Do you Need General Principles or Concrete Heuristics? - a Model for Categorizing Usability Criteria

Dr Stefan Cronholm
Dept. of Management and Engineering
Linköping University, Sweden
stefan.cronholm@liu.se

Vince Bruno
School of Business Information Technology
RMIT University, Victoria, Australia
vince.bruno@rmit.edu.au

ABSTRACT
This paper analyses the character of usability criteria found in lists, which are used for interface design and evaluation. In order to understand usability criteria and relations between different criteria, a categorization of six usability criteria lists has been performed. The analysis has shown that the formulations of criteria reside on different abstraction levels. The results consist of two knowledge contribution. The first contribution is a hierarchical categorization model. The role of this multilevel abstraction hierarchy is to support practical problem solving processes by enabling and supporting the explicit articulation of criteria for a given context. The second contribution is a categorization of usability criteria. The aim of this categorization is to support the understanding of how different usability criteria relate (e.g. overlap or complement) to each other and highlight possible gaps.

Categories and Subject Descriptors
D.2.2 [**Design Tools and Techniques**]: User Interfaces

General Terms
Measurement, Design.

Keywords
Usability criteria, principles for design, usability guidelines

1. INTRODUCTION
As a support for design and evaluation of IT-systems there exist a lot of usability criteria lists [1-6]. Many of the newer criteria lists are based on Nielsen's [5] original ten heuristics, and are tailored for a given technology, users, tasks and/or context [7]. Criteria lists are sometimes referred to as principles, golden rules, factors or heuristics. In this paper, we will use the name criteria when we refer to any of the concepts above.

The problem we are facing is that the support for business actions offered by IT-systems often seems to be disharmonised with the actions performed in the work practice. Hägerfors [8] points out the discrepancy between design of IT-systems and work situations. Bannon [9] describes the need among researchers and designers for a better understanding of work settings. Users of IT-systems should be understood as actors with a set of skills and shared practices based on work experiences (ibid.). A similar claim can be found in Cronholm & Goldkuhl [10]; IT-systems don't fully support the business actions. Our work has similarities with the research performed by Gerlach & Kuo [11]. The aim of the work by Gerlach & Kuo [11] is to enable design practice to become more systematic and less intuitive than it is today. This aim is also valid for this study. By providing a structured and categorized set of criteria we want to support design practitioners in understanding and choosing relevant usability criteria. A structured approach is supported by Somervell and McCrickard [7]. They prescribe that the need of creating/choosing criteria lists ought to be a structured process.

According to Chevalier & Ivory [12], there is little support for the complexities involved in the design activity. The ability of usability professionals, both novice and expert, to articulate or utilise guidelines during the design process is an important skill, that can enhance the usability of an interface design and interaction style. Furthermore, the work by Tao [13] suggests a significant gap between the knowledge and application of web design guidelines. The outcome of Tao's [13] research suggests a strategy for developing web design guideline skills is needed. Fitzpatrick and Higgins [14] imply that a problem exists in defining usability requirements, usability attributes and criteria lists. They suggest three strands to focus on: Software quality, Statutory Obligations, and Human Computer Interaction. These strands seem important, but in our opinion they are formulated at a relatively high abstraction level and don't provide much support if you are looking for concrete criteria. Support for the need of this study can also be found in Gould and Lewis [15]. The claim, in their study, is that design guidelines are limited since they are not detailed enough.

In our opinion there is a need for both abstract and concrete criteria and an understanding of how they are related to each other. This paper provides a categorisation model that could support practitioners in generating both abstract and concrete criteria. Based on these claims several questions could be asked: What is the character of existing criteria? Are they formulated in an understandable way? Are they too general or are they too concrete? Are they formulated in a way that they really are supporting the design of interactions? Are they supporting the design of a whole interaction or just a part of it? Are the criteria supporting business actions or are they supporting a limited human-computer interaction? Several of the existing usability criteria lists seem to be heavily oriented towards the design of the interface instead of supporting the performance of business actions. All these initially questions are summed up in a broader research question that reads: how do we support usability practitioners in the explicit generation of a usability criteria list? That means, the broader question should been seen

OZCHI 2008, December 8-10, 2008, Cairns, QLD, Australia.

OZCHI 2008 Proceedings ISBN: 0-9803063-4-5

as an overarching question consisting of the initially questions. This research will focus on this broader question.

In order to answer the questions asked we have analysed a number of criteria lists. We have performed the analysis from a communicative perspective [16-20] as a contrast to the traditional theories that Human Computer Interaction [21] is based on e.g. computer science and cognitive science/psychology). This introductory section is followed by a presentation of a theoretical model that is used for categorising existing usability criteria. In section 3 the research process is presented and in section 4 we are describing our findings. Finally, in section 5 we are discussing the conclusions drawn.

