

# Usability of Discovery Portals

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## Abstract

As INSPIRE progresses to be implemented in the EU, many new discovery portals are built to facilitate finding spatial data. Currently the structure of the discovery portals is determined by the way spatial data experts like to work. However, we argue that the main target group for discovery portals are not spatial data experts but professionals with limited spatial knowledge, and a focus outside the spatial domain. An exploratory usability experiment was carried out in which three discovery portals were assessed by five participants representing the main target group “the professional outside the spatial domain”. The aim was to accept or reject our proposition that discovery portals are difficult to use for non-GIS specialists, and to identify the main obstacles in the interface. The Think Aloud Protocol was used to conduct the test. The participants were asked to perform the same search task in three discovery portals. Performance, accuracy and emotional response of the participants were assessed. Given the language constraints and the concise task the differences between the discovery portals were found to be relatively small. We conclude that for all portals indexing and underlying techniques are well implemented. The content of metadata is a point of concern. We recommend that more attention should be given to the requirements and expectations of the end-user and the discoverability of the data sets when creating metadata. But most of all the design and implementation of the client interface should be improved.

*Keywords:* usability, geoportals, metadata, discovery portals.

## 1 Introduction

As INSPIRE progresses to be implemented in the EU, many new discovery portals are built to facilitate finding spatial data. Currently the structure of these discovery portals is determined by the way spatial data experts like to work. From their point of view, most discovery portals are excellent since they give many, often technical, details of datasets. Spatial data experts are familiar with those details and are capable of deciding whether the dataset is suitable for the purpose they want to use it for and subsequently use it properly. However, we wonder whether spatial data experts, who have other ways of accessing datasets they require, are the target group of the discovery portals. We think that the main target group of discovery portals are or should be scientists, policy makers and other professionals with some spatial knowledge, but generally with a focus outside the spatial domain. Experts from hydrology, soil and other domains for instance use spatial data regularly but are not always familiar with metadata for spatial datasets. The question is, do they find their way through the discovery portals or should the portals be structured differently? Many researchers [1,2,3] pointed out that a data-centric approach should be replaced by a user-centric approach, but the implementation of a user-centric approach seems to be very hard. We are interested to find out whether the user-centric approach that has been discussed in literature has found its way to the discovery portals.

This paper describes an exploratory usability experiment in which three discovery portals are assessed by five participants representing the main target group “the professional outside the spatial domain”. The aim is to accept or reject our

proposition that discovery portals are difficult to use for non-GIS specialists, and to identify the main obstacles in the interface for further research. Additionally, we want to assess the suitability of the experimental setup and usability methods selected for this test. The results are analysed and recommendations to improve the usability of discovery portals are made.

## 2 Background

### 2.1 Metadata for spatial data

Metadata is information about information. The U.S. FGDC (Federal Geographic Data Committee) definition [4] is that a metadata record is a file of information, usually presented as an XML document, which captures the basic characteristics of a data or information resource. It represents the who, what, when, where, why and how of the resource. Geospatial metadata are used to document geographic digital resources. Metadata is published in so called discovery (geo-)portals as a mean to find spatial data. For the geo spatial community this is an excellent source, since it provides all information available for that dataset. It contains amongst others technical information, descriptive information, quality information, and organisational information. The full standard contains over 400 elements, but in practice usually a core set is defined to indicate the most important elements that are commonly used. An example is the INSPIRE profile composed out of core elements.

## 2.2 Discovery portals

Metadata records are kept in registers that are published on the web as catalogue services. On top of these services so called discovery portals are built. These allow users to find the spatial datasets they need.

Metadata, registries and catalogue services are all defined in standards by OGC and ISO. These standards describe how the different components of a Spatial Data Infrastructure should interoperate with each other. Adhering to these standards does not automatically lead to a successful discovery portal. In order to create a successful discovery portal, the catalogue must be provided with high quality content aimed at the user's needs. Moreover, this content must be indexed properly and a user-friendly client application must be created on top of the catalogue.

To create useful metadata records two important notions should be considered. One is that at least for a common used metadata profile like INSPIRE the set is compliant to the standard in a technical sense. This is the easy part. Secondly, the content of the metadata supplied must be targeted at the needs of the user. This means that the metadata elements should contain the proper information to be discoverable from an user point of view. This part is much harder.

## 2.3 Usability

To assess the successfulness of a discovery portal we focus on usability, defined by ISO (9241-143:2012 ) [5] as "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".

