

SPATIAL DATA USABILITY

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Almost 150 years ago a London doctor combined maps of cholera deaths and water pumps to discover the source of a deadly epidemic, and the case has since become an acclaimed use of spatial analysis taught to generations of geography students worldwide. Moving forward to the present day, data mining techniques are now radically changing the way supermarkets think about product placement within their stores, and telephone customers are moving away from their traditional “YellowPages” directories and turning instead to enhanced “YellowMap” products. While these are all very positive examples, on the other hand a recent UK government hearing into the establishment of an underground radioactive waste repository determined not to proceed with this major project after the results of groundwater hydrology modelling were rejected because they could not be validated.

Each one of these cases tells us different stories about the degree of success of each data set when addressing information needs. The ability of the data to accommodate user-defined expectations translates their degree of usability in terms of ‘usefulness’. Our interest here lies in understanding exactly what distinguishes these cases from others. Is it the correct choice of data, models and algorithms for a given application? Is it simply a matter of data quality, is it the ‘interestingness’ or ‘unexpectedness’ of the data (as knowledge discoverers would say)? Is it the integration of data and adding of value that produces these extreme examples? Clearly, a better understanding of the parameters that define the usability of individual data sets seems to be necessary in order to improve their *usability*.

A number of possible definitions of usability are available in the literature, and the needs of spatial data usability have been compared and contrasted with broader data-related activities of providers and users of geoinformation. For example, one official definition of usability is given by the ISO 9241-11 standard on Display Screen (VDU) Regulations, Use of Ergonomics for Procurement and Design (ISO, 2002a). In this definition, system usability comprises " the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use, where:

- Effectiveness measures the accuracy and completeness with which users achieve specified goals;
- Efficiency measures the resources expended in relation to the accuracy and completeness with which users achieve goals;
- Satisfaction measures the freedom from discomfort, and positive attitudes towards the use of the product."

Usability elements outline the features and characteristics of the product that influence the learnability, effectiveness, efficiency and satisfaction with which users can achieve specified goals in a particular environment. The context of use determines the types of users, tasks, equipment, and the physical and social environments in which a product is used. Therefore, a system consists of users (i.e. the people who interact with the products), equipment (hardware,

software and materials), tasks (activities required to achieve a goal) and a physical and social environment, for the purpose of achieving particular goals.

Usability has also been defined 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" (ISO, 2002b). This definition differs from the definition from an ergonomic point of view, in which other characteristics such as efficiency and effectiveness are also seen as elements of usability.

Nielsen, concerned with software usability, sketches a broader context he calls system acceptability. One aspect of it is usefulness, "the issue of whether the system can be used to achieve a desired goal" (Nielsen 1993, p. 24). Following Grudin (Grudin 1992), he breaks it down into utility and usability, utility denoting "the question of whether the functionality of the system in principle can do what is needed", and usability denoting "the question of how well users can use this functionality" (Nielsen 1993, p. 25). These definitions distinguish contents and "packing" in such a way that quality would belong to utility meanwhile presentation would belong to usability. It was difficult to arrive at a consensus amongst the participants for a valid definition of data usability. In particular, it was hard to isolate a core set of fundamental techniques that clearly distinguish data usability from any single component discipline: in some way it was a uniquely powerful combination of individual techniques that characterises the field. In summary, data usability might be identified as an umbrella term consisting of several elements aggregated into several groups:

1. **Marketing:** Added Value, Benefits, Costs, Novelty, Services Provided, and Satisfaction
2. **Quality:** Authoritative, Guarantee Against Error, Integrity, Metadata, Reliability, Validity, and Utility
3. **Software and Tools:** Human Computer Interaction, Standardisation, Integration, Searchable, and Interface
4. **Human Perception - Cognition:** Authoritative, Decision Type, Interestingness, Novelty, Popularity, Satisfaction, Trust, User Skill Levels, Familiarity, Interpretation, Visualisation
5. **Applications:** Aggregation Levels, Type, Exclusiveness, Visualisation, Integration, Decision Type, Use with Models and Algorithms, Availability and Accessibility.

Each individual category can be discussed in the light of specific user groups and/or applications. For example, in the marketing category, cost is a very common and often a very important element and plays a large part in usability. In the applications group, availability and accessibility also determine the use of data. Moreover, it is important to realise that elements such as accessibility and cost of spatial data can vary between different countries and cultures. Another example is the update frequency. In order to decide on the desired update frequency, users should be asked to define the tolerable difference between decisions made and the time frame for future decisions.

There is also a dynamic component in the definition of usability. As time goes by, some data sets will be more useful than others. This is a consequence of the nature of the elements being depicted and the temporal and spatial scale of the representations. Accordingly, considerations will have to be made about the best way of improving the use of the database. Again, a usability framework should provide milestones for the application of objective methods aiming to extend the lifespan of a database within reasonable limits. This methodology will affect the way data sets are produced, maintained and used. There is also

considerable scope for the implementation of data modelling techniques like rule-based classifications, data mining, etc.

Finally, there is an important element linked to the way users perceive and use existing data sets. The same data presented in an unfamiliar way to the user seem to fail their usability. The human interface is an important area for constant improvement. Some visualisation like 3-D representations, virtual reality and animations seem to bridge the gap between data producers and data consumers. Therefore, these techniques improve the likelihood of these data being fully understood and used.

This special section contains five papers on related research topics to spatial data usability. Hunter, Wachowicz and Bregt, from the University of Melbourne and Wageningen University in the Netherlands, introduce the usability topic in detail and identify over 40 usability elements. They consider whether there might be some hidden grouping of these elements and raise a series of research questions and priorities.

Riedemann and Timm from the Institute for GeoInformatics, University of Munster, Germany are the authors of the second paper. The paper proposes a model for the dynamic automated integration of distributed metadata and geospatial services. The discussion focuses on the limitations of appropriate definitions for data and operation semantics of the existing and evolving standards and technologies. The aim is to show how freeing the user from difficult and time consuming pre-processing steps can enhance spatial data usability.

The third paper by Josselin from CNRS, France, discusses usability in the context of spatial exploratory analysis by looking at definitions of usability, a conceptual model of interaction between data, users and methods, and then a practical example. The discussion of a practical example using ARPEGE points to the use of such tools as a means of improving data usability.

The fourth contribution is from Benenson and Omer, Department of Geography and Human Environment, Environmental Simulation Laboratory, University Tel Aviv. This paper demonstrates that even though we now have the high-resolution social science data that everyone had asked for over the past few decades - no one wants to use it. So three related usability problems are identified in the paper: understanding, analysis, and inference of the data. The authors then discuss a real life example related to how they overcame the problems of using such a detailed dataset.

The last paper is from Bielecka, Institute of Geodesy and Cartography, Poland, focuses on the ability to share spatial data with reference to the Polish Spatial Data Infrastructure. The paper illustrates the strong link between usability and the impact that institutional and technical arrangements for sharing data will have upon it. The author then considers that there are methodological, technical and organizational considerations that must be adhered to if high usability is to follow. It also provides a good discussion on what elements in the Polish Spatial Information Systems are required to make the data more usable, and the barriers to data sharing. The author gives readers not familiar with spatial data some insight into the scope and requirements for setting up large, national spatial information systems.

References

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