2. THEORETICAL BASES

Sjöström & Goldkuhl [22] present a communicative view on user interfaces (see figure 1). They argue that this communicative view is important if we wish to understand the business communication that is going on when using IT-systems. Their model is based on semiotic and socio-pragmatic theories. IT-systems are regarded as systems for technology mediated business communication.

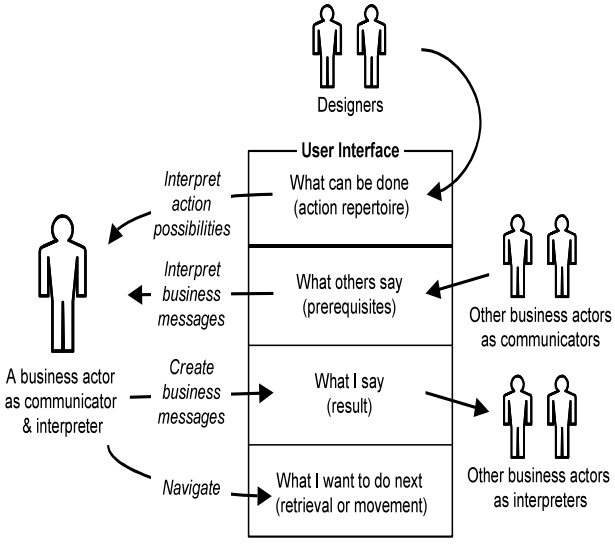

Figure 1. A communicative view on user interfaces [22]

The model of the user interface is divided into four parts dependent on its communicative functions. First, the possible business actions that a user could perform are considered as communication from designers to users. This part means that the user interprets different action possibilities of the IT-system. The user is interpreting the action possibilities in order to understand how he/she could communicate through the IT-system with other business actors. Second, the user may interpret messages from other business actors. Third, the user may also formulate messages intended for other business actors. Fourth, the user can also navigate in the document space offered by the IT-system. Navigation is not seen as a communication with other actors, but is part of the user's management of the IT-system.

The reason for choosing a communicative view is that this view emphasizing an actor (a user) communicating with other business actors while interacting with the interface. It is a human-to-human interaction, not just a human-computer interaction. Thereby, the use of IT-system is viewed as a social process consisting of technology mediated business communication. In order to further clarify the interaction seen from a communicative view the Elementary InterAction Loop (EIAL) has been developed. EIAL is originally introduced in Ågerfalk [23] but has been further developed in Cronholm & Goldkuhl [10] and Goldkuhl et al. [24]. According to EIAL an interactive situation consists of four phases: informing, execution, IT-system reaction and interpretation (see figure 2). The first phase, informing, means that a business actor interprets the action repertoire offered and possible messages from other business actors in order to reach a decision about what to do. The second phase, execution, describes that the user is doing the action chosen. The third phase, IT-system reaction, describes the IT-systems response of the business actor's action. Finally, the fourth phase, interpretation, means that the business actor is interpreting the result of the IT-system's reaction.

In the middle of the interaction loop a screen document[1] is placed. The screen document (as part of the user interface) plays different roles in the phases. One can say that the screen document is multifunctional. In the informing phase the screen 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 action conditions. In the next phase the screen document is used for execution. In this sense, the screen 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 screen document consists of action results and functions as a basis for interpretation.

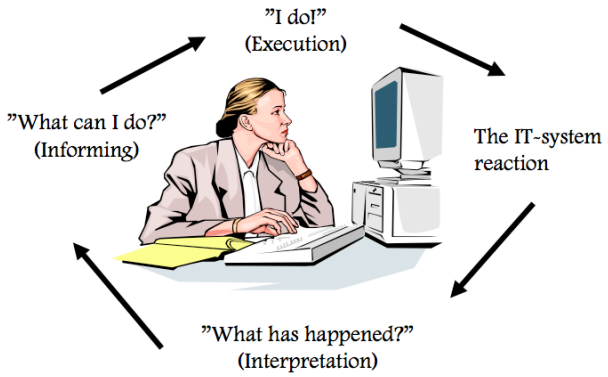

Figure 2. The Elementary InterAction Loop (based on [10])

The EIAL model has some similarities with the action model presented in Norman [25]. The seven stages in Norman's model can be grouped into three main stages: Preparation, performance and evaluation [26]. The phases of the EIAL loop correspond to the phases of Norman's model in the following way. The first phase (informing) corresponds with preparation, second phase (execution) corresponds with performance, and the final phase (interpretation) corresponds with evaluation. The third phase (IT-System Reaction) is missing in Norman's model (ibid).