The usability of discovery portals is determined not only by the ease of use of the interface, but to a large extent by the presentation of the metadata and the spatial data to non-experts. If users are unfamiliar with the technical conventions used to present the data, or with some of the datasets, they will be not be able to assess the relevance of the data for their search tasks and easily give up their attempts. The users knowledge of spatial data and their expectations of the system response to their actions are therefore important factors influencing their satisfaction with the discovery portal. To help externalise and understand the users mental models of the portals, we selected the think-aloud protocol for this test. This technique has been widely used over a long period of time in human computer interaction and is now used in many variations [6]. The basic principle is that representative users are asked to complete a set of tasks with the application or website, and to constantly verbalise their thoughts while performing these tasks. An observer notes the remarks of the user, but also non-verbal responses that indicate frustration, doubt, or contentment towards the system. The observer also records the actions of the user, successful steps and the occurrence of mistakes. Although the method has been criticized (talking about what one perceives and expects modifies users cognitive processes) [7] the think-aloud is still recognized as an easy to apply, and effective technique to reveal users conceptions and lines of thought when working with a system.

## 3 Usability test

### 3.1 Participants

We defined our target groups as "the professional outside the spatial domain". We selected 5 co-workers (2 male, 3 female) from our institute being non-GIS experts, but familiar with spatial data in their daily work. Their age varied between 32 and 57.

In the early 1990s, Jakob Nielsen [8] examined how many users are needed to carry out usability tests. He concluded that about 85% of all usability problems can be detected by 5 users. Although our evaluation included other aspects of the user's response, we decided to select that number of users for our exploratory test.

### 3.2 Materials: discovery portals

For the selection of discovery portals we considered the following main criteria: 1) language (interface and metadata itself); 2) coverage on at least the national level; 3) collected metadata records from a distributed network (following a harvesting or well structured protocol) and 4) the level of maturity of the discovery portals (proper search functionality and full operational discovery portal). We limited the amount of portals to three different portals. Due to language constraints of the metadata records we selected from native (Dutch) and English discovery portals. We selected three discovery portals on a national scale offering sufficient data sets and functionality to search:

1. The Dutch National Geo Register: <http://www.nationaalgeoregister.nl/geonetwork/srv/nl/main.home> version 21-01-13
2. The UK government data portal [data.gov.uk](http://data.gov.uk/): <http://data.gov.uk/> version 21-01-13
3. The UK GoGeo from EDINA/Univ of Edinburgh: <http://www.gogeo.ac.uk/gogeo/> version 21-01-13

### 3.3 User tasks

The participants were asked to perform a search task and assess the results of their search actions. The task represented the most common tasks performed by users of these discovery portals. We asked the user to find data on Natura2000 areas in the country the portal originated from and to assess 1) if the metadata contained acceptable information on the dataset, 2) if a point of contact (name, email contact person /organisation) could be found and 3) if a preview of the data could be given in a map. A map view is not necessarily a functionality of a discovery service. However, we assume that most users want to see a map of spatial data to facilitate assessing whether it is appropriate for intended use, so we included this in the user tasks.

### 3.4 Measurements

For our experiment we measured three aspects contributing to the usability of discovery portals:

1. Performance: how many steps are needed to complete the task. We counted the number of clicks made. We did not include clicks needed to zoom and pan in a map since these are no direct indications of success and vary widely between users.
2. Accuracy: how many mistakes are made in carrying out the task. We made corrections for users who were distracted and performed unintentionally other tasks as well like searching for another interesting dataset. The clicks performed for those distractions were not added.
3. Emotional response: the emotional state of users is an indication of their satisfaction with the system. Negative as well as positive emotions when using an application may affect the users performance. All reactions were recorded by observers.

### 3.6 Procedure

We performed the test with two observers, one to keep track of the statistics (number of clicks, mistakes, clicks for zooming, and clicks for actions that were not included in the task) and one to carry out the survey prior to the test and pose the evaluation questions after the test. The second observer also took notes on the users verbal and nonverbal reactions when performing the tasks.

At the start of the tests the participants were told the English profile name for metadata (GEMINI) and Natura2000 (protected areas) in order to minimise a language effect on the test.

The experiment started with a questionnaire on personal characteristics like age, gender, education background, number of years of relevant work experience, use of GIS software and familiarity with metadata to create insight into the personal user profiles.

After the tasks, evaluation questions were asked per discovery portal: 1) Did the site present you sufficient information on what to do; 2) Did the site present you sufficient information on the content of the site (to determine that you would find what you are searching for); 3) What would you prefer to see different; 4) What would you have needed to reach the result quicker; 5) Is the site easy and nice to use (design, performance).

After finishing the test of all three portals the participants were asked to name the weakest and strongest points per portal and to give a rating per portal from 1 to 10. Finally they were asked whether the language (two English sites vs one Dutch site) was of influence.

## 4 Results

This exploratory experiment was conducted with a small sample of participants (five). The quantitative results included in this section should therefore be considered with caution and seen in relation with the qualitative, explanatory results.

