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USABILITY OF IT-SYSTEMS IS MORE THAN INTERACTION QUALITY - THE NEED OF COMMUNICATION AND BUSINESS PROCESS CRITERIA

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Abstract

The design and evaluation of IT-systems are usually supported by different usability criteria. Our hypothesis is that criteria are predominantly formulated as supporting interaction between a user and an IT-system. We are claiming that there is a need for criteria formulated at higher levels such as communication and business processes. One example of a criterion formulated at the interaction level is "Visibility of system status" and one example of a criterion formulated at the business process level is "Quality of work". If criteria is formulated and used on the interaction level only, the impact on design and evaluation can only take place at this level. This choice will also mean that you are only able to speculate whether the IT-system is supporting higher levels. We are not saying that criteria belonging to the interaction level are unimportant; rather we are saying that there is a need for formulating complementing criteria that resides on the communication and business process level.

Keywords: Usability criteria, Usability heuristics, Design principles,

1 INTRODUCTION

There is a lot of support available for designing and evaluating IT-systems (Jones 1970; 1990; Preece et al. 1994; Shneiderman 1998). The type of support we are addressing in this paper is normally referred to as usability criteria, principles, golden rules, factors or heuristics. We will use the name criteria in this paper when we refer to any of the concepts above. A common definition of criterion reads: a standard on which a judgment or decision may be based (AskOxford 2008; Merriam-Webster 2007). When we use the word criterion in this paper we mean a basis for comparison, like a reference point against which other 'things' can be evaluated. The aim of usability criteria is to support the design or evaluation of IT-systems (see section 2). We define usability as "a set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by a stated or implied set of users" (AS/NZS_4216 1994).

The problem we are addressing is that several of the existing criteria seem to support the interaction between a user and IT-System and not the business process. In order to support this hypothesis we present a few concrete examples that can be found in the "Ten heuristics" constructed by Nielsen & Molich (1990). The first heuristic reads "Visibility of the systems status". The second heuristic reads: "User control and Freedom" and the third heuristic reads: "Consistency and Standards". All these heuristics are important but they are *not primarily referring to the business process*. They are formulated to *support the interaction between a user and an IT-System*. The same observations can be made from studying the "Eight golden rules" constructed by Shneiderman (1998). One of the golden rules reads: "Enable frequent users to use shortcuts" and another golden rule reads: "Offer simple error handling". Our claim is that usability criteria should also be formulated to support communication between users and the business process.

We are viewing IT-systems as media or instruments that are used in order to support communication between users and business actions that are performed in the business process (Goldkuhl 2005), (see section 3). Therefore the use of an IT-system per se is only a means to achieve a higher goal; to successfully manage a business action that produces value for a client (Porter, 1985). Another basis supporting this hypothesis is a famous quote from Norman (1998), "I don't want to use a computer, I want to accomplish something". The first part of the quote "I don't want to use a computer" is related to the interaction between a user and IT-System. The second part "I want to accomplish something" is directly related to the business process. Norman (1998) doesn't want to worry about the system status, IP addresses, search algorithms or database structures. Norman (1998) wants to perform business actions in order to achieve a goal of a task. The IT-system is only a tool that should support him to achieve the goal through the performance of tasks. Therefore, the tool should reside in the background and the task (the business process) should reside in the foreground. The same way of reasoning is valid for usability criteria. Besides supporting interaction, we claim that usability criteria should support the design of the IT-mediated communication between users and should support the business process.

We have identified a few criteria that support the communication between users in a business. One example reads: "Satisfy communication needs" (Cronholm and Goldkuhl 2002). The meaning of this criterion is that a user should be able to "say" what he/she wants through the IT-System. We find these criteria are important, since they are highlighting the human-to-human perspective and not the more limited user-to-computer perspective (see section 2 for a more exhaustive discussion). Thereby, the use of an IT-system can also be viewed as a social process consisting of technology mediated business communication

We have also identified a few criteria supporting the business process. We find these criteria very important since they are oriented towards the actions or activities that exist in a business process. One example of a business oriented criterion is "Task sequencing" (see Participatory Heuristic Evaluation constructed by Muller et al., (1998)). "Task sequencing" is important since it governs the designers' attention towards how the IT-system can useful in the business. Our view is that there is a need for complimentary criteria supporting interaction, communication and business processes.