The EIAL model is also compared to the classical action model by Mead [27]. This model consists of four stages: 1) impulse, 2) perception, 3) manipulation, and 4) consummation. The first phase (informing) corresponds to Mead's perceptual stages impulse and perception. Before one can act, one must perceive

[1] Any designed interface with which a user interacts such as a form or a web page.

the action environment and become informed about action possibilities. The second phase (execution) corresponds to the manipulation stage of Mead and the last phase (interpretation) corresponds to the last stage of Mead (consummation).

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 use of IT-systems aiming at permitting and promoting actions in order to achieve other business aims. A user interacting with an IT-system in a business normally means that the user is communicating with another user. The IT-system is mediating the business communication. The business communication is an important part since it contributes to fulfil important business goals. 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.

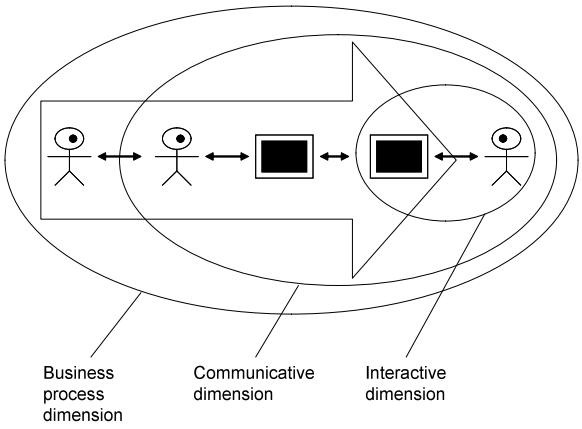

Figure 3. Relations between the interactive, communicative and business process dimension

The relation between the discussed dimensions is pictured in figure 3. The use of IT-systems is multi-functional. When a user interacts with an IT-system she is at the same time communicating with other users in order to satisfy the needs of the business clients. This means that the qualities can be seen as three levels. The first level is the interaction dimension (the interplay between as user and an IT-system), the second level represents communication dimension (the IT-system as a mediator of business communication and the third level is a business process dimension (the use of IT as an instrument in business processes).

This section provides the basis on which the categorisation hierarchy is built. The EIAL provided the phases that described the various activities occurring during the interactive situation. The communicative dimension provides the perspective and context through which we examined the criteria.

3. RESEARCH APPROACH

The EIAL model (see section 2) has been used as an analysis model for categorising usability criteria. The aim was to understand the character of each criterion. To categorize means to order 'things' by a class or a category [28]. It is a basic cognitive process of arranging 'things' [29].

We have categorised each criterion according to the four phases of EIAL. We discovered that some criteria are formulated in a more abstract way than others. Thereby, several criteria were too general to fit into one of the phases. In fact, some of the criteria could fit into every phase. As a consequence, we needed to introduce general categories and more concrete subcategories. In order to support the generation of categories and subcategories we used a question battery [30]. Examples of questions asked are: What is this criterion about, what is this criterion an example of and what examples are there for this criterion. The aim of these simple questions is to support the identification of different abstraction levels.

In order to fully understand and to clarify the meaning of each criterion, the categorization work resulted in a hierarchical model consisting of four levels. Criteria residing on a higher level are operationalized in a lower level, that is, a lower level contains more concrete formulations of criteria compared to the higher levels. The aim of this categorization and detailed analysis is to present a model that supports a conceptual understanding of usability criteria.

The characterization model and the categorization itself have emerged in a dialectic fashion. Dialecticism supports the understanding between the wholeness and its parts [31, 32] or between the system and its elements [33]. That means that categorization model was not constructed and ready for use before this study took place. Rather, the model emerged in parallel with the analysis of individual criteria.

We have selected six different usability criteria lists for analysis. The criteria for choosing the criteria list are: they should targeting both traditional computers and small screen devices. They should represent a variation in perspectives such as business, technical and user perspectives. A variation in perspectives means that different perspectives should be represented such as business, technical and user perspectives. They should also be thorough. Thoroughness means that the criteria lists cannot be too small. They must have a broad coverage since the user of criteria lists is focused on finding as many 'problems' as possible and wants the results to be as complete as possible [34]. The sets 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 criteria that are well known. The chosen criteria lists are: 10 usability heuristics [5], Eight Golden Rules [6], design guidelines for small screen devices [3], context-aware mobile applications [2], Actability Principles [10, 35] and Participatory Heuristic Evaluation [4].

The idea of categorising criteria into different levels is inspired by Muller et al. [4]. Muller et al. explicitly using the flat criteria list (the ten heuristics) by Nielsen [5] as a base for deriving five new criteria. Muller et al. have exemplary grouped all the 15 criteria and thereby identified one higher abstraction level. We want to further develop the work by Muller et al. [4] by relating usability criteria to different phases of an elementary interaction (see section 2). The work by Muller et al. [4] is not taken for granted; rather it has been questioned. Something that is unclear in their work is what grounds have been used for the division. In the concluding section we will compare our findings by the work of Muller et al. [4] .

