# Analysis of Human Computer Interaction

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*Abstract--* *The History of HCI is briefly reviewed together with three HCI models and structure including CSCW, CSCL and CSCR. It is shown that a number of authorities consider HCI to be a fragmented discipline with no agreed set of unifying design principles. An analysis of usability criteria based upon citation frequency of authors is performed in order to discover the eight most recognised HCI principles.*

*Keywords*: HCI, CSCW, CSCL, CSCR, Usability.

## Introduction

According to Diaper (2005) the chronology of HCI starts in 1959 with Shakel's paper on *"The ergonomics of a computer"* which was the first time that these issues were ever addressed. This was followed by Licklider who produced what has come to be known as the seminal paper (1960) on *"Man – Computer Symbiosis"* which sees man and computer living together. There was no further significant activity for almost 10 years when in 1969 the first HCI conference and first specialist journal, *"The International Journal of Man-Machine Studies"* was launched. The 1980s saw the launch of three more HCI journals and conferences with an average attendance of 500 (Diaper 2005). It was not until the 1990s that the "I" in HCI switched from *"interface to "interaction"* reflecting the vastly expanding range of digital technologies. It was also during the 1990s that the term "Usability" has come to be synonymous with virtually all activities in HCI.  Prior to this HCI encompassed five goals to develop or improve:

- Safety
- Utility
- Effectiveness
- Efficiency
- Usability

Originally usability was the least but has since been promoted to cover everything.  *"The study of HCI became the study of Usability"* (Diaper, 2005).

Brad Myers (1998) has reviewed the history of HCI from a technological point of view and shows that HCI started with university research in direct manipulation of graphical objects as long ago as 1960, with commercial research not starting until 1970 and commercial products available from 1980. Myers also highlights up and coming areas of modern HCI research

**• Gesture Recognition:**
pen-based input device,

**• Multi-Media:**
multiple windows and integrated text and graphics

• **3-D:**
ultrasonic 3D location sensing system

• **Virtual Reality and "Augmented Reality":**
much of the early research on head-mounted displays and on the DataGlove was supported by NASA.

• **Computer Supported Cooperative Work.**
the remote participation of multiple people at various sites

• **Natural language and speech:**
fundamental research for speech and natural language understanding and generation

## HCI Theories and Principles

There are typically many thousands of rules which have been developed for the assessment of usability (Nielsen, J. 1993, p19), and there have been many attempts to reduce the complexity to a manageable set of rules (Nielsen, J. 1993, Baker, Greenberg and Gutwin, 2002. Jacob Nielsen has produced 10 rules which he calls usability heuristics and which are designed to explain a large proportion of problems observed in interface design, which he recommends  should be followed by all user interface designers.

**1. Simple and natural dialogue**
Efforts should be made to avoid irrelevant information. Nielsen says that every extra unit of information competes with units of relevant information and diminishes its visibility.

**2. Speak the Users' language**
All information should be expressed in concepts which are familiar to the user rather than familiar to the operator or the system.

**3. Minimize the Users' memory load**
It is important that the user should not have to remember information from one part of a dialogue to another. Help should be available at easily retrievable points in the system.

**4. Consistency**
Words situations and actions should always mean the same thing no matter where they occur in the system.

**5. Feedback**
Users should always be informed about what is going on in the system in a timely and relevant way.

**6. Clearly marked Exits**
Errors are often made in choosing functions which are not required and there needs to be a quick emergency exit to return to the previous state without having to engage in extended dialogue.

**7. Shortcuts**
Required by the expert user (and unseen by the novice user) to speed the interaction with the system.

**8. Good error messages**
These need to be expressed in a plain language that the user understands which are specific nough to identify the problem and suggest a solution.

## HCI Models

A variety of different models have been put forward which are designed to provide an HCI theory in a particular context. This includes Norman's Model, Abowd and Beale's model and the audience participation model of Nemirovsky (2003) which presents a new theoretical basis for audience participation in HCI.

## Norman's model of interaction

This has probably been the most influential (Dix *et al* 1992 p105) because it mirrors human intuition. In essence this model is based on the user formulating a plan of action and then carrying it out at the interface. Norman has divided this into seven stages:
1. establishing the goal
2. forming the intention
3. specifying the action sequence
4. executing the action
5. perceiving the system state
6. interpreting the system state
7. evaluating the system state with respect to the goals and intentions

## The Interaction Model

Abowd and Beale (Dix *et al* 1992 p106) have produced an interaction framework built on Norman's model but theirs is designed to be a more realistic model.

This has four main components:
1. the system
2. the user
3. the input
4. the output

The interface sits between the user and the system and there is a four step interactive cycle as shown in the labeled. The user formulates a taskto achieve a goal. The user manipulates the machine through the input articulated by the input language. The input language is translated into the systems core language to perform the operation. The system is in a new state which is featured as the output. The output is communicated to the user by observation.

