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# Usability of geographic information – Factors identified from qualitative analysis of task-focused user interviews

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ABSTRACT

Understanding user needs for geographic information and the factors which influence the usability of such information in diverse user contexts is an essential part of user centred development of information products. There is relatively little existing research focused on the design and usability of information products in general. This paper presents a research approach based on semi structured interviews with people working with geographic information on a day to day basis, to establish a reference base of qualitative data on user needs for geographic information with respect to context of use. From this reference data nine key categories of geographic information usability are identified and discussed in the context of limited existing research concerned with geographic information usability.



## 1. Introduction

Evaluating the usability of a product is in large part dependent on who the users are and what they are using the product for. In this respect, geographic information or indeed other information products (e.g. census information), may present more complexity than other more physical or tangible products such as computer application interfaces or mobile phones, in that the range of potential users, purpose of use and environment of use (both physical and technological) is enormously diverse. Systems for interaction with geographic information vary, for example, from simple web based map viewing applications accessible by smart phone, to complex analytical operations on workstation based geographic information systems (GIS). The overall user experience of geographic information derives from the combined elements of source data, application system and interface. For purposes of geographic information design, development and support it is important to be able to decouple usability issues caused by the data itself, from usability issues caused by an application system or interface.

A core objective of geographic information providers, such as national mapping organisations, is to provide information products that meet user needs across a wide range public sector, private sector and recreational purposes. Geographic information, for example a topographic map or digital terrain model, is necessarily an abstract simplification and model of the real world. At the source data level therefore, in terms of data model and specification, design decisions are made which influence usability potential of derived information products. Further, design decisions for the data model and specification of the products themselves (derived from source data) could then enhance or degrade usability of the output product to the end user, dependent on purpose of use. An architect, for example, may have need for three dimensional (3D) geographic information of a particular specification for purposes of creating a new development proposal, while a risk modeller for insurance applications also requires 3D information but specified differently.

The term 'information' is used in this paper to denote a dataset which has meaning added (as for example defined by Devlin, 1999). In terms of geographic information, meaning is added in the sense of descriptive attributes, classification and unique identifiers added to feature geometry, conveying more information about the real-world feature represented than just points and lines. The term 'information product' is used in this paper to denote a dataset with such added meaning which is made available, usually with supporting user guides and metadata, for free access or for purchase.

As a provider of geographic information Ordnance Survey, the national mapping agency of Great Britain, produces a range of geographic information products used for many different purposes in diverse organizations including government departments, commercial businesses and by individuals. Understanding user needs for geographic information and the factors which influence its usability in diverse user contexts is an essential part of ongoing user centred development of information content and products. This paper first presents a research approach to establish a reference base of qualitative data on user needs for geographic information with respect to context of use. It then builds on previous

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work using this reference data to identify elements of geographic information usability and discusses results in the context of other research concerned with geographic information usability.

### 1.1. Background to the qualitative user needs research

Besides a strong focus on efficiencies in data capture, storage and delivery technologies, Ordnance Survey's research group also works with other parts of the organisation on the enhancement and development of data content and new information products. To inform this research, especially content development and enhancement, need was recognized for a knowledge base of sufficiently detailed and representative information about different users' needs for information on aspects of the real world (buildings, roads, vegetation etc) in order to support their purposes (contexts of use). Existing sources of user knowledge, including market research and the knowledge of sales and customer support staff, are useful towards this objective. These represent a wide range of user views but tend to be market focused and to not capture sufficient depth of information concerning specific use contexts. A different approach was needed that could develop the knowledge base required to inform data research and development from the perspective of user needs and usability considerations.