4. FINDINGS

The findings are presented in two parts. First each criteria list is individually characterized. Then, the categorization model and the results of the characterization are presented. The wording of the guidelines used has not been changed simply categorized.

4.1 The character of each criteria list

The criteria proposed by Nielsen [5] and Shneiderman [6] correspond to all the phases of EIAL. Several of the criteria are formulated on a more general level. Examples of such formulations are Nielsen's criteria "User control and freedom" and "Consistency and standards". Shneiderman's corresponding

formulations are “Support internal locus of control” and “Strive for consistency”. In fact, Shneiderman seems to be heavily inspired by Nielsen’s work. Both Nielsen’s and Shneiderman’s criteria are formulated from a perspective where one user is interacting with one computer. The communicative aspect is not present.

The criteria lists constructed by Häkkilä & Mäntyjärvi [2] and Kärkkäinen & Laarni [3] represent proposals for small screen devices. The criteria proposed by Häkkilä & Mäntyjärvi [2] are represented in all the phases of EIAL except the phase IT-system action. Several of Häkkilä & Mäntyjärvi’s criteria are general in character and some are small-screen specific. An example of a general and at the same time, small-screen specific, contextual criteria is “Remember mobility”. Häkkilä & Mäntyjärvi [2] propose a few criteria that are similar to the proposal of Nielsen [5] such as “User control” and “Visibility of the system status”. Several of the criteria proposed by Kärkkäinen & Laarni [3] are formulated on a more concrete level than the other criteria lists analysed. Examples of formulations are “Use markers while scrolling or paging text” and “Indicate the links clearly”. The criteria are mainly orientated towards the user and the interaction between the user and the IT-System. The criteria proposed by Kärkkäinen & Laarni [3] are mainly general or oriented towards the informing phase. The communication aspect is not present in these two criteria lists which represent small screen devices.

The criteria presented by Cronholm & Goldkuhl [10, 35] are explicitly formulated from a communication and business process perspective. This is also evident through the vocabulary used in the formulations of the criteria. Examples of communicative oriented criteria are: “The user should be able to ‘say’ what he/she wants through the system (satisfy communication needs)” and “Understand the communicative intention of different messages”. The criteria proposed by Cronholm & Goldkuhl [10, 35] are represented in all the phases of EIAL except the phase IT-system action. The last criteria list chosen contains criteria proposed by Muller et al. [4]. The work by Muller et al. [4] both build upon and challenge the proposed heuristics of Nielsen [5]. Muller et al. have added five more criteria to Nielsen’s original ten criteria. Some of the additional five criteria are more business oriented than the original ten. This business perspective is represented by criteria such as “Quality work” and “Privacy (The system helps the user to protect personal or private information—belonging to the user or to his or clients). The criteria proposed by Muller et al. [4] are represented in all the phases of EIAL.

4.2 Categorisation model and results

The findings constitute both a categorization model (see figure 4) and the results of the categorizations made. The model has been constructed during the analysis and in parallel with the emerging results. One can say that the model and the results of the categorization have emerged in a dialectic fashion.

The categorization model represents a hierarchy of criteria. The top level contains principles. A principle is defined as a fundamental truth, a proposition or a general rule [29]. An example of a principle is “usefulness” [5]. The next hierarchical level consists of advices. An advice is defined as a general opinion [36] . An opinion about what could be done about a situation or a problem [29]. An example of an advice is “The system should speak the users’ language” [5]. The third level consists of guidelines. To guide means to lead, to show the way [36] or something that determines the course of action [29]. An example of a guideline is “error prevention” [4]. The lowest hierarchical level consists of heuristics. A heuristic is defined as serving to discover or find out [36]. An example of a concrete heuristic is “present the most important information at the top” [3]. The outcome of the categorization is described in section 4.2.1 – 4.2.3 (P=Principle, A=Advice, G=Guideline and H=heuristic).

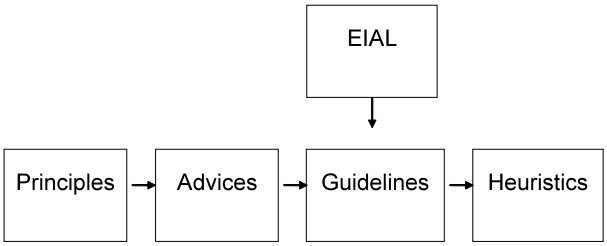

Figure 4. The categorization model of usability criteria

4.2.1 Principles

Identified principles are: P1 usefulness, P2 offer a good support for business actions, P3 quality work, and P4 match between system and the real world. We are considering them as very abstract since they are rather pointing out a general rule than providing a support for how-to-do. These abstract criteria fit into every one of the four phases of EIAL.