It seems that there are at least three levels that criteria can reside on; the "interaction level", the "communication level" and the "business process level" (see section 3). Furthermore, it also seems possible to create relations between the levels. The formulation of criteria at the "business process level" can be formulated as business goals that should be achieved. The formulation of criteria at the "communication level" can be formulated as means for achieving the criteria formulated at the "business process level". Consequently, criteria formulated at the "interaction level" can be viewed as means for achieving the criteria formulated at the "communication level". This hierarchy and a classification of criteria will be the focus of this research.

The relation between the three levels constitutes a hierarchy. The advantage and role of a multilevel abstraction hierarchy is discussed in Rasmussen et al. (1994). Rasmussen et al. (1994) compares a multilevel abstraction hierarchy with a means-end hierarchy and claim that a multilevel abstraction hierarchy is often used in practical problem solving processes. Furthermore, having access to several levels of abstraction is important for effective problem solving. That is, the hierarchy could be used for identifying more concrete interaction criteria that supports the fulfilment of more abstract business process criteria. Vice versa; the hierarchy could be used for searching more abstract business process criteria when that is needed. Shifts in the level of abstraction during problem solving have proved to be supportive and has been demonstrated by Wason & Johnson-Laird (1972). We are not saying that usability criteria formulated at the lower "interaction level" are unimportant; vice versa they are an important means for supporting the achievement of a higher level and to offer concrete criteria.

Research on the concept of interaction is reported within the area of Human-Computer Interaction (i.e. (Bratteteig and Stolterman 1997; Löwgren and Stolterman 1999; Preece et al. 1994). Research on the concepts of business processes is reported within the area of business processes and information systems (Davenport 1993; Hammer 1990). The growing number of criteria lists has intensified the need for practitioners to be able to understand that criteria are formulated on different levels. Our ambition is that the results will hopefully contribute to both novice and experienced practitioners; primarily as an imperative to look for criteria supporting the business process level. A second aim is to persuade criteria constructors to formulate criteria residing on all levels. This introductory section is followed by a definition of the concept of criterion (section 2). In section 3 the concepts of interaction, communication and business process are discussed. Section 4 describes our research method and in section 5 we present the findings. Finally, in section 6 we present the conclusions drawn.

2 INTERACTION, COMMUNICATION AND BUSINESS PROCESSES

The aim of this section is define the concepts of interaction and business process in order to further explain why there is a need of criteria being formulated on communication and the business process level. An interaction is defined as the interplay between a user and an IT-system (Ågerfalk 2003). To further clarify the concept of interaction with IT-system we have used the Elementary Interaction Model (EIAL) originally introduced in Ågerfalk (2003) and revised in Goldkuhl et al. (2004) (see figure 1). According to the EIAL an interaction consists of four phases: informing, execution, IT-system reaction and interpretation (see figure 1). The first phase, informing, means that a user interprets the action possibilities offered by the IT-systems and in order to reach a decision about what to do. The second phase, execution, describes that the user is performing the action chosen. The third phase, IT-system reaction, describes the IT-system's response to the user action. Finally, the fourth phase, interpretation, means that the user is interpreting the result of the IT-system's reaction.

In the middle of the interaction loop there is an interface containing documents with which a user interacts. A document can be a form or a web page. The screen document plays different roles in the phases, providing a multifunctional interface. In the informing phase the document is used when the user is reading the screen to figure out what to do. It contains information about the action possibilities and other conditions. In the next phase the screen document is used for execution. In this sense, the

document functions as an action medium. For example, the user enters some data in a field and clicks on a button on the screen in order to perform an action. The phase of the IT-system reaction should be understood as a response to the user execution. The IT-system's reaction can result in changes of the screen document (as a feed-back to the user). In this sense, the document consists of action results and functions as a basis for interpretation. This interaction can be examined in more detail from the human perspective by describing the low-level capabilities that may impact the interaction, like sensory, cognitive and motor domains (Persad et al. 2007).

