

# TOWARDS PRINCIPLES FOR USABILITY EVALUATION IN WEB MAPPING -USABILITY RESEARCH FOR CARTOGRAPHIC INFORMATION SYSTEMS

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## Abstract

User-centred design and usability engineering are advancing in the field of online mapping applications. A vast number of different methods of usability evaluation exist and not many studies have yet investigated their suitability and usefulness for testing cartographic online applications. The importance of designing products for the users and around how users work is evident for creating successful online mapping applications. Selected methods of user testing are examined and a framework for evaluating usability of online mapping applications in prototype and final stages is proposed.

## Introduction

Over the last century nothing influenced the methods, techniques and dissemination channels of cartography stronger than the transition from distributed media to the era of the web and subsequently web 2.0. Today interactive and collaborative web mapping applications featuring integrated-media are a major stake in cartographers' commercial and academic endeavours. Cartographic products have become ubiquitous and the number and heterogeneity of mapping product users has been increasing rapidly. The urge for user and usability research in this discipline therefore becomes stronger than ever before.

## User-Centred Design

Unfortunately all-too often the “*Ghee-Whiz attitude*” (Cartwright and Hunter, 2001) dominates map application design. New visualization methods and technical possibilities are implemented without questioning their significance for cartographic communication and the future users. The application designers believe that they know exactly what the user needs or wants.

The philosophy of user-centred design (UCD) originating from the research area of Human-Computer Interaction (HCI) gives instructions on how to meet user requirements and reach high quality levels by incorporating the needs, wants and limitations of the end-users in various iterative design stages throughout the whole life cycle of interactive computer systems.

The ISO 13407 standard (Human-centred design processes for interactive systems) describes UCD “*as a multi-disciplinary activity, which incorporates human factors and ergonomics knowledge and techniques with the objective of enhancing effectiveness and productivity, improving human working conditions, and counteracting the possible adverse effects of use on human health, safety and performance*” (URL: UsabilityNet, 2009).

The purpose of UCD approaches is to identify user groups, their requirements and to improve the overall application usability in regard to interfaces, user interaction and user specific visualisation methods. Applications are optimized around how people work, so that they do not have to change their habits to accommodate to functionalities. By following a user-centred design approach, application developers should be enabled to guarantee an effective and efficient end-product with a high degree of user satisfaction.

As displayed in figure 1, user-centred design is a four-stage process. The user and business requirements are identified in the first stage. Then these requirements are analysed and weighed against each other. In the third and fourth stage design solutions are developed and evaluated. This process is repeated until designs are produced that satisfy most/all of the users’ and business requirements.

Pucher (2008) constitutes that “the most significant advances in software during the last few years are actually advances in user experience, not in technology.” Incorporating a UCD approach for cartographic online application design constitutes an important step towards increasing the usability and productivity of such systems.



Figure 1 User-Centred Design stages

(URL: [http://www.experientia.com/blog/uploads/2007/04/ucd\\_game.gif](http://www.experientia.com/blog/uploads/2007/04/ucd_game.gif)).

## **Usability and mapping products**

User research is a highly complex field. The execution and interpretation of user studies requires specific skills that are not taught thoroughly in standard cartography and GI curricula. The necessity for guidelines and principles on how to correctly apply methods of user research to cartographic products is evident.

A number of book publications does exist that are dealing with possibilities for enhancing usability of everyday products (Lidwell, et.al., 2003, Norman, 2002) and websites (Krug, 2006), but still not many publications specifically address usability issues concerning online mapping applications.

The focus of this paper is on usability evaluation of prototypes and final online mapping products. It is understood that many usability problems can be eliminated during the design stage based on extensive guideline reviews and a thorough examination of similar existing systems. This approach can save the developers a lot of time and thus money and should definitely be carried out before elaborating on design solutions. It is common knowledge that the correction of usability problems becomes more and more cost intensive with advancing product stages.

## **Usability evaluation methods**

A vast number of methods exist for evaluating the usability of services in the World Wide Web. Below a selection of methods that seem particularly useful for evaluating the usability of online mapping products is listed.

### **- Interviews**

Though time-consuming, interviews are especially useful for gathering qualitative data (opinions) about the system designed. Interviews can be guided by a questionnaire but typically they are more open about the answers. Usually interviews have a one-to-one nature, allowing the interviewer to dig deeper when the interviewee appears to have promising thoughts about one or the other issue concerning the design of a cartographic mapping application. Interviewees can either be experts from cartography and geoinformation, from other disciplines or regular users. Interviews can be very useful during the requirements stage to find out what functionalities the respective user groups might expect from an online mapping application.