4.2.2 Advices

A1 Vocabulary is the first identified advice. Vocabulary means that the system should speak the users' language and that familiar concepts should be used. The second advice is A2 User control. User control is about to design the system to make users the initiators of actions rather than the responders, users should be able to select and sequence tasks (when appropriate), rather than the system taking control of the users’ actions and that users should understand consequences of proposed and performed actions. The third advice is A3 Consistency and standards. This advice means that real-world conventions should be followed and that consistent sequences of actions should be required in similar situations. The fourth advice is A4 Flexibility and efficiency of use. To design for flexibility and efficiency mean to allow users to tailor frequent actions, to provide accelerators, implementing filtering according to the user’s personal preferences, to provide the user a possibility to edit context attributes and to make sure that previously stored information is easy to access. The fifth advice is A5 Secure the user’s privacy. Secure the user’s privacy means that the system supports the user to protect personal or private information. The character of the advices is mainly human-computer orientated and not human-to-human orientated. According to our analysis, these advices could fit into every one of the four phases of EIAL.

4.2.3 Interaction phases, guidelines and heuristics

There are a high amount of guidelines and heuristics related to the interaction phases and both levels are well represented. The following sub-sections show how guidelines and heuristics are related to different phases of the EIAL.

4.2.3.1 The Informing phase – What can I do?

G1 Reduce memory load
H1 Make objects, actions, and options visible
H2 Instructions for use of the system should be visible
H3 Displays should be kept simple
H4 Multiple page displays be consolidated
H5 Window-motion frequency be reduced

H6 Sufficient training time be allotted for codes, mnemonics, and sequences of actions
H7 Clear action repertoire
H8 Reduce short-term memory load
H9 Recognition rather than recall
H10 Use markers while scrolling or paging text

G2 Aesthetic and minimalist design
H1 Dialogues should not contain information which is irrelevant or rarely needed
H2 Avoid information overflow
H3 Present the most important information first at the top of the hierarchy
H4 Re-think the navigation aids. Constantly visible navigation bars require too much display space
H5 Pleasurable and respectful interaction with the user
H6 Re-think the navigation aids
H7 Optimize the reading process
H8 Use pictures with caution

G3 Avoid anonymity
H1 The IT-systems should contribute to making actors visible and neutralize anonymity
H2 Users should know who has said what

G4 Communicative intent
H1 The user should understand the intention of different messages (documents) received.

G5 Help and documentation
H1 The IT-system should offer explanations for each concept

Clearly, there are a large number of guidelines and heuristics related to the informing phase. For every guideline there is one or several heuristics represented. We believe that a good mix between abstract and concrete formulations makes a criterion more understandable and thereby usable. The majority of the guidelines belonging to the informing phase are oriented towards the interaction aspect. They are thereby oriented towards the human-computer relation. However, a few guidelines are oriented towards the communication aspect or the human-human relation such as "Avoid anonymity" and "Communicative intent"

4.2.3.2 The Execution phase – I do!

G1 Error prevention
H1 Careful design which prevents a problem from occurring in the first place
H2 Eliminate error-prone conditions
H3 Present users with a confirmation option before they commit to the action
H4 Prevention from interruptions
H5 Easy to navigate

G2 Design dialog to yield closure
H1 Sequences of actions should be organized into groups with a beginning, middle, and end
H2 The IT-system should be designed in a way that users in advance understand the meaning of the business action
H3 Prevention from interruptions

G3 Understand consequences of proposed actions
H1 The IT-system should be designed in a way that users in advance understand the consequences of a business action

G4 Satisfy communication need
H1 The use should be able to "say" what he/she wants through the system
H2 There should be possibilities for registration of information in the system that the user wishes others to read
H3 Understand the communicative intention of different messages

G5 Consider the degree of automation
H1 Consider asking for confirmation from the user instead of executing fully automated actions
H2 Secure the user control
H3 Visibility of system status

G6 Skill
H1 Enable frequent users to use shortcuts

Several guidelines and heuristics related to the execution phase have been identified. The proportion of guidelines is fewer compared to the informing phase. We think that a higher amount of guidelines would have been more supportive, especially for novice users (designers/evaluators). This phase consists of both interactive and communicative oriented guidelines. An example of interactive oriented guideline is "error prevention" and an example of a communicative oriented guideline is "satisfy communication need".'