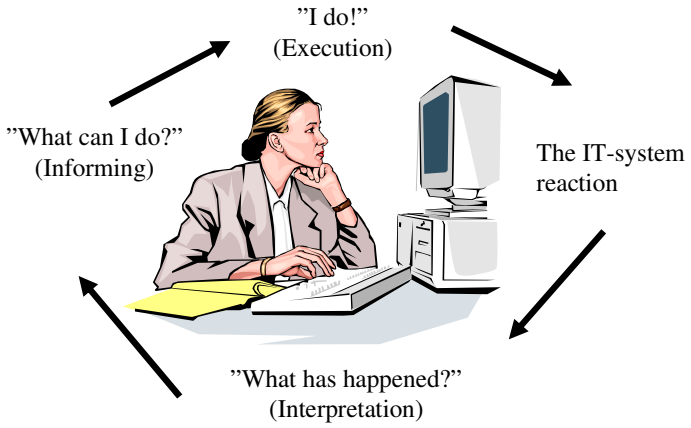

Figure 1. The Elementary Interaction Loop (Goldkuhl et al. 2004)

As mentioned in section 1, IT-systems are viewed as media that support the business actions. In most businesses or social contexts there is a lot of communication. Employees are communicating with each other through IT-system and employees are communicating with clients through the IT-systems in order to achieve business goals (Goldkuhl 2005). One example of such communication is a confirmation of an order. This is a communication that takes place between an employee and a client and it is also a communication that is taking place between employees (the order agent is informing a store man about the confirmation of an order).

The theoretical basis for viewing IT-system as communication and business systems are social action theory (e.g. (Weber 1978) and language action theory (Goldkuhl and Lyytinen 1982; Habermas 1985; Searle 1969; Winograd and Flores 1986). One main point in Weber's (1978) theory of social action is that communication is intentional. Using a social action perspective means that it is not acceptable to view IT-systems as a black box with some social and organizational consequences (Dietz 2001). IT-systems should therefore be perceived as systems for business action. The language action theory conceives communication as one type of action. Communication is not restricted to a mere transfer of information. To communicate is to establish interpersonal relationships between the sender and the receiver (Searle 1969). In a language action perspective, IT-systems are not considered as "containers of facts" or "instruments for information transmission" (Goldkuhl and Ågerfalk 2002). This perspective emphasizes what users do while communicating through an IT-system. IT-systems are thereby socio-technical systems for action in business and such actions are the means by which business relations are created.

The need of communication between employees and between employees and clients can be supported by IT-systems. The use of IT-systems is not an end in itself. The use of IT-systems is instrumental in relation to other aims and actions. The aim of using IT-systems in a business context (or a public context) is to support the communication that is taking place when performing business actions. The communication is important since it contributes to fulfilling business goals. The communication level can in this respect be considered as means for the level of business action. Business communication is therefore part of business processes. The aim of a business process is to produce product(s) and/or service(s) in order to satisfy the need of a business client and business goals.

The concepts of interaction, communication and business process are depicted as three sets or three levels (see figure 2). As pictured, the interaction is the interplay between a user and IT-System and the communication is something that occurs between two users; mediated by an IT-system. The arrow in the picture symbolizes the business; a business that produces something (a product or a service) for a client. The communication level is viewed as a subset of the business process level and the interaction level is viewed as a subset of the communication level. That means that if the IT-system is considered as providing good support for the business level it consequently also provides good support for the lower communication level and interaction level. On the other hand, if an IT-system is evaluated at the interaction level no predictions can be made of the higher communication level and business process level. Our claim is that there is a need to formulate a balanced set of criteria at all the three levels discussed, not only at the interaction level. The aim of figure 2 is to bring forward three important and related levels. We are not saying that criteria formulated at the interaction level are useless; ideally we would like to see criteria residing at all the three different levels and that they are coherent and complementary.

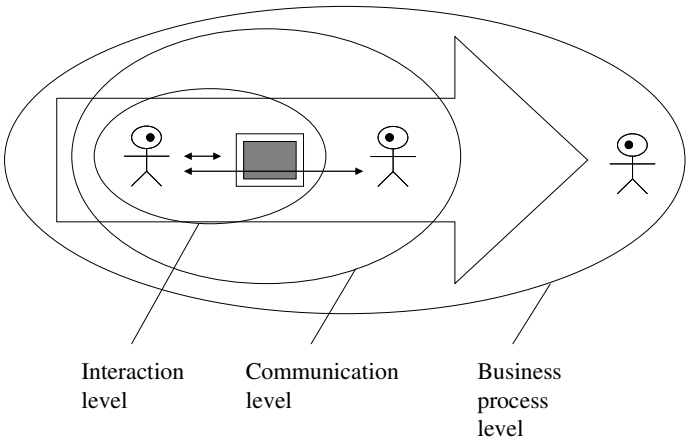

Figure 2. Relations between interaction, communication and business process

3 RESEARCH METHOD

Our hypothesis reads that there is a need for formulating criteria on higher levels than the interaction level. To verify our hypothesis we need to establish that existing criteria lists mainly reside on the interaction level. Looking closer into existing criteria lists it is obvious that some of them can be characterized as general while others are more context specific. In order to choose lists that represent a variation we have used the following criteria of selection: general/context-specific, variation in perspectives, thoroughness, easy accessible and familiar to practitioners.