## 2. A user and task focused approach

### 2.1. User focused approaches applied to geographic information and systems

While much work exists within human factors and design disciplines on usability of physical products, and within the fields of software engineering and Human Computer Interaction on software interface and website usability, relatively little published research appears to focus on design and usability of information products. This focus on technologies and interfaces is reflected within the geographic information industry, where the benefits of User Centred Design (UCD) approaches for technologies of interaction and data presentation (e.g. geographic information systems GIS, web mapping applications) are discussed for instance by Haklay and Nivala (2010), Kramers (2008), Medyckyj-Scott (1993). The need to focus on geographic information or data usability has, however, long been recognised. Initiatives within the GI research community, including those reported by Onsrud and Calkins (1993) and Wachowicz et al. (2002) began dialogues on this subject.

Some examples with more of an emphasis on information usability as distinct from applications and interfaces, though not necessarily applying UCD approaches, are cited by Hunter et al. (2003) such as the long term usability of NASA observational data and the usability of U.S. Environmental Protection Agency data to support decision making. In relation to work from NASA on planning earth science data capture, Maiden (2009) points out that the heterogeneous characteristics of spatio-temporal data, including different format types and structures, different states of processing (raw, derived, interpreted etc), data volumes, can lead to usability problems.

More recently, and post dating the research discussed in this paper, some studies have focused on aspects of geographic information usability itself, as distinct from application interfaces. For example, Haklay (2010) examined the usability of Code-Point® Open, a dataset providing point locations for GB postcodes which is provided as part of OS OpenData™. While downloading the data was found to be straight forward, the lack of descriptive information with the dataset to explain the different data fields was found to be a major usability issue. Some example cases of geographic information usability are reviewed in Harding et al. (2009), identifying challenges for research. Brown et al. (2011) develop further the case for focussing on geographic information usability independent of interfaces.

### 2.2. Overview of approach in this study

Drawing on and adapting aspects of UCD, we investigated people's needs for geographic information in professional domains primarily through identifying the context of use. This element of UCD addressed a large part of our knowledge base development objectives in that it involves profiling characteristics of the user group (e.g. planning officers), their tasks (e.g. processing new planning applications) and the environment in which the tasks are carried out. Beyond these standard profiling areas, we also wished to identify specifically how geographic information does or could support the user's task, any issues surrounding current information usage and future trends which may impact on geographic information needs. Through this focus on geographic information needs and usage in the task context, usability issues could be identified which directly relate to information required or used, as distinct from issues with interface or system usability. Interviewer knowledge of geographic information structures and specification helped in determining the root source of issues in some cases.

A qualitative approach using semi-structured interviews was used to elicit this information from research participants. Due to the exploratory nature of the investigation with each user and the need for flexibility to follow responses to achieve clarity of understanding, a semi-structured interview approach capturing qualitative responses was preferred to that of a more highly structured questionnaire. This enabled sufficient flexibility to explore key factors whilst maintaining consistency of approach and scope with all participants. The process outlined below was piloted with internal volunteers taking the role of information user, to ensure effectiveness for capturing the required information within an interview of between one and 2 h duration. As described by Corbin and Strauss (2008) the aims of qualitative research can vary from description to conceptual ordering, through to theorising. The intention in this study was primarily to capture descriptive information. In this way the information captured is necessarily subjective in accordance with participants' experience. From this a degree of conceptual ordering of data was applied to organise results into themes.

### 2.3. Preparatory document analysis

Prior to each interview, relevant background information was extracted through analysis of documentary sources describing aspects of the user organisations' objectives, areas of work and in particular noting the terms used for real-world (geographical) objects in the areas of work concerned. Sources included web pages and documents published by the organisation.

### 2.4. Semi-structured interviews

Following document analysis, the interview itself was focused on a specific task or use context by previously agreeing this with the person to be interviewed; the sampling and recruitment approach is described in Section 2.5. A generic outline for user needs interviews (as for example described by Kuniavsky, 2003) formed the basis of the interview structure, beginning with introductory information about the purpose for the research and general context of use questions followed by more specific focus on the 'product idea' (in this case the use of information about geographic/real-world things in the task context), followed by stepping back to