4.2.3.3 The IT-system reaction phase

G1 Secure the user's privacy
H1 The system helps the user to protect personal or private information

We have only identified one guideline related to the IT-system reaction phase. The guideline is oriented towards one user using the IT-system and not towards communication. The reactive part of the system falls heavily into utility, robustness and reliability of the software developers to implement the functional aspects of the IT System. It is this automated situation which facilitates the communicative intent of the user through the IT System.

4.2.3.4 The Interpretation phase – What has happened?

G1 Feedback
H1 Keep users informed about what is going on within reasonable time
H2 Error messages
- should be informative (plain language - no codes)
- precisely indicate the problem
- constructively suggest a solution
- should not blame users for error

H3 Can immediately see if the intended action is executed
H4 Understand the communicative intention of different messages
H5 Visibility of system status

Only one guideline has been identified for the interpretation phase. For this guideline several supportive heuristics have been related. This guideline is oriented towards interaction but could be oriented towards communication as well.

4.2.4 Other findings

When an interaction between a user and a computer is working as expected all the phases of the EIAL are involved. The first

interaction loop is carried out. When an error of some kind has occurred a second iteration is needed. This error will force another loop in order to correct the error. The user is informed through the feedback from the IT system that the intended action has failed and an error message appears. The next step is that the user has to inform him/her about what actions could be carried out in order to recover from the error. The user chooses an action and executes the chosen action. Then the IT-system reacts and performs the corresponding action. Finally, the users can hopefully interpret that the originally intended action is performed. Due to this second interaction loop we have identified the following related guideline:

G1 Error recovery
H1 Support undo and redo
H2 Offer simple error handling
H3 Help users recognize, diagnose, and recover from errors
H4 Emergency Exits

Beside the categorisation above we have also identified a general criterion that is context dependent. The formulation of the criterion reads "Remember mobility".

5. CONCLUSIONS

The analysis of the six criteria lists has revealed that criteria reside on different abstraction levels. The levels are hierarchically related to each other in a categorization model (see figure 4). The levels identified are called principles, advices, guidelines and heuristics. The higher levels contain more general formulated criteria while the lower levels consist of more concrete formulated criteria. General formulated criteria provide more of a vision or a goal. They point out a design direction. The concrete criteria provide more specific design support for how to do.

We hope that our categorization model will support usability practitioners in the explicit generation of a relevant usability criteria list. This criteria list should be part of the usability requirements. The usage of a reflective criteria list should be done regardless of whether the IT-system is supporting business-to-business communication or business-to-consumer communication.

We believe that a mix of criteria formulated on different abstraction levels is needed. The lower heuristic level supports the practitioner with concrete hints while the higher abstraction level supports the understanding of the criteria and widens the applicability. The need of different abstraction levels is supported by Cronholm & Goldkuhl [37]. Abstractions and concretions are tightly coupled; concretions confirm and simplify the abstraction and the abstraction informs you on what the phenomenon of interest is about (ibid.).

In our opinion, the fact that criteria resides on different abstraction levels is not always visible to practitioners. Therefore, there is a risk that practitioners (or other users of criteria) are unaware of the existence of levels. The advantage and role of a multilevel abstraction hierarchy, as the characterization model represents, is discussed in Rasmussen et al. [38]. Rasmussen et al. 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 model could be used for identifying more concrete and practical guidelines or heuristics related to a specific abstract principle or advice. Or vice versa; the model could be used for searching a more abstract 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 [39] .

The model also reveals if any gaps exist between the hierarchical levels. A gap could consist of missing guidelines for a more abstract advice or a missing advice for a more concrete guideline. Ideally, there should be traceability from the most abstract general principles all the way to the concrete heuristics. A gap reveals a need of development. For example, the Small Screen Device guidelines [3], did not provide guidelines for the Execution, IT-System Reaction, and Interpretation phases. The criteria were either very general, focused on the informing phase or contextually specific. Furthermore, the results of the categorisation support the construction of a frame of reference which can be used as a base for interpretation of other criteria than the chosen criteria lists.

The analysis has also revealed that most of the guideline criteria are related to the informing phase. The execution phase also has a fair number of criteria. Several criteria are also considered to be of a general perspective relating across all the EIAL phases. The IT System reaction phase is very functionally orientated, the only related criteria is "Secure the user's privacy". This phase relates to the automatic situation that handles the communicative needs of the actions performed. The interpretation phase has only one category, "Feedback", being the predominant activities performed at this phase.

The analysis has been done from a communicative view. Not surprisingly, most of the criteria are predominantly supporting a human-computer interaction perspective, rather than a communicative perspective. Communicative oriented criteria could preferably be founded in the criteria lists constructed by Cronholm & Goldkuhl [10, 35] and Muller et al. [4]. The other four lists do not primarily offer communicative support.

