UML (Booch et al 1999) and use cases to specify the future system. In addition, requirements engineers can model the business processes around a target product with UML (Erikson et al 2000), following the business modeling discipline in RUP (BM). HCI professionals contribute to requirements engineering

with user research and user interface prototyping. When CD is used in conjunction with RUP and UML, the CD models need to be translated to UML. This translation happens ad hoc, without tool support and adds redundancy to the data.

2 Contrasting RUP with CD

Contrasting RUP with CD happens on several levels:

- L1 philosophy: the principles and axioms behind the development process.
- L2 process: the overall procedure to complete the development project.
- L3 project management: organising, planning and monitoring a project.
- L4 methods: methods used to gather data, to understand users and to define a product
- L5 models: models used to record, visualize and work with the data.
- L6 tools: tools that support modeling.

Three models from CD and RUP are of interest:

- from CD: the CD models, a set of models about the current work.
- from RE: the requirements model, a set of models specifying the target system.
- BM: the business model, a set of models showing the business processes of a target organisation.

On the model level (L5), RE focuses on the product and the development. It models the target system only. BM focuses on the target organisation and shows the business processes now and/or in the fu-

ture. RE and BM use the standard modeling language UML. CD uses models to visualize the current way of working and makes heavy use of user interface prototypes to specify the future product. RE and BM models are formal and are not easily understood by non-technical staff. CD models are geared towards non-technical people and make use of informal communication.

On the tool level (L6), for RE and BM, many highly integrated tools are available to create models, track changes and even generate code. CD employs video recordings for interviews, paper to work with the models and a team room make the models visible.

On the method level (L4) RUP uses workshops, interviews and reviews with stakeholders. RE expects the stakeholders to define the future system. CD employs contextual interviews and participatory workshops to gather information from users. The project team does the modeling. CD expects the project team to define the product.

On the project management level (L3), RUP defines roles, assigns these to individuals and separates work accordingly. CD also defines roles but stresses the creation of a team doing the work together, where members can switch roles.

On the process level (L2), RUP mainly follow a top-down strategy: start with an overview and refine the models iteratively, driven by the high risks. CD follows a bottom-up strategy and uncovers hidden structure in work, driven by data found. The highly structured approach from RUP makes every data point and decision traceable. CD's process enables creative thinking rooted in reliable data. RUP is an iterative process that allows developing a product in small steps. CD rather follows a waterfall principle, putting user research, interface prototyping and implementation in a sequence.

On the philosophy level (L1), RUP stresses especially iterative development, visual modeling, risk reduction and traceability. For CD, observing concrete work, including actual users, generating visual models and creative thinking from reliable data are key principles.

3 Contextual Business Models

CD models the work around a product and identifies the following entities:

- individuals, groups, roles
- goals, responsibilities, values
- information flow, influences
- steps and sequences, standards, regulations
- tools, objects, documents
- locations, space, layout

- breakdowns

The content of CD models overlaps with the RUP business model. CD models show a local, detailed, internal view of a business model. In consequence, integrating CD into RUP means to do business modeling where the UML business models replace the models from CD. As CD models include data not contained in the UML business models, additions must be made. The extended model is called contextual business model.

Business use case diagrams and activity diagrams replace the information flow model and the sequence model from CD. Roles become business workers or actors. Analysts identify business use cases and activities from the collected data (especially from responsibilities and activities) and model the sequence of activities in activity diagrams. Swimlines in activity diagrams show how roles cooperate to complete a task. This corresponds with the communication from the information flow diagram. At last, the description of business use cases is extended with goals and triggers and the activity descriptions accommodate intents.

The business object diagram shows what business worker and what actor use which business entities, or artefacts in CD terminology. For each business object, the description contains the consolidated artefact view of that business object. In CD's information flow model places can be modelled. They have no direct representation within the UML business model but, in general, business entities substitute places.

BM does not include a cultural model, as known from CD, and UML cannot be extended to draw the cultural model as it is. The practical solution is to capture the culture with the known models from CD and include the models in electronic form in the business architecture or the business vision document provided by RUP. Similarly, BM does not include a physical model. A consolidated physical view can be included in the business architecture document or the vision document.

One of the first steps in RUP is to form a vision of the future product to develop. In this process a vision document is created that contains, amongst others, a description of the different actors (roles in CD). This allows recording the profile of a user group. RUP proposes to capture data points like responsibilities, expertise and needs. CD shows new characteristics to record: adding values, preferences, personal goals, relevant demographic data and general notes completes the view on an actor.

