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A HUMAN WORK INTERACTION DESIGN (HWID) CASE STUDY IN E-GOVERNMENT AND PUBLIC INFORMATION SYSTEMS

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Abstract

This paper first outlines a revised version of the general HWID framework, with a focus on what connects empirical work analysis and interaction design, and then presents a case study of the Danish government one-for-all authentication system NemID. The case is briefly analyzed, using ethnomethodology, work domain/task analysis, and the HWID approach, and comparing the results. Compared to the traditional approaches, the HWID focus on case-specific connections between human work and interaction design, gives different and supplementary answers. The conclusion is that there are benefits in studying how human work analysis and interaction design in concrete cases are related and connected.

Keywords: Human Work Interaction Design, usability, user experience, authentication systems

1. Introduction

Human Work Interaction Design is a developing research specialty of human computer interaction (HCI) (Campos & Campos, 2009; Clemmensen, Campos, Orngreen, Pejtersen, & Wong, 2006; Katre, Orngreen, Yammiyavar, & Clemmensen, 2010). This paper presents a revised version of the general HWID framework, and illustrates the approach with a case analysis. The case is about e-government and public information systems: the Danish one-for-all authentication system "NemID". The main learning point from the case analysis is about the benefits designers can obtain by connecting human work analysis studies (and its artifacts) and the interaction design.

HWID is a comprehensive approach in HCI, and to provide an easy understanding and to illustrate the coverage of this research topic, we developed the model in Figure 1. The model shows the characteristics of humans and work domain contents and the interaction during their tasks and decision activities, individually or in collaboration. The top box in the model illustrates the influence of theory. Analysis of users' work and life, as well as the design of computer-based information systems,

has inspired the development of numerous theories, concepts, techniques and methods. Some of the concepts have been widely adopted by practitioners; others are used mainly by researchers, and these are naturally part of HWID research, and they will obviously influence the work and user analysis as well as the technology design. This explains the top box.

Environmental contexts, such as national, cultural, social and organizational factors, impact the way in which users interact with computers in their work and life. In a similar way, the nature of the application domain, the tasks, and the users' skills and knowledge impact the way in which users interact with computers in their work and life. The analysis and design of HWID will necessarily also include these contextual factors. As a consequence hereof, the bottom box of Figure 1.

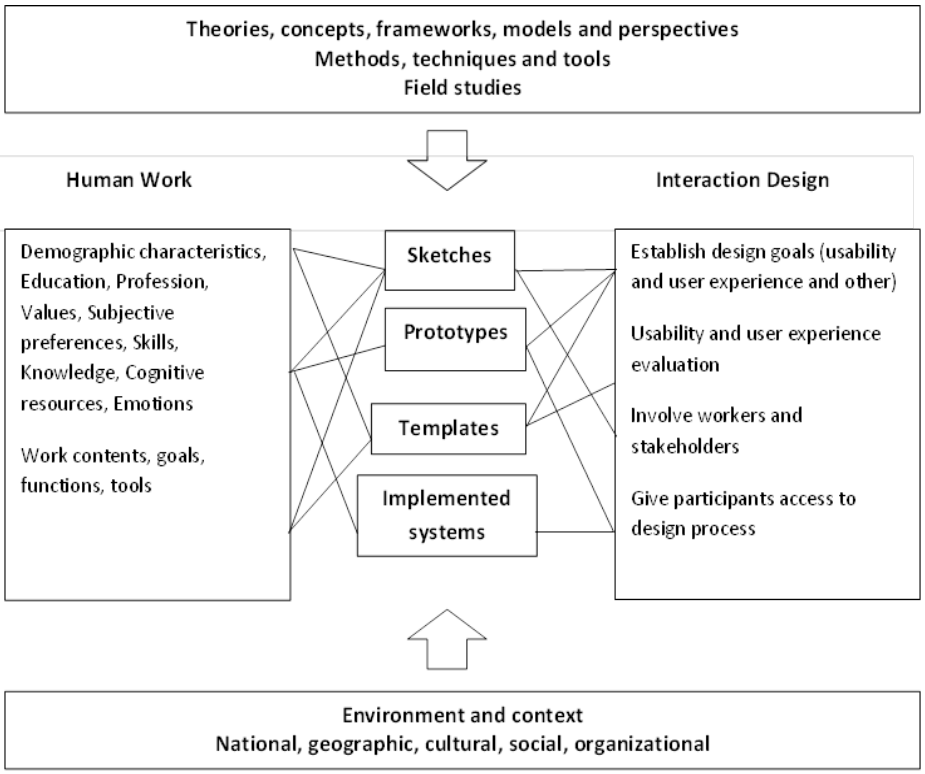

Figure 1: A revised version of the general HWID framework. Inspired by (Orngreen, Pejtersen, & Clemmensen, 2009).