As mentioned in section 3 our categorisation work has been inspired by the categorisation work by Muller et al. [4]. Muller et al. have exemplary grouped 15 criteria and identified one higher abstraction level. Muller et al. [4] has the following higher-level guideline categories (See Appendix – Criteria lists): System Status, User Control and Freedom, Consistency and Relevancy, Error Recognition and Recovery and finally Task and Work Support. We have further developed the work by Muller et al. [4] through relating criteria to different parts (phases) of an interaction by using the EIAL model and we have identified four hierarchical levels. We acknowledge the work by Muller et al. and at the same time we are challenging their work since it is unclear what grounds they have used for their division of criteria.

REFERENCES

1. Nielsen, J. and R.L. Mack, *Usability Inspection Methods*, John Wiley & Sons, New York, 1994
2. Häkkilä, J. and J. Mäntyjärvi (2006) *Developing design guidelines for context-aware mobile applications*, *ACM International Conference Proceeding Series; Proceedings of the 3rd international conference on Mobile technology, applications & systems*. Bangkok, Thailand, ACM.
3. Kärkkäinen, L. and J. Laarni (2002) *Designing for small display screens*, *ACM International Conference Proceeding Series; Proceedings of the second Nordic conference on Human-computer interaction*. Aarhus, Denmark, ACM, p. 227-230.
4. Muller, M.J., et al., *Methods & Tools: participatory heuristic evaluation*, in *interactions*. 1998. p. 13-18.

5. Nielsen, J., *Usability Engineering*, Academic Press, Boston, 1993
6. Shneiderman, B., *Designing the user interface: Strategies for effective human-computer-interaction*. 3rd ed, Addison Wesley Longman, Reading, Mass, 1998
7. Somervell, J. and D.S. McCrickard, *Better discount evaluation: illustrating how critical parameters support heuristic creation.* Interacting with Computers, **17**,5 (2005), p. 592-612.
8. Hägerfors, A., *Co-Learning in Participative Design*. 1994, Lund University.
9. Bannon, L., *From human factors to human actors: the role of psychology and human-computer interaction studies in system design*, in *Design at work: cooperative design of computer systems*. 1992, Lawrence Erlbaum Associates, Inc. : Mahwah, NJ, USA. p. 25 - 44.
10. Cronholm, S. and G. Goldkuhl (2002) *Actable Information Systems-Quality Ideals Put Into Practice*, *Information Systems (ISD)*. Riga, Latvia.
11. Gerlach, J.H. and F.-Y. Kuo, *Understanding Human-Computer Interaction for Information Systems Design.* MIS Quarterly, **15**,4 (1991), p. 527-549.
12. Chevalier, A. and M.Y. Ivory, *Web site designs: Influences of designer's expertise and design constraints.* International Journal of Human-Computer Studies, **58**,1 (2003), p. 57-87.
13. Tao, Y.-H., *Information system professionals' knowledge and application gaps toward Web design guidelines.* Computers in Human Behavior, **24**,3 (2008), p. 956-968.
14. Fitzpatrick, R. and C. Higgins (1998) *Usable Software and its Attributes:A synthesis of Software Quality, European Community Law and Human-Computer Interaction*, *Proceedings of HCI on People and Computers XIII*, Springer-Verlag, p. 3-21.
15. Gould, J.D. and C. Lewis, *Designing for usability: key principles and what designers think.* Commun. ACM, **28**,3 (1985), p. 300-311.
16. Goldkuhl, G. and K. Lyytinen (1982) *A language action view of information systems,*, *Proceedings of the 3rd international conference on information systems*. Ann Arbor, Michigan, p. 13-31.
17. Habermas, J., *The theory of communicative action. Volume 1. Reason and the rationalization of society*, Beacon Press, 1985
18. Searle, J.R., *Speech Acts – an Essay in the Philosophy of Language*, Cambridge University Press 1969
19. Weber, M., *Economy and Society*, ed. G. Roth and C. Wittich, University of California Press, 1978
20. Winograd, T. and F. Flores, *Understanding computers and cognition: A new foundation for design*, Ablex, Norwood, 1986
21. Preece, J., et al., *Human-Computer Interaction*, Addison-Wesley, 1994
22. Sjöström, J. and G. Goldkuhl (2003) *The semiotics of user interfaces – a socio-pragmatic perspective*, *6th International Workshop on Organisational Semiotics*, Reading.
23. Ågerfalk, P.J., *Pragmatization of Information Systems A Theoretical and Methodological Outline*, in *IDA*. 1999, Linköping University: Linköping, Sweden.
24. Goldkuhl, G., S. Cronholm, and J. Sjöström (2004) *User Interfaces as Organisational Action Media*, *7th International Workshop on Organisational Semiotics*. Setúbal, Portugal.
25. Norman, D.A., *The psychology of everyday things*, Basic Books, New York, NY, 1988
26. Goldkuhl, G. and P.J. Ågerfalk, *Actability: A way to understand information systems pragmatics.* In Coordination and Communication Using Signs: Studies in Organisational Semiotics 2, (2002), p. 85-113.
27. Mead, G.H., *The Philosophy of the Act*, University of Chicago Press, 1938
28. AskOxford. *Oxford Dictionaries*. 2008 10 April 2008 [cited; Available from: http://www.askoxford.com.
29. The_Free_Dictionary. 2008 [cited; Available from: http://www.thefreedictionary.com/.
30. Strauss, A. and J. Corbin, *Basics of Qualitative Research: Second Edition: Techniques and Procedures for Developing Grounded Theory*, Sage, Newbury Park, California, 1998
31. Gadamer, H.G., *Truth and method*, Sheed & Ward, London, 1975
32. Heidegger, M., *Being and time*, Harper Row, New York, 1962
33. Spirkin, A., *Dialectical Materialism*, Progress Publishers, 1983
34. Sears, A., *Heuristic walkthroughs: Finding problems without the noise.* International Journal of Human-Computer Interaction, **9**,3 (1997), p. 213-234.
35. Cronholm, S. and G. Goldkuhl (2005) *ACTABILITY AT A GLANCE*
36. Harper, D. (2008) *Online Etymology Dictionary*.
37. Cronholm, S. and G. Goldkuhl, *Involving Novice Users in Document-Driven System Requirements Analysis.* Journal of Information, Information Technology, and Organizations, **1** (2006), p. 131-149.
38. Rasmussen, J., A.M. Pejtersen, and L.P. Goodstein, *Cognitive Systems Engineering*, Wiley & Sons Inc, 1994
39. Wason, P.C. and P.N. Johnson-Laird, *Psychology of Reasoning: Structure and Content* harward University Press, Cambridge, MA, 1972

