Collaborative design in system development: What place for design rationale?

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1. Introduction

This paper reports a study of the use of Design Rationale methods in the co-operative design of a software system. Structured records of the design process aim to support the understanding of decisions taken and thereby allow designers to give better informed reconsideration to them at a later stage. This can be particularly important during maintenance. Methods for capturing the complexity of design deliberations in order to produce a Design Rationale (DR) in software design are still in the early stages of research (Carroll & Moran, 1991). The approaches adopted are diverse: for example, from constructing representations for DR that are applied by the designer as part of the reflective process (e.g. MacLean et al, 1991) to relating DR to design practice by examining concrete problems rather than abstract issues (e.g Lewis, Rieman and Bell, 1991). Nevertheless, evidence drawn from actual data gathered about the process of software design in practice remains limited.

2. Design of a Software Artifact

A software system can be viewed as an 'artifact' that embodies implicit theoretical constructs that realize functional and operational requirements (Carroll and Campbell, 1989). Throughout the design process, structures are chosen because of their ability to achieve the intended functionality, and such decisions may be evaluated against various criteria. During the design process the descriptions are modified and there is a clarification and refinement of intended functions and requirements. There may be additional factors arising from the context of the project that affect the way the process is carried out : for example, the need to keep sight of the general applicability of the design whilst meeting domain specific needs in a bespoke application or the constraints of the given hardware platform and the software architecture and tools. In particular, it is necessary to be aware of the influence of the differing contributions of the team members arising from the application of experience and skills to the common problem addressed.

3. A Study of Collaborative Design

This paper draws upon an exercise in collaborative design of a Knowledge Support System (KSS) (Edmonds and Candy, 1993) in which an attempt was made to elicit design rationale during the design process itself. It describes the evolution of the system design as it emerged from the initial requirements document to the design specification of the new system. The

collaborative design process described concentrates upon the designer/programmers, primarily, but also takes account of the roles of the other members of the team, such as the user and the independent evaluator.

The design process was documented from the conceptual phase to the implementation of the first prototype constructed in the intended delivery vehicle. More rigorous procedures than used in an earlier version of the system were employed and methods for recording the development process in all areas of the project activities discussed. It should be noted that this was a major re-design exercise building upon the evaluation results from an earlier system (Candy et al, 1993). Thus an explicit attempt to incorporate DR during the process of interpreting requirements into design was made. The initial primary goal of building DR into the design process of the re-design of the system was based upon the hypothesis that this would improve the design results by eliciting decisions based upon justifiable criteria, enabling the sharing of design thinking and encouraging more 'rigorous' attention to usability issues (as defined for example in The Guide to Usability, 1990 and Smith and Mosier, 1986). Validation procedures were applied at all stages of the design activities having been devised and agreed by the team. These procedures required the designers to justify options and decisions during the process and that design guidelines from research literature would be applied where appropriate. Requirements were to be based upon the evidence from previous studies. Solutions and possible options available to meet requirements would be identified and documented. The idea of a design database for this purpose arose from the discussions that took place. Design choices and decisions were recorded and a detailed account of how a solution was to be handled given.

In the conceptual design phase, the requirements were interpreted by the team as set of design options. These options were then validated against the requirements statements by the user and the evaluator. The requirements document and the design drawings, notes, documents and prototypes (dynamic simulations) represented the shared understanding of the team and as such, provide tangible records of the evolution of the decision making. The monitoring of their use provided evidence about how design of this kind actually takes place in situations constrained by time and resource limitations. These factors which emerged about the dynamics of the group thinking are identified. Two main tasks carried out by the designers are highlighted: firstly, the joint interpretation of initial general requirements and, secondly, the selection and use of the materials and tools of design.

4. Conclusions

The design rationale ideas that informed the initial intentions of this exercise were based upon a model of design that is rational, deductive and hence, can be shared. The evidence from putting this into practice is that the design processes are disrupted by the required analytic considerations and that the process is strongly synthetic, based upon models of known systems and the handling of new systems, during construction. The rationale that did emerge is post hoc, and, in effect, a rationalisation of design decisions rather than a true account of the unfolding of the process. The observation of the design process and its outcomes led us to conclude that DR as applied in the form used, did not necessarily support the co-operative design process itself. These results suggest that it is difficult to apply DR as a support to the design process whilst nevertheless being able to provide an analysis of what happened. DR as something open to scientific scrutiny as a psychological or sociological area of study is possible. However, the ingredients of design practice itself are not necessarily subject to the same kind of analysis. Questions are posed as to the kind of knowledge that is required for the support of co-operative software design in practice. Thus, whilst Design Rationale might be valuable as a post hoc method for communicating between different stages of the design, development and maintenance of process, other methods are required to facilitate communication and sharing during a given design phase.

5. References

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