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Interaction design and design management: Challenges for industrial interaction design in software and system development

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Introduction

The objective of this paper is to describe aspects of and provisions for industrial interaction design that influence approaches to design management within system and software development.

Traditional product and service industries have developed design management systems over a long period of time. Some of the effects of the work performed during the 80's and 90's can be seen in standards, such as the British Standards series, in classical texts (Gorb, 1990; Svengren, 1995; Ulrich & Eppinger, 2003), or in best-practice books (Bruce & Bessant, 2002; Bruce & Jevnaker, 1998). Typically these assume a product development process where (re)production is separate from design. For the software and system development industries there have been little general work of similar kind. The kind of problems for design resemble the complexity describe by Sebastian (2005).

As a background to the three cases we will review, the view of interaction design and design management that will be held throughout the paper will be presented.

Interaction design

The terminology for the design work that goes into software is commonly known as Interaction Design, Experience Design or User-Centered Design.

Interaction design takes as its starting point the use of an interactive artefact (the software), and thus on the interaction with and around the artefact (Löwgren & Stolterman, 2005; Winograd, 1996). Interaction Design gained popularity during the 90's, together with its sister discipline Experience Design. Especially web-development companies focused on interaction and experience design. Both these design disciplines utilize user-centered design methods, but rely heavily on the creativity and sketching/design/expressive abilities of

the designer. For the design methods a lot of inspiration has been sought from design researchers such as Jones (Jones, 1992).

It has been an important research venue within the interaction design community to show that the material which an interaction designer works with is a material with attributes that sets it apart from other materials with which designers work. In Löwgren & Stoltermans book (2005), with the original title of the Swedish edition "The material without qualities" (Löwgren & Stolterman, 1998, 2004), the authors try to argue that the interactive material, as opposed to other physical material, possess few qualities as a material: They argue that most qualities will be the task for the designer to create with the help of the material. Edeholt & Löwgren (2003) compare Interaction Design with Industrial Design in an attempt to distinguish interaction design from industrial design, partly as an aspect of the design material. Other authors provide similar interpretations (Petersen et al, 2004; Hallnäs & Redström, 2002). Henceforth the Interaction Design approach to software will be referred to as IxD.

User-Centered Design, here referred to as the origin for design within the realms of software, takes as its starting point the involvement of users in design processes, and on the usability of the software product developed (Ehn & Löwgren, 1997; Nielsen, 1993; Holtzblatt & Beyer 1997). Thus, the practice of user-centered design for software focused on what was possible to construct, rather than what was supposed to be designed. Usability Engineering, as this approach sometimes is referred to, gained in popularity in the late 80's and during the 90's, especially within large software product developing companies. In the beginning of the 21st century the Usability Engineer/Architect could be found as a role in some of the large software development process standards, such as the Rational Unified Process, RUP. Henceforth the User-Centered Design approach to software (including Usability Engineering) will be referred to as UCD.

The visually evident design object for software are their user interfaces (Löwgren & Stolterman, 2005; Hallnäs & Redström 2002), although there are other form factors and design objects, such as packaging, installation procedures, remote controls, licensing procedures, support and after market services, functionality and construction of algorithms, innovation and architectural aspects. For most software products, though, the design of the software is manifested through the usage of it (Holmlid, 2002, 2005; Bannon & Bödker 1991), which in turn can be viewed as being mediated by its interface. At some point during system development the user interface will be programmed, just as the rest of the system.

Design management in brief

For the benefit of the analysis of the cases with design management as a background a snapshot of the interpretation of design management that goes into the analysis will be provided. Svengren (1992, 1995) identifies two arenas on which design management operates, the strategic level, comprising corporate identity and design policy, and the operational level, comprising project management and design work. This view is supported by e.g. Felber (1984), and Lawrence (1987). Felber (1984) differentiates between business with uncoordinated areas of design work and strategically coordinated design work. In the uncoordinated case design work is typically the responsibility of its specific organizational function, such as product design being

the responsibility of a research and development function, design of communication being the responsibility of the marketing function, etc. Lawrence (1987) identifies functional design management and strategic design management, which resembles Svengren's two arenas. A similar way of describing design management is held forward by Gorb (1987, 1990), where he identifies several different meanings of design management, and one definition: "...the effective deployment by line managers of the design resources available to an organization in the pursuance of its corporate objectives. It is therefore directly concerned with the organizational place of design, with the identification of specific design disciplines which are relevant to the resolution of key management issues, and with the training of managers to use design effectively." (Gorb, 1990, p2)

Sebastian (2005), not wholly unrelated, states that there are three design management approaches; managing the product, managing the process and managing the organization. In the same article, he is critical towards these, and suggest that design management should focus on "managing the creative cognition through the dynamics of a design team" (Sebastian, 2005, p92), and that perspectives from cognitive science should become central to design management. Other authors highlight design as an organizational capability (Jevnaker, 1998; Bruce & Morris, 1998

Dumas & Mintzberg (1989) points out a set of strategies to integrate design into an organization; design champion, design policy, design program, design function and infused design. This structure is well-known within the usability engineering community (see e.g. Carlshamre & Rantzer, 2000).