APPENDIX – CRITERIA LISTS

Nielsen's Heuristics [5]

1	Visibility of system status
2	Match between system and the real world
3	User control and freedom
4	Consistency and standards
5	Error prevention
6	Recognition rather than recall
7	Flexibility and efficiency of use
8	Aesthetic and minimalist design
9	Help users recognize, diagnose, and recover from errors
10	Help and documentation

Shneiderman's Eight Golden Rules [6]

1	Strive for consistency.
2	Enable frequent users to use shortcuts.
3	Offer informative feedback.
4	Design dialog to yield closure.
5	Offer simple error handling.
6	Permit easy reversal of actions.

7 Support internal locus of control.

8 Reduce short-term memory load.

Häkillä & Mäntyjärvi's Context Aware Mobile Application Guidelines [2]

1 Consider the uncertainty in decision-making situations.

2 Prevention from interruptions.

3 Personalization.

4 Avoid information overflow.

5 Secure the user's privacy.

6 Remember mobility.

7 Secure the user control.

8 Access to context.

9 Visibility of system status.

10 Usefulness.

Kärkkäinen & Laarni's Small Screen Device Guidelines [3]

1 Determine the purpose of the site / service

2 Re-evaluate the interface metaphors

3 Present the most important information first at the top of the hierarchy

4 Re-think the navigation aids

5 Indicate the links clearly

6 Optimize the reading process

7 Use markers while scrolling or paging text

8 Use pictures with caution

Cronholm & Goldkuhl's Actability Principles [10, 35]

1 Easy to understands what can be done with the system (clear action repertoire)

2 Able to "say" what he/she wants through the system (satisfy communication needs)

3 Can easily move to another document (easy to navigate)

4 Understand consequences of proposed and performed actions (action transparency)

5 Can immediately see if the intended action is executed (clear feed back)

6 Can easily access information of what has been done previously (easy access to action memory)

7 Know who has said what (personalized information)

8 Understand used concepts (familiar and understandable vocabulary)

9 Understand the communicative intention of different messages

10 Offer a good support for business actions

Muller et. al.'s Participatory Heuristic Evaluation [4]

System Status

1 System Status

User Control and Freedom

2 Task Sequencing

3 Emergency Exits

4 Flexibility and Efficiency of Use

Consistency and Relevance

5 Match between System and the Real World

6 Consistency and Standards

7 Recognition rather than Recall

8 Aesthetic and Minimalist Design

9 Help and Documentation

Error Recognition and Recovery

10 Help Users Recognize, Diagnose, and Recover from Errors

11 Error Prevention

Task and Work Support

12 Skills

13 Pleasurable and Respectful Interaction with the User.

14 Quality Work

15 Privacy