An analysis of the previous HWID studies (Orngreen, et al., 2009) have resulted in the identification of six main themes, which reflect those problems which the researchers perceive to be of major concern in HWID.

Within interaction design processes:

- encouraging the dialogue between users and designers in the design process;
- bridging the HCI and software engineering gap by working with user requirements and collaboration in software development processes; and
- supporting communication and design exploration through sketching.

Within work and user analysis:

- bridging the work analysis and interaction design gap through detailed case and field studies and action research projects empirical field studies;
- rich contextual user descriptions, including methods to study unpredictable and opportunistic tasks; and
- broadening the scope to social, organizational and cultural aspects.

Although this list presents these themes and problems as separated, interaction design and work and user analysis are in practice intertwined as can be seen in the examples of previous published HWID research (Orngreen, et al., 2009).
In practice, interactive artefacts (design sketches, prototypes) may be what connects, through different types of relations, work analyses and interaction design (Clemmensen, in press). Thus, the real interesting thing about the model in Figure 1 is the relations, the lines that are between the "human work" box, the artefact boxes and the "interaction design" box. Relations between the artefacts, work analysis and interaction design may include "Is part of", "Strategy", "Archive", "Creates conditions for", "Creates emotions about", "Designs", "Is cause of", "Reflection on", "Specifies how", and "Is associated with"(Clemmensen, in press), or they may be other relations dependent on the specific case. Such relations may not be orderly or symmetric, missing or included, depending on the particular empirical reality that is studied in the case. This in-completeness of the framework is sought illustrated in Figure 1 by not connecting every artifact any other, e.g. "Give participants access to design process" only connects to "Implemented systems" and "Prototypes" and not "Sketches" (in this particular instance of the framework)? Later in this paper we will show that in a rich case, any connection is possible.

The model in Figure 1 is a revised version of the original model of HWID presented in (Orngreen, et al., 2009). Our understanding of HWID should be modified to accept that design artefacts connects, but may have different relations to, work analysis and interaction design. In the case study that we present here, we try broadly to illustrate the revised HWID model as a basis for discussion of the HWID approach. For the same reason, we briefly analyse the case from two established perspectives on human work in HCI: ethnomethodology and work domain analysis/task analysis, and compare this with a HWID analysis of the case. The question that we ask is: *What connects human work with interaction design in the domain of eGovernment and public information system design?*

2. The case

As stated in the call for papers in this special issue, Human work analysis is very critical in public information systems design as the procedures, working styles, organizational contexts are different in various public sector organizations. Interaction design of e-government system and public information systems has to simultaneously address the user experience requirements of diverse users such as people from varied educational and professional backgrounds, senior citizens, physically disabled, illiterate and people with different languages and cultural preferences. A perfect case of this is the design of the Danish one for all mandatory use authentication system called "NemID". In 2011, the Danish government was behind the creation of a single digital signature for all Danes, with the aim of accelerating the Danish vision of one login for public and private services on the Internet (NemID, 2011). The idea was that this login could be used many places, e.g. to access online banking services, local public authorities' self-service, insurance companies, government tax authorities, and more. The idea was not new, but having a working, practical solution, was new. The solution gave cross-platform access via any device connected to the internet, e.g. work computers, home computers, internet cafes, smartphones, and more. The signature worked by having a username, password and a paper-based code card, which the user carried around, presumably in her/his wallet, i.e. a "something you have" solution (Paul, Morse, Zhang, Choong, & Theofanos, 2011) see Figure 1.