The first selection criterion, general and context-specific, means that we have chosen criteria list that represents both general and context-specific criteria (see appendix). The need for using context specific criteria is touched upon, in a study performed by Beck et al., (2003). Results from a literature survey indicate that 44 of 114 papers in the area of mobile human-computer interaction (small-screen devices) utilized traditional usability evaluation techniques such as heuristic evaluation (Nielsen 1993; Nielsen and Molich 1990) and that only six of the papers employed new methods in realistic mobile use situations. A mobile phone or a PDA, provide a significant increase in supporting communication of a large range of business actions. Examples communication and business actions supported by small screen devices are buying and delivering of tickets for travelling or tickets for entertainment.

The second criterion, a variation in perspectives, means that different perspectives should be represented such as business, communication, technical and user. The third criterion, thoroughness, means that the criteria lists should have a broad coverage. A broad coverage is condition since the

designer (or evaluator) is focused on finding as many 'problems' as possible and wants the results to be as complete as possible (Sears 1997). The lists of criteria chosen must also be accessible to us, that is, they should be well described and easy to understand. Finally, as far as possible we have chosen lists of criteria that are well known.

We have also selected a research oriented, or an "academic", criteria list that is not well known to practitioners. The reason for choosing this list is that it is based on a communication perspective and it has good thoroughness. The idea of incorporating this list is to understand if and how criteria generated from a communication perspective will relate to the more familiar criteria lists. Our final selection consists of six different criteria lists. All criteria lists (except the "academic" list) meet the selection criteria. Two of the lists can be characterized as being of a general character; these lists are the 10 usability heuristics (Nielsen 1993) and the Eight Golden Rules (Shneiderman 1998). Two of the lists represent the context of small-screen devices; the chosen lists are design guidelines for small screen devices (Kärkkäinen and Laarni 2002) and context-aware mobile applications (Häkkilä and Mäntyjärvi 2006). The final two lists represent the communication and business context. The chosen lists are Participatory Heuristic Evaluation (Muller et al. 1998) and the "academic" criteria list Actability Principles (Cronholm and Goldkuhl 2002).

The model presented in figure 2 has served as an analysis model (see section 2). Two coders (the authors) have classified the formulation of each criterion as belonging to the interaction level, the communication level or to the business process level. Both coders have been involved with the concept of usability for the past ten-year, in a pedagogical and research perspective. Each coder was provided with the criteria lists, which included the description text published by each criteria list author. The coder performed the categorisation of each criterion in the criteria list individual (separately). The coders identified that some of the criteria are formulated in a way that they can belong to more than one level. In these cases the coders needed to make a judgement for a primary classification based on the emphasis placed on the criteria's description. Through classifying criteria an understanding of the scope and limitations of each criteria list has been achieved. The result of the classification of the criteria is based on the interpretation of the definitions and clarifications of the criteria presented in the literature. The results of the individual coding were then compared using the Cohen Kappa coefficient to ascertain the level of agreement between coders (Cohen 1960). This measure provides an easy calculation that test whether agreement between coders exceeds the chance levels of the coder classification. The calculation of classification of the criteria shows the level of agreement between coders (see section 5). The translation of the Kappa Statistics into strength of agreement is described by Landis and Koch (1977).

Once agreement levels were ascertained the similarities and discrepancies in the interpretation between coders of the criteria have been discussed. Where a disagreement existed, the criterion description was examined. The classification was then decided on the wording of the criterion and related to the level with the strongest relation. This process is not dissimilar to the conducting of a heuristic evaluation (Nielsen and Molich 1990), where inspectors examine an interface individually on two separate occasions and then come together to discuss their findings. In this way, both coders have ultimately agreed upon the final classifications discussed in the findings.