## Audience Participation Model

Nemirovsky (2003) considers that the old perspective is that of computers as deterministic boxes blindly following their commands while users are incapable of changing the course of the program running on the computer. To this he presents an alternative and proposes that users should be considered as an audience rather than participants This is a strikingly radical approach. Instead Nemirovsky is concerned with users as an audience that explore the media space. He goes on to discuss the emonic environment which he defines as a framework for creation, modification, exchange and performance of audio visual media. This is composed of the three layers:

• Input (interfaces for sampling)
• Structural (a neural network for providing structural control)
• Perceptual (direct media modification)

## HCI Analysis Methodology

A number of different methodologies have been created to determine the effectiveness of HCI measurements.  These have been refined resulting in the ***User Needs Analysis*** of Lindgaard ***et al*** (2006) that suggests how and where user centred design and requirements engineering approaches should be integrated. After reviewing various process models for user centred design analysis they suggest a refined approach and identified the main problems as:

• The decision where to begin and end the analysis needs to be clarified.
• Deciding how to document and present the outcome

Lindgaard's user needs analysis method involves the following steps

• **First**: Identify user groups and interview key players from all groups to find the different  roles and tasks of the primary and secondary users

• **Second**: Communicate this information to the rest of the team by constructing task  analysis data and translating this into workflow diagrams supporting the user interface design. Create a table that shows the information about user roles and data input

• **Third**: Upon submitting the first draft of the user needs analysis report create the first iterative design prototype of the user interface based on minimising the path of data flow. (Initially prototyping in PowerPoint was faster and more effective that prototyping in Dreamweaver).

• **Fourth**: Prototypes were handed over to developers as part of the user interface specification package.

• **Fifth**: Usability testing was used to determine the adequacy of the interface. Feedback from watching users work with the prototype and discussing with them what they were doing always resulted in more information.

• **Sixth**: Prototype usability testing meant that the requirements became clearer which resulted in more changes to the user interface design and the prototype.

• **Seventh**: The formal plan involved three iterations of design- prototype- usability test for each user role (they could not keep to this and had no more that two test iterations and in most cases only one)

• **Eighth**: Practical issues of feasibility should not be overlooked in the quest to meet users' needs. A highly experienced software developer is a necessity on the user interface design team in order to ensure that the changes were proposed were feasible ( in some cases interface ideas were dropped because they were not feasible, take too long or cost too much).

## Conclusion:

This section has briefly considered the history of HCI which showed how usability has become the central feature of virtually all HCI activities from the 1960's onwards. The structure of HCI has been reviewed to show how it encompasses a number of disciplines.  Three HCI models were examined which illustrated the increasing refinement of interactive description culminating in Abowd and Beale's interaction theory. The approach to HCI analysis has evolved into the methodology of Lindgaard ***et al*** which focuses on user's needs. This is an approach which is commonly adopted and it will be addressed in more detail when the methodology of this project is considered. Because of the fragmentation of HCI principles it was felt necessary at this stage to perform a frequency analysis of HCI authors and their chosen principles. The purpose of this was to produce a set of principles which would be held to be the most accepted. It was found that eight rules have been established by this analysis.

## References

Baker, K., Greenberg, S., and Gutwin, C. 2002. Empirical development of a heuristic evaluation methodology for shared workspace groupware. In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work* (New Orleans, Louisiana, USA, November 16 - 20, 2002). CSCW '02. ACM Press, New York, NY, 96-105

Diaper, Dan and Sanger, Colston, (2006) Tasks for and tasks in human–computer interaction, *Interacting with Computers* 18 (2006) 117–138Dix, A., Finlay, J., Abowd, G. D., and Beale, R., (1992), Human Computer Interaction, 2nd ed., Prentice Hall, ISBN 0-13239864-8.

Hinze-Hoare, V. (2006) CSCR: Computer Supported Collaborative Research,
Karam. M., and Schraefel, M. C., (2005) A Taxonomy of Gestures in Human Computer Interaction, *ACM Transactions on Computer-Human Interactions 2005*, Technical report, Electronics
and Computer Science, University of Southampton, November 2005.
http:/eprints.ecs.soton.ac.uk/11149/01/GestureTaxonomyJuly21.pdf

Kligyte, G. (2001). 'I Think I Know What Is Good For You?'. User Interface Design for a CSCL system. Master's Degree Work: *Master of Arts in New Media*

Lindgaard, G., Dillon, R., Trbovich, P., White, R., Fernandes, G., Lundahl, S., and Pinnamaneni, A., (2006) User Needs Analysis and requirements engineering: Theory and practice, *Interacting with Computers* 18 (2006) 47–70 www.elsevier.com/locate/intcom