One of the strength of CD is that the project team searches and collects breakdowns. Breakdowns are

the strongest indicator for improvement and point to key product features. RUP can be extended in several ways to record breakdowns. First UML can be extended with breakdowns using stereotypes. This needs a different solution for every diagram type and is not possible e.g. in activity diagrams. Second, breakdowns can be recorded with notes. Notes can usually be drawn in a case tool, but they are not part of the model and cannot be operated on. Third, breakdowns can be recorded within the description of any UML element. In this case, breakdowns are spread over many elements, are not visible in the overview and by that lose their power. Fourth, breakdowns can be recorded in the vision document, together with the actors and their needs. Here no graphical view is possible, but the breakdowns are recorded at a central place and receive high importance. The fourth solution is the proposed one.

BM creates the consolidated view only. If needed, individual models for each interviewee can be drawn with the actual participants instead of roles as actors and workers. The consolidation process can then take place using contextual business models.

4 Combining RUP and CD

The goal for combining RUP and CD is to add thorough user research into a structured and established software development process. The approach chosen is to complete gaps in RUP with elements from CD. A thorough development process allows traceability of requirements and changes. This needs support by tools. In general, the requirements engineer must use the tool available within the company, as introducing new tools is usually not possible within the scope of a project. Thus on L6, existing tools must be used to record data as much as possible. The main tool from CD, i.e. paper, does not integrate well with the existing electronic tools. An electronic form is preferable. This however should not prevent the project team from printing models and mounting them in the team room.

The question of tools has a huge impact on the model level (L5). The tools used in concordance with RUP support UML. We must therefore use existing UML models as much as possible and record additional information at the appropriate places as discussed in chapter 3.

On the philosophy level (L1) CD and RUP are somewhat opposite. One important assumption behind RE is, that stakeholders are able to create a good solution. Experience shows that stakeholders do generally not know the exact problem and do usually not have the background needed to find the

best solution. RUP neglects the users and the details of work and by that tends to miss important features and constraints. RUP is extended with the new core principles of gathering detailed data and feedback from actual users as well as enable creative thinking from data.

This directly impacts the method level (L4). Some workshops with stakeholders are replaced by contextual interviews and modeling sessions from the video tapes during the inception phase and workshops with users in the elaboration phase.

Thus the RE process needs adaptation (L2). Within the inception phase, CD captures the users' needs and forms a sound vision of the future product supported by the stakeholders' vision for the next five to ten years. The project team thus engages in the following activities:

- gather vision from the stakeholders
- create an overview of the current work in the contextual business model
- draft a product vision
- collect risks
- conduct contextual interviews with users, driven by risks, missing data and the product vision and tape them
- detail the contextual business models based on the interviews
- walk contextual business model to refine product vision, as proposed in CD.
- review contextual business model with stakeholders

During the elaboration phase, CD is used to refine the envisioned product with storyboards. The project team does the following activities:

- create the requirements model with actors, use cases, non-functional requirements and more from the vision and the contextual business model.
- draft user interface prototypes and user interface storyboards
- refine the product with users and stakeholders in workshops and further contextual interviews.

Of course other known activities from RUP, like software architecture prototypes, project planning, setting up the development environment and more are still needed. The integrated process combines the risk-driven approach with the data driven, the top-down approach with the bottom-up and makes full use of the possible agility of RUP.

On the project management level (L3), teamwork between software architects, requirements engineers and user interface designers is needed. Another chal-

lenge for the project manager is to integrate users into planning and the project organisation.

5 Conclusion

For successfully applying HCI methods in practice, they must be integrated into existing software development processes. In case of the requirements engineering discipline of RUP, user votes must have higher impact. Using CD to create contextual business models within RUP and deriving and validating product requirements reaches this goal while still following an established process.

The outlined integration of CD into RUP meets the following requirements:

- people that know RUP and UML can easily understand and work with most additions from CD.
- the resulting process includes methods, documents, terminology from RUP as much as possible.
- standard tools can be used to create models and documents in most cases
- traceability can be ensured throughout the documentation.
- reduced redundancy and therefore lesser additional costs (money and time) for user research.
- balanced influence of users and stakeholders.

6 Future Work

The integration outlined here has been practiced in several projects to different degrees, depending on the needs and the possibilities of the respective project. Project budget however never allowed to focus on some essential work:

- The cultural model of CD cannot be represented within UML. It is however of great importance in many projects. The chosen approach using the standard CD cultural model works in practice but is not supported well by the tools. A UML representation of the cultural model is needed and the main focus of future work.
- Breakdowns can be recorded in the vision. However a graphical representation as

known from CD is not easily possible within UML. An important question to solve is, how UML can be extended to accommodate breakdowns.

- RUP is documented in an electronic, searchable form that can be extended. In order to integrate CD completely with RUP, the documentation, templates and examples must be adapted and made available through the online documentation.
- For graphic designers, the characteristics of prototypical people are very helpful to design the right mood into a product. Such information can be modelled using personas and scenarios (Cooper 1999). From contextual interviews, such information is usually available but not modelled in the contextual business models so far.

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