4 FINDINGS

The findings are presented according to the different contexts of the criteria lists chosen. First, we present the findings for criteria lists categorized as being of a general character (i.e. 10 usability heuristics (Nielsen 1993) and the Eight Golden Rules (Shneiderman 1998)). Second, we will present findings concerning the small screen devices (i.e. design guidelines for small screen devices (Kärkkäinen and Laarni 2002) and context-aware mobile applications (Häkkilä and Mäntyjärvi 2006)). Third, we will present our findings concerning the communication and business oriented criteria lists (i.e. Participatory Heuristic Evaluation (Muller et al. 1998)) and Actability Principles (Cronholm and Goldkuhl 2002)). Finally we will present a summary of the classifications. For each context the

criteria classification is made according to one of the levels interactive, communicative or business process. All the criteria lists are presented in the appendix.

4.1 Classification of criteria lists of general character

The findings show that most criteria belong to the interaction level, a few to the communication level and none to the business process level (see Table 1). This means that there is a heavy weighting towards the interaction level. The level of agreement between authors for this context is a Kappa value, κ = -0.1, that shows a poor agreement level. This disagreement was mainly due to the different interpretations of the wording of the description for criteria. The proportion of classifications made where authors agreed was P_o = 0.6. The main contention from the classification was with the interaction and communicative level.

Examples of criteria proposed by Nielsen (1993) that are classified as belonging to the interaction level are "Visibility of system status", "Match between system and the real world", "Consistency and standards" and "Aesthetic and minimalist design". Another example proposed by Shneiderman (1998) reads: "Offer informative feedback". The reason for classifying them at the interaction level is that they are all primarily referring to the interplay between a user and an IT-system. Examples of criteria belonging to the communication level are "Flexibility and efficiency of use" (Nielsen 1993) and "Design dialog to yield closure" (Shneiderman 1998). The reason for classifying these at the communication level is that they support the communicative intent of an action.

Name of criteria list	Number of Criteria	Interaction level	Communication level	Business Process level
Heuristics	10	7	3	0
Eight Golden Rules	8	7	1	0

Table 1: Classification of criteria lists of general character

4.2 Classification of criteria lists of small screen devices

The findings concerning the criteria lists of small screen devices show that most criteria belong to the interaction level, a considerable number to the communication level and one to the business process level (Table 2). It is clear the concentration of criteria is predominantly found in the interaction level. It is interesting that the classification of the criteria list "context aware mobile applications" resulted in five of the criteria being classified as belonging to the interaction level and four of the criteria as belonging to the communication level. The level of author agreement for this context was a Kappa value, κ = 0.4, that is considered a fair level of agreement between the authors. The proportion of classifications made where authors agreed was P_o = 0.7. The disagreements in classifications were spread across all levels.

Examples of criteria proposed by Kärkkäinen and Laarni (2002) that are classified as belonging to the interaction level are "Present the most important information first at the top of the hierarchy", "Re-think the navigational aids", "Indicate the links clearly" and "Optimize the reading process". Another example proposed by Häkkilä and Mäntyjärvi (2006) is "Avoid information overflow". Clearly, the primarily aim of these criteria is to support interaction within the context of small screen devices.

Examples of criteria proposed by Häkkilä and Mäntyjärvi (2006) that are classified as belonging to the communication level are "Consider the uncertainty in decision-making situations" and "Prevention from interruption". These criteria support the communicative intent of the performance of a task. These criteria are especially important for small screen devices because the mobility of the device can find the user in various situations that can have an impact on the communicative intent of IT-System (mobile device). Examples of criteria belonging to the business process level are "Determine the

purpose of the site / service" (Kärkkäinen and Laarni 2002) and "Usefulness" (Häkkilä and Mäntyjärvi 2006). The argument for classifying these criteria at the business process level is that they are primarily referring to purpose and usefulness to the business.

Name of criteria list	Number of Criteria	Interaction level	Communication level	Business Process level
Small Screen Devices	8	6	1	1
Context aware mobile applications	10	5	4	1

Table 2: Classification of criteria lists of small screen devices

4.3 Classification of criteria lists of communication and business process

The findings concerning the criteria lists of communication and business processes show that most criteria belong to the interaction level, a fair number to the communication level and a fair number to the business level (Table 3). Some interesting differences are that the actability principles are predominant at the interaction level and the communication level while the participatory heuristics evaluation criteria are predominant at the business process level (the +5 in the column "number of criteria" refers to the extension of the 10 heuristics (Nielsen 1993) and number between brackets refers to the 10 heuristics). The level of agreement by the authors for this context was a Kappa value, κ = 0.9, that is considered an almost perfect level of agreement. The proportion of classifications made where authors agreed was P_o = 0.9. The one difference was the criteria "Understand used concepts (familiar and understandable vocabulary)" (Cronholm and Goldkuhl 2002), which was classified within the interaction level by one author and communication level by the other author. This difference was discussed placed primarily in the interaction level based on the emphasis placed in the wording of the criteria's description.