Moreover, Svengren (1995) concludes that, for companies developing goods, three integrative processes are important to understand the drivers of the development of design as a strategic resource; functional integration, visual integration and conceptual integration.

Cases
The three cases we will refer to here all come from software development companies that develop large systems for an industrial market and professional users.

Case 1 (Beep) and case 3 (Hip) are held short and illustrative, while case 2 (Loop) will be elaborated on. The cases should be viewed as three attempts to provide a collective understanding of what could be considered to be interesting research questions. In accordance with Svengren (1995) we have chosen not to limit the study to one perspective or one product. Instead we provide three cases, of which one comprises product, project and strategic management.

For Beep a semi-structured interview was performed with one informant. The interview focused on how the company organizes their usability and user-interface development work. The informant was part of a process management team.

For Loop interviews, document analysis and participatory research was performed. Twelve semi-structured interviews were performed. The questions of interest to this study concerned how the company organizes their

usability and user-interface development work. Documents, such as internal and external management communication, product, project, process and organization definition documents, current as well as of older origin, were analyzed. As the researcher was part of the organization, notes from a range of project meetings were analyzed, as part of a participative research strategy. The informants ranged from project management over product management to strategic management teams.

For Hip a semi-structured interview was performed by the author with one informant. The interview focused on how the company organizes their usability and user-interface development work. The informant was part of the product management team.
All interview protocols and documents were analyzed qualitatively by establishing categories concerning the management issues of interaction design.

Case 1: Beep
The company develops a business software system, and has been an actor on that market for over 20 years. They develop their solutions on open standards, and the actual development work is performed as distributed development. Some of that development work is off-shored to Asia.

The overall design is developed by a centralized R&D centre. The look & feel of the products, across different platforms, is developed and specified through a user-centered and agile approach. To communicate this design and the design goals a designer travels to the different development centers to train programmers and developers.

This case illustrates one solution regarding communicating design objectives, and design guidelines to the developers, and an effort to implement a process wide understanding of these. It relies heavily on individual communication.

Case 2: Loop
The company develops software for the telecom industry. They develop their solutions in large and complex projects, distributed over several development centers. The products are physical products, such as switches and the like, and software running on these, as well as software for operation and maintenance of telecom networks.

During several years the design work has been performed by individuals in the different projects, with an informal network of experts trying to coordinate the design. In some projects this has worked well, while in others the spread and uptake of best-practice has been slow or ignored. The success of design work has been appropriated to considerate project managers or the inclusion of specific formulations in requirements specifications. The latter strategy has had some success as it provides a formal basis to argue for performing specific work-packages.

In an attempt to understand where the responsibility for delivering well designed products a set of interviews were made. Interviews with product management, project management, development centre management, and brand management revealed that all of them attributed that responsibility to themselves, but that they were unclear how they were to implement actions necessary to respond to that responsibility. Some of them were performing good design activities sporadically, but did not possess the systematic means to carry through to the end result.

In the organization, designers have had top management support since 1998, when the CEO announced that user-centered design is a key to success. More than that, there had been pressure from key customers that the design work needs to advance further and faster.

When interviewing enterprise level brand management about interaction design, their perspective made them focus on packaging, graphical layout and industrial design concerned with operation of the physical products. They also managed to find a traditional design manual developed in the 90's also focusing on such issues.

By providing some examples of how the interaction design of the product portfolio looked and felt like, brand management realized that there were more to managing the brand when dealing with software, than the packaging, the physical products and the details of graphical layout. One of the eye-openers were when they realized that they could not distinguish the company's operations and maintenance software from other software running in the same environment, and that they could not tell which software that were produced by the company.

This case illustrates two things; firstly how a strong project and process structured approach provide difficulties with a bottom-up approach to design and secondly how branding can become involved outside a traditional brand management perspective.

Case 3 Hip
The company develops product management software for professional users. The development process is distributed, and utilize off-shoring to reduce costs.

The informant discussed challenges when changing sites for off-shored programming work. In doing this there is a need to configure the software development processes and procedures for the new alliance. When configuring the software production process and the business relationship it is necessary to configure the design processes, although this is not a prioritized issue. Configuring design processes would concern ways of achieving good design and maintaining the look and feel of the software product. When software production is brought up to speed, little time and effort can be directed towards these issues.

This case points towards difficulties with a distributed development environment and the need to find ways of boot-strapping competence in off-shored development.

Discussion

The two arenas from Svengren (1992, 1995) will be used to structure the discussion over the cases.

The strategic arena

In the Loop case there was support for design by top-level management, even though they did not know how implementation of the important design work is to be performed in the organization. Similar aspects have been described, especially concerning the spread and uptake of best-practice usability work within organizations (Carlshamre & Rantzer, 2000; Carlshamre, 2001).