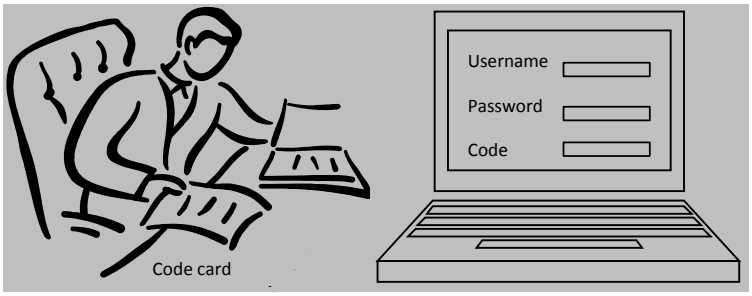

Figure 2. The NemID authentication system: Paper card with code, in combination with (memorized) username and password

History of design. The solution was by the government put out to tender in 2007, and became operational in January 2011. The preceding history included many designs, among those "Den Fælles Pinkode", which was stopped in March 2011. It was part of the Danish government's strategy for digitalization (Danish_government, Local_Government, & Danish_Regions, 2007). By April 2011 more than 3 mill Danes (the total population is 5,6 mill) had activated their digital signature, which meant that the company behind the signature estimated that the migration was ended with success (see http://www.computerworld.dk/art/115725/ computerworlds-laesere-nemid-er-tvang-og-spin).

Usability and user experience problems. Despite its long history of preceding solutions and development, many Danish users expressed their dissatisfaction with the new solution in blog, letters to newspaper, interviews in media, etc. Most famous among the expressions were a YouTube video made by a local stand-up comedian, who showed the problems that he had with the solution, among the biggest one was that he did not like to having to carry the paper based code card, which he saw as very out-dated method in the era of mobile computing, see http://www.youtube.com/watch?v=qE-bbRoSrR4&feature=player_detailpage.

3. Analysis

In the following we will present a brief analysis of the case from three different theoretical perspectives, ethnomethodology, cognitive work analysis, and human-work interaction design.

3.1. Ethnomethodology

In HCI, ethnomethodology has been presented as an important approach to studies of work and the workplace. One of the main features of ethnomethodology is that it is a-theoretical; it does not aim at theorizing about the content of work. So how would an Ethnomethodology study of NemID look like and what results would it give? What would it tell us about the UX?

While we were not able to find an ethnomethodology study of NemID, we found a useful example in an ethnographic field study of the use of mandated authentication systems with a "something you have" solution (Paul, et al., 2011), similar to the the paper-code-card NemID. In this study, the smartcards were meant to be used throughout the day as often as passwords would be used, i.e. during normal work situations. 24 users of a smartcard authentication system for U.S. Government employees (in technical work, support staff, or administration) were followed over 10 weeks and the researchers explored their user behaviour and perceptions through daily interviews and diaries. The main findings concerning the users experience was found by doing exit interviews, at the end of the study period. The users reported some

frustrations that they had had. Generally, they reported positive feelings related to the use of the authentication technology. Interestingly, though, the authors of the study report that when they asked the participants why they only responded daily in the beginning of the period, several participants said that later in the period they did not think or feel anything new to report. On basis of this, the authors suggest as a methodological improvement for their next study to modify the daily survey questions to fit with participants' evolving user experience.

This briefly presented case of an ethnographic/ethnomethodological approach to the analysis of the use of mandated authentication systems with a "something you have" solution suggest that the users' experience of the system evolves across time, and that this change may not be captured by a completely a-theoretical, user-oriented approach.

3.2. Work domain analysis/Hierarchical task analysis

In HCI, cognitive work analysis or its more narrowly scoped relatives, work domain analysis (WDA) and hierarchical task analysis (HTA), are theory-laden and somewhat formalistic approaches to studies of work and the work environment. How would a WDA/HTA study of NemID look like and what results would it give? What would it tell us about the UX?