Name of criteria list	Number of Criteria	Interaction level	Communication level	Business Process level
Actability Principles	10	6	4	0
Participatory Heuristic Evaluation	+5 (10)	1 (7)	0 (3)	4 (0)

Table 3: Classification of criteria lists of communication and business process

Examples of criteria proposed by Cronholm & Goldkuhl (2002, 2005) that are classified as belonging to the interaction level are "Clear action repertoire", "easy to navigate and "Familiar and understandable vocabulary". Another example is "Skills" (Muller et al., 1998). The aim of these criteria is to support interaction. Examples of criteria proposed by Cronholm & Goldkuhl (2002, 2005) that are classified as belonging to the communication level are "Satisfy communication needs, "Understand the communicative intent of different messages" and "Offer good support for business actions". All these three examples are primarily aimed at supporting the communication between users. Examples of criteria proposed by Muller et al. (1998) that are that are classified as belonging to the business process level are "Task Sequencing" and "Quality of work". The reason for viewing these criteria as belonging to the business process level is that they refer to the business tasks or work. They are aiming at providing value for a client.

4.4 Summary of Classifications

The findings concerning all the criteria lists show that a huge majority of the criteria is classified as belonging to the interaction level, some to the communication level and a few to the business level

(see Table 4). Five of the six analyzed criteria lists consist of a majority of interactive criteria. It is not surprising that the business process orientated contexts embrace more criteria that are characterized as related to the communicative or business process dimension. What is notable is that both the contexts of general and small screen devices have a strong focus on interaction. The analysis shows that the communicative and business process levels have been neglected in several of criteria lists. An interesting observation is that even criteria lists characterized as being communication and business oriented, embrace criteria that mostly belong to the interaction level.

In summary, for all the criteria lists analysed, the proportion of classification made where authors agreed, $P_o = 0.78$, and the proportion of categorisations made where agreement is expected by chance, $P_c = 0.51$. This describes a very high level of agreement on classifications between authors, based on P_o. The coefficient of agreement, Cohen's (1960) Kappa, for all of the criteria lists classified, $\kappa = 0.56$, is a moderate level of agreement between authors, as describe by Landis and Koch (1977), see figure 3. This provides an excellent starting point for the two authors to come to a consensus in the classification of criteria. The heavy weighting towards the interaction level has also been identified by Sears (1997). Sears (1997) discusses this gap from an evaluation technique perspective and proposes a combination of a heuristic evaluation (Nielsen 1993) with a cognitive walkthrough (Nielsen and Mack 1994) in order to achieve a better usability outcome. Our interpretation of the research by Sears is that he attempts to compensate for the gap between the interaction level and the business level. All the lists contain gaps in one or two of the proposed levels. It seems that the inventors of the lists have applied, consciously or not, a specific perspective while constructing the lists. The best coverage of all the levels can be found in Participatory Heuristic Evaluation (Muller et al. 1998).

Context	Set of criteria	No of criteria	IL	CL	BPL	Kappa
General	Nielsen's Heuristics	10	7	3	0	-0.1
	Eight Golden Rules	8	7	1	0	
Small Screen Device	Small Screen Device	8	6	1	1	0.4
	Context Aware Mobile Devices	10	5	4	1	
Business Orientated	Actability Principles	10	6	4	0	0.9
	Participatory Heuristic Evaluation	+5 (10)	1 (7)	0 (3)	4 (0)	
						0.56

Table 4: Summary of all criteria classification

5 CONCLUSIONS

Our hypothesis reads that there is a need for formulating criteria at higher levels than the interaction level. The analysis has shown that criteria: mainly support the interaction between a user and an IT-System, are not formulated to support a human-to-human communication (mediated by an IT-System) and are not formulated to support the higher level of business processes. The definition of usability (see section 1) puts the onus on the practitioner to define the "set of attributes" that defines the usability goals for a project. The aim of the model presented in section 2 is to support the practitioner to explicitly define and select criteria at different levels.