Dumas & Whitfield (1990) differentiates between manufacturing and service businesses and whether they have or do not have a design manager. Given these it seems as if the companies in all three cases view themselves as manufacturing companies. In the Loop case engineering have the actual control over design regarding the product, and the different design competencies have little coordination. In the Beep case design coordination regarding the product is performed through a pedagogical approach.

In the Hip case managing the off-shored resources seem to hamper the achievement of the overall design goals. If not having a negative effect on design and quality, it seems to stall the development of better design.

The operational arena

For Loop and Hip programming is viewed as purely construction work. Basically this means that setting up a software development centre is similar to setting up an assembly factory, or acquiring production capacity for a component. The provisions for enabling component based software development is that the software can be modularized in components, that there is an architecture that defines the assembly of the components, and that there is an assembly process that directs the requirements for the development of components. This perspective resembles a traditional production-process perspective. With the position IxD argues for, that the design material is not like traditional industrial design material, the production-process perspective would not be accepted without good arguments.

In the Beep case, on the other hand, programming is viewed as complex and competent product development work. That is, the doings of programmers feed into the design and quality of the product in a way that requires them to be knowledgeable of the overall design goals and the product's look & feel.

In system development practice some solutions have been suggested to accommodate for these two positions, such as agile methods (Constantine, 2000), inspection procedures (Näslund & Löwgren, 1999), etc. While being project focused on the operational level, they do not provide insights for the strategic management issues of design and development work.

It seems as if IxD, as well as UCD, only cover design management aspects in general terms, especially when it comes to the strategic arena. IxD is focused on the designer's work, and the position of the designer within an

organization. UCD focuses on the product attributes, the technology construction process come first, then the user-centered design issues. In IxD and UCD literature, project management issues are central, and other aspects such as branding, marketing, etc., are only referred to very briefly.

Conclusions

The cases developed here are short, but describe what can be considered as normal practice, even though, in the wider software development industry a few bright exceptions exist.

We conclude that there are aspects of and provisions for industrial interaction design that influence approaches to design management within system and software development.

The usage/product perspectives: these are two non-excluding perspectives on the software development process. The usage perspective's stance is to view software development as a means to create computerized resources for computer usage, resources provided to e.g. solve work tasks, have fun, etc. The product perspective's stance is to view software development, and especially the actual programming, as the production of an end-product. In traditional terms this would mean that the software development process acts as a production planning process, a component production process, and an assembly line.

These perspectives should be viewed as non-excluding as they highlight different aspects of a software development process. In both perspectives, the programmers have a direct influence on the design, quality and functionality of the system. That is, if design decisions have not been made before programming time, these decisions will be made during programming time. This does not imply that programmers should be excluded from making such decisions; rather it implies that we need to have an interaction design strategy and direct design work.

In line with the product perspective traditional software engineering has evolved. In software engineering mainly functionality and construction quality has been attended to. In a critical parallel, but under the conditions of software engineering, Usability Engineering have emerged and been institutionalized. That is, the possibilities for usability engineering to function as a tool for design management will be performed in reference to the product perspective. The product perspective thus highlights the idea that user-centered design work can and need to be performed before the actual assembly, i.e. programming, of the software, e.g. as part of the specification of the requirements.

Design tools and practice: Within the user-centered design paradigms there have been developed a set of best-practices. Most of these relate to project management and execution. Within these practices some companies have succeeded with approaches such as; guidelines, programming design tools, design reviews, critique systems, design patterns, templates etc. They highlight the fact that the interaction design work of systems can not be dis-integrated from the development of the rest of the software product. For example, the user interface is not something that can be viewed as an add-on to a technically well-constructed software product.

Modularized and distributed processes: With the strong modularization of production and sometimes distributed or off-shored production some specific challenges arise. There need to be organized a way of directing a good overall design as well as the design of the details. From software engineering perspectives, and thus with a focus on construction quality, there have been employed a varied set of methods, such as verification driven development, integration driven development, and feature based development, although there is little said about design management aspects within these. There need to be developed ways of aligning the design strategies, with respect to the specific provisions of software development, with the business strategies. For example, if outsourcing is an effect of lowering costs, the design strategies need to be aligned with such a strategy.

Future work

To develop the observations from the case studies further research is needed regarding the interface between design management practice and interaction design in software development.

Two emerging issues that can direct future work have been identified:

•   Is the usage perspective important enough for software development companies to have design established as an integrative process in the sense of Svengren (1995)?

•   Can Dumas & Mintzberg (1987) and Svengren (1995) inform the development and maturity of the distributed software development processes?

On a more general level research questions such as the following might be of interest:

•   What are the strategic alternatives and possibilities for the companies to organize interaction design work under different software product and production strategies and assumptions?

•   What are the concrete interaction design activities and methods made possible by such design management systems and strategies?

•   How do agile software development processes, open-source programming or embedded systems affect the possibilities and alternatives for interaction design management?

By working with trying to answer these questions, software industry will be better prepared delivering well-designed products. As research issues these questions form areas of research rather than concrete research issues.

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