As an illustrative example of a WDA/HTA study of NemID, we chose a master thesis study of NemID. The NemID solution was tested thoroughly by a usability consultant company during the development, which was an optimal situation even for the mature Danish market at that time. Later, after the NemID became operational, it was also tested in detail as part of a master thesis work (Pedersen, 2011). The thesis was not strong in work domain analysis (for an introduction of WDA, see e.g., (Jamieson, Miller, Ho, & Vicente, 2007)). In fact, the thesis explicitly did not focus on a broader view of what this type of authentication systems for citizens was. However, the thesis was a good example of an approach based on HTA analysis. Several user tasks for usability testing were identified, and usability tests based on these tasks were executed with two different user groups. Eight to 10 critical usability problems and many more serious usability problems were found (Pedersen, 2011). The thesis did not give much attention to UX, but treated it as traditional subjective satisfaction. The result was that the users were medium satisfied ("…middelmådige subjective satisfaction…", (Pedersen, 2011, p113), which was interpreted as a poor result on the background of the large amount of money used to develop the system. The conclusion was that up to 300.000 users could experience severe usability problems with NemID.

This briefly presented case of a WDA/HTA study of mandated authentication systems like NemID suggests that it is easy to forget about the work environment and focus only on free-floating universal user tasks, and also that neither WDA or HTA help understanding UX beyond frustration and satisfaction.

3.3. Human work interaction design

As presented in the introduction, in HCI Human work interaction design (HWID) is an emergent approach that aims at connection studies of work and the workplace with interaction design. How would a HWID study of NemID look like and what results would it give? What would it tell us about the UX?

A grounded theory HWID analysis of the type outlined in (Clemmensen, in press) was done of case material the about NemID (see Appendix A). The case material was simply all relevant documents that we could collect regarding the

NemID case. The analysis included 39 documents, which were segmented into 49 quotations that were coded with 40 codes. The codes were used to create a network, of which a simplified version is shown in Figure 3. The relations were those used by (Clemmensen, in press). When deciding on which relation to use, the list of quotations for each code (the boxes in Figure 3) was considered. The analysis was stopped when all quotations had been reviewed at least once.

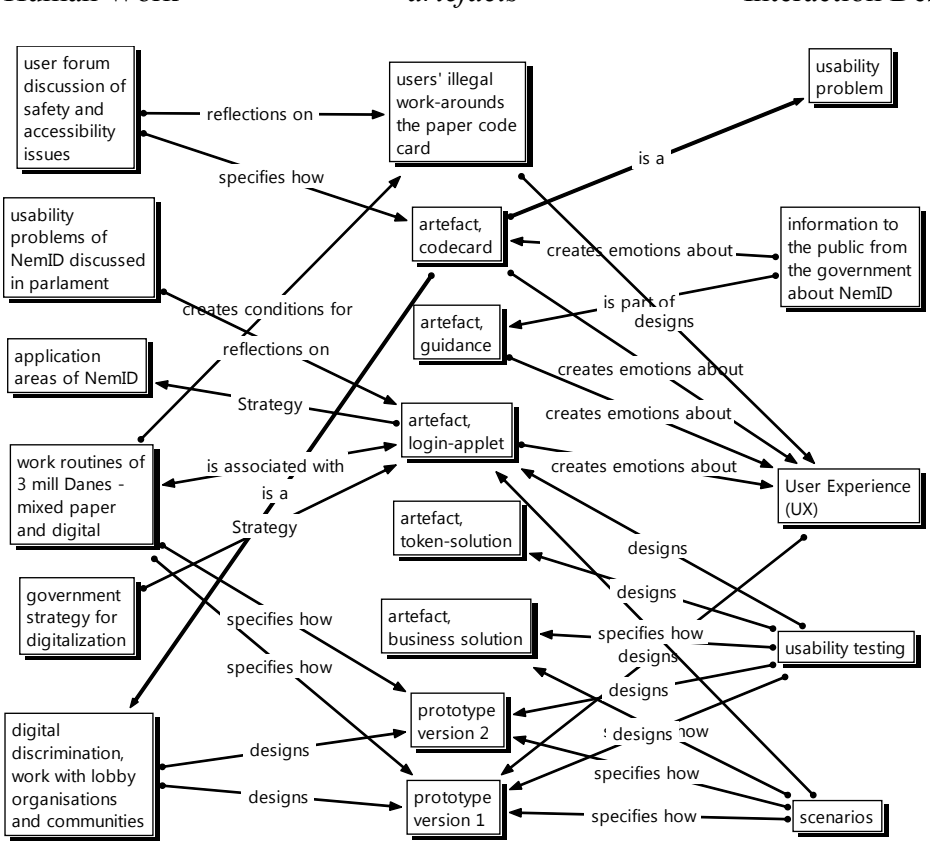

Figure 3. The analysis of connections between Human Work analysis and Interaction Design in the case of NemID.