### **- User Observation**

This method can help to discover usability problems while a proband is interacting with the system. Observation can either be direct when the investigator is present or indirect when interaction with a cartographic application is recorded via video tape or screen capturing methods. The direct method bears the advantage that the investigator can interfere with the test person and focus his attention on specific tasks and goals.

But direct observation is obtrusive. The user might behave differently when other individuals are around. (URL: Usabilitynet, 2009)

The “Think-aloud protocol” (cp. Haklay, 2006) is a special form of observation where the proband and investigator sit in front of the system. The subject explains his course of action while working with the application. The investigator can assign special tasks or ask questions during the process. This method can be used for evaluating usability of prototypes and final map applications.

Indirect observation can reveal usability problems that would otherwise not be discovered. Observation methods lead to qualitative data and are useful throughout all design stages of a cartographic online application.

#### - **User Surveys**

User surveys are a well-known method of getting quantitative and therefore objective data from large sample-sizes. They can either be conducted by sending hardcopy questionnaires to selected users or by implementing online surveys. A prerequisite for questionnaire surveys is that the design team of the cartographic application has specific questions in mind that they want to have answered. Therefore this method is more useful in later product design stages when considerations about application design alternatives need to be backed up by objective data. Designing good and valid questionnaires is not an easy task, a main problem being suggestive and biasing lines of questioning. Interpretation of obtained data requires specific knowledge about techniques of statistical analysis.

An example of user surveying for a cartographic online mapping product can be found in Kramers (2006) book chapter in *Multimedia Cartography* (Cartwright et al., 2006) on the user centred development of the Atlas of Canada.

#### - **Remote evaluation**

The main advantage for remote methods of evaluating the usability of web-based products in prototype or final product stages is that they are cost-effective and less time consuming than other methods. In their article about the state of the art in automating usability evaluation of user interfaces Ivory and Hearst (2001) describe which methods can be used for remote data collection. By automatically logging statistics about the users' interaction with the system, large amounts of quantitative data can be collected rather easily, without the need of an investigator.

Usability problems can be detected by analysing the time that passes between the invocations of different processes (time for a task). The number of requests of implemented functionalities sheds light on their relevance for the actual system users. If a cartographic application features an online help, the access numbers for this function give information about how easy to use and intuitive the system and interface has been designed.

Another very important figure is the number of users who revisit the site repeatedly. If most users never return to the online mapping application, there is good reason to think that they are frustrated, haven't found what they were looking for, or that the user experience and satisfaction with the application was poor. The data collected by remote evaluation often needs to be backed up by other methods to discover the reasons behind the usability problems.

A special form of remote evaluation is the method of screenshot studies, which was amongst others utilized by Haklay and Zafiri (2008) for evaluating how users are organizing and customizing the interfaces of their GIS packages in order to perform routine tasks.

#### - **Eye-tracking**

This rather expensive and time-consuming method is suitable for exploring visual patterns of subjects interacting with the online application. Measuring the points of gaze can help finding out if the placement for features and functionalities in the application interface is optimal. The main disadvantage is that this type of evaluation needs a laboratory with eye-tracking equipment which is often not available for cartographic application designers.

### **Proposed usability evaluation framework for online mapping products**

Thorough usability evaluation of prototypes and final online mapping products requires a set of evaluation methods. The combination of remote evaluation methods with methods of observation and surveys seems fortunate for this task. While automated methods of logging user-system interaction help indentifying problem areas, observation methods can be used to find the specific problems inherent to the applications user interface. User surveys might then be utilized to retrieve background information about the probands observed and to collect data about user satisfaction and experience.

### **Conclusion, Objectives & Methodology of further research**

Within the scope of the "Cultural history of the Western Himalaya from the 8<sup>th</sup> century" research network, a web based cartographic information system is currently being designed at the University of Vienna. This application will serve as a testbed to compare strengths and weaknesses of various usability evaluation methods in different stages of the UCD process.

One goal of this integrated application/research project is to apply the above mentioned usability evaluation framework to the Cultural History Information System and to deduct general principles for usability research related to the development of web-mapping applications. The meta-evaluative approach includes comparative analysis of various methods and techniques of usability testing.

Therefore case studies of evaluations carried out in various international commercial and academic web-mapping projects will be critically reviewed. Their methods and outcomes will be analyzed for scientific validity. Interviews with stakeholders in usability research projects will help to identify the most useful evaluation methods and problems specific to particular methods in regard to web-mapping applications.

The overall objective for the planned research is to propose guidelines and general principles for usability evaluation of web mapping applications. These should be based on the experiences and findings that are present in the field of cartography and backed up by case studies carried out with the cultural history information system and other online mapping applications currently developed at the University of Vienna.

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