Before drawing conclusions we would like to say that criteria are not something that should be used in a mechanical way. You should always be open to other problems and strengths that are not covered by the criteria used. But, using criteria means to intentional focusing on certain aspects that correspond to the criteria selected. That's why a selection is important. If criteria formulated on the interaction level only are used, design and evaluation can only take place at this level. This choice will also mean that you are only able to speculate whether the IT-system is supporting the higher levels, i.e. the communication level and the business process level. If a designer or evaluator is using criteria belonging only to the interaction level, there can be a risk of unconsciously overlooking other

important aspects of the IT-systems. We are not saying that criteria belonging to the interaction level are unimportant, rather we are saying that there is a need for formulating complementing criteria residing on the communication and business process level.

In order to get a broad coverage of different criteria lists, we selected three different contexts. The importance of identifying different contexts is acknowledged by Henninger et al. (1995). They claim that "If the potential of usability guidelines as an interface design technique is to be fully realized, they need to be augmented with context-specific guidelines and examples that synthesize isolated guidelines into domain-specific solutions to design problems". One conclusion is that the contexts do not differ that much when looking at each lists relative distribution of interactive, communicative and business process oriented criteria. Most of the criteria, considering all the contexts, are formulated as interaction criteria. Otherwise, there are no major differences between the lists, except that the lists "Context Aware Mobile Devices" (Häkkilä and Mäntyjärvi 2006) and "Actability principles" (Cronholm and Goldkuhl 2002) that tend to lean more towards the communicative level.

Our conclusion that most criteria are oriented towards interaction is supported by Hartson et al. (2001) who are claiming "Usability is seated in the interaction design". Another observation that supports our conclusion is the criteria list constructed by Muller et al. (1998). We interpret the criteria added by Muller et al. (1998) to Nielsen's 10 heuristics (1993) as a reaction towards Nielsen's formulations. The five added criteria by Muller et al. (1998) are mostly formulated at the business process level. Table 4 clearly shows that the work done by Muller et al. (1998), has identified the imbalance in the original criteria, proposed by Nielsen (1993). Hornbæk & Erik Frøkjær (2008) support the importance of using criteria residing on higher levels. They claim that problems discovered will have higher business relevance.

The result is based on the analysis of six usability criteria lists and the results have to some extent been compared to existing theory. Our opinion is that the direction of the results works as a good basis for further elaborations. There is a need of further elaborations considering other criteria lists and other types of IT-systems. As future research we also propose a deepened elaboration on the relations between the three levels described.

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Appendix

Nielsen's (1993) Heuristics

Visibility of system status
Match between system and the real world
User control and freedom
Consistency and standards
Error prevention
Recognition rather than recall
Flexibility and efficiency of use
Aesthetic and minimalist design
Help users recognize, diagnose, and recover from errors
Help and documentation

Shneiderman's (1998) Eight Golden Rules

Strive for consistency.
Enable frequent users to use shortcuts.
Offer informative feedback.
Design dialog to yield closure.
Offer simple error handling.
Permit easy reversal of actions.
Support internal locus of control.
Reduce short-term memory load.

Häkillä & Mäntyjärvi's (2006) Context Aware Mobile Application Guidelines

Consider the uncertainty in decision-making situations.
Prevention from interruptions.
Personalization.
Avoid information overflow.
Secure the user's privacy.
Remember mobility.
Secure the user control.
Access to context.
Visibility of system status.
Usefulness.

Kärkkäinen & Laarni's (2002) Small Screen Device Guidelines

Determine the purpose of the site / service
Re-evaluate the interface metaphors
Present the most important information first at the top of the hierarchy
Re-think the navigation aids
Indicate the links clearly
Optimize the reading process
Use markers while scrolling or paging text
Use pictures with caution

Cronholm & Goldkuhl's (2002; 2005) Actability Principles

Easy to understands what can be done with the system (clear action repertoire)
Able to "say" what he/she wants through the system (satisfy communication needs)
Can easily move to another document (easy to navigate)
Understand consequences of proposed and performed actions (action transparency)
Can immediately see if the intended action is executed (clear feed back)
Can easily access information of what has been done previously (easy access to action memory)
Know who has said what (personalized information)
Understand used concepts (familiar and understandable vocabulary)
Understand the communicative intention of different messages
Offer a good support for business actions

Muller et. al.'s (1998) Participatory Heuristic Evaluation (the added five criteria to Nielsen's 10 heuristics)

Task Sequencing
Skills
Pleasurable and Respectful Interaction with the User.
Quality Work
Privacy