A total of 47 relations were found. A frequency count, see Table 1, suggests that the artifact connects the work analysis and the interaction design by being the object of design and specifying how to relations. It is interesting to observe how users' illegal work-arounds (e.g., scanning and saving pictures of the paper card code on their mobile phone) connects what goes on in user forums (debates about work-arounds and more, i.e. work analysis) with the user experience (anticipated and real perceptions and responses, in particular emotional responses, on the use, i.e. interaction design). For example, two users' dialogue in a forum *"...anybody who has scanned their NEM-ID but found an app which could put a password on a pdf doc?...[response from another user:] ...I have just taken a picture of my NemID card, if that is what you mean..."* and what is found in usability studies about the UX is according to the researcher who did the study *"...people do apparently like the NemID less and less as the months pass, and their critique is related to use of an analogue code card in a digitized world..."*. Furthermore, when the users' illegal responses come to the light of the day, it suddenly is obvious that the UX must be

closely connected to the fact that there are 3 mill users. Studies of what they do in practice have shown that many Danes use mixed media (paper and computer) in their everyday office work (Glensbjerg, 2005).

Furthermore, the login-applet artifact connects the government strategy for digitization with the UX that the individual user experience; this underscores how theories and studies of UX should take into context more into account, what most studies of UX do not do (Bargas-Avila & Hornbæk, 2011). There are many more of the relations that could be analyzed in detail. We could e.g., mention the relations between a) what organizations and communities say about their user groups, and b) the designers' scenario writing.

Table 1. Relations that connects in the case of NemID

Relations	*Count*
is part of	10
Designs	9
is a	8
specifies how	7
creates emotions about	4
is associated with	4
reflections on	2
Strategy	2
creates conditions for	1
Total	47

4. Discussion

4.1. Comparison of ethnomethodology, WDA/HTA and HWID analysis

When comparing ethnomethodology with HWID, the ethnomethodology study found that the participants' user experience evolved throughout the study, but could not measure it or understand it by studying the user' daily practice – after a while the users did not seem to report anything new. In contrast, the HWID study by taking a much broader view on both work analysis in a broad sense and interaction design, suggests that what is considered UX is connected to a variety of artefacts to many different aspects of human work.

When comparing WDA/HTA with HWID, the HWID analysis illustrates that while the usability (and user experience) of the code card continues to be a problem, this is only one small thing in the larger picture of the human work interaction design of the NemID authentication. Thus, in the HWID interpretation frame, the possible "medium subjective satisfaction" identified as a negative result in the WDA/HTA usability study, is actually an acceptable result for culturally sustainable design. There is no need to get agitated about your use of work systems, but it does not mean that you do not feel anything about the use of them.

4.2. Studying relations

The revision of the general HWID framework that has been suggested in this paper focuses on studying the relations between human work and interaction design. In this paper we identified nine different types of relations with 47 instances of those. The

instances were each grounded in one or more quotations from empirical material used as primary documents or sources in the grounded theory analysis. We believe that this approach to study empirically and qualitatively the relations between human work and interaction design is needed to understand user experience and usability of large, complex, and mandatory use systems such as many eGovernment and public information systems. Many usability professionals may have experienced that even though we have well know methods of work analysis and also good interaction design techniques, usability is not a priority in eGovernment development and implementation. With this paper, we argue that HWID is an approach that by empirical studies of the relations can help us understand the larger context of connecting human work and interaction design.

5. Conclusion

This paper has outlined a revised version of the general human work interaction design (HWID) framework, with a focus on what connects empirical work analysis and interaction design, and then presented a case study of the Danish government one-for-all authentication system NemID. The case was briefly analyzed with two competing HCI approaches, ethnomethodology and work domain/task analysis, and then in more length, analyzed with the HWID approach. The three analyses were compared. Compared to the traditional approaches, the HWID focus on case-specific connections between human work and interaction design, gives different and supplementary answers.

This paper was written with the intention to be a basis for discussion and development of the HWID framework, by illustrating the benefit of studying real-life, empirical cases to see how human work analysis and interaction design in concrete cases are related and connected.

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