### 4.1 Personal user profiles

All participants have an academic background. They have between 6 to 25 years of GI related work experience and basic use of GIS software regularly (one participant) or seldom (four participants). They all search the internet for spatial data, some seldom, others now and then. For this purpose three of them would use standard search engines like Google, one would use a discovery portal and one would use both. Four of the participants are familiar with metadata and one of them once produced metadata herself.

### 4.2 Results: performance and accuracy

The participants tried to complete three tasks in three discovery portals. Most participants managed to complete the tasks in the National Geo Register (NGR) discovery portal, except for two participants who did not manage to find a map. The success rate for the first and third task was equal for the data.gov.uk portal and the GoGeo portal. Two participants managed to find a map in the data.gov.uk portal, but no participant succeeded in conducting this task in the GoGeo portal.

Table 1: Number of participants reaching a positive result per task and per portal

Task	NGR	data.gov.uk	GoGeo
1.information	5	4	4
2. map	3	2	0
3. contact	5	3	3

Table 2 gives an overview of the number of clicks that lead to expected results vs the number of clicks that did not. The data.gov.uk portal shows slightly better results than the NGR portal with the clicks that lead to expected results, while NGR scores better (in this case the least amount of clicks) for the clicks leading to unexpected results.

Table2: Average right (with expected results) and wrong (unexpected results) clicks per portal

	NGR	data.gov.uk	GoGeo
+	8	8,4	6
-	6	7,2	7

### 4.3 Results: Usability and emotional response

#### National Geo Register (NGR)

The participants found the portal easy to use, except for the icons. The number of icons was too high and their functionality was often unclear. In the mouse-over explanation often technical terms like WMS, WFS appeared and most of the participants did not know what they meant and were annoyed. Participants would have liked to see a map with the natura2000 areas earlier in the process and missed the link between map and metadata and reacted disappointed.

#### Data.gov.uk

The participants evaluation of the ease of use of this portal diverged. Some found the portal well-structured and user-friendly, while others spoke of an unstructured portal and

could not work with it. Three out of five participants said in the evaluation that it was not clear to them what to do. The number of buttons and options in the search list were confusing. They also mentioned they had missed a ‘tips and tricks’ option. The layout of the home page includes colourful graphics and photos which did not convey the purpose of the site to the users. One participant appreciated that the map showed real GIS data, but most of the participants could not find the map option and wondered about the ‘map-based’ search. A map-preview button was also missed.

**GoGeo**

The first impression of the homepage was very positive, although some found that it displayed too much distracting information (events etc.). However, during their tasks participants found the mouse-over main menu very frustrating. The main steps to navigate the search were regarded as fine and lead quickly to a map-frame, but the map-frame lead to frustration. First of all a map of the world appeared on which they had to zoom in to the UK; and secondly it only showed extents (boxes) which most of the participants did not regard as information, but as a malfunction.

In the end participants were asked to rate the discovery portals between 1 and 10 (10 being the best). The result is shown in table 3.

Table 3: average mark per portal

NGR	data.gov.uk	GoGeo
7.6	6.3	5.1

**5 Discussion**

The character of this study is exploratory and done in a short period of time. Only five participants were invited and three discovery portals were selected. A more elaborate test would have given more reliable results. The results of this test provided us with enough valuable information to propose further research.

Three participants admitted that the language had some influence on their evaluation and because of this they might have favored the Dutch site. The other two testers denied any influence of the language on the tests.

In our script we asked three questions. Information and a contact point is always part of the used metadata profile and should be found. The datasets found by the users did contain this information, but the users did not find it easy to locate this because it was buried deep down in the metadata. The other question, to show the data on the map is not a basic functionality of a discovery portal. But since also the on-line resource is part of the metadata it is not difficult to realize and it will be much appreciated by the user. In case the resource is not on-line available this should be (and can be) made clear to the user easily. In addition we observed that many times only geographical extents of datasets are shown on a map. Despite this is very useful to determine to what region the data set

applies, almost none of the users were interested. Instead, they expected to see the real data and were very disappointed that no map of the data was shown.

In the development of a discovery portal a developer can influence three main variables. In order to create a successful portal all three variables should implemented properly:

1. Contents of the catalogue
2. Indexing of the contents of the catalogue
3. Design and implementation of the client application

This is illustrated by the usability test. The Dutch NGR site was evaluated positively on user-friendliness, so the client application seems to be well designed. But for the Natura2000 dataset there are more than one services presented based on the type of service but describing the same dataset. This assumed technical knowledge of the user which is not very realistic, but also not relevant for finding the dataset. As a result users sometimes had difficulties finding a map. This implies that the variable ‘contents of the catalogue’ needs to be improved.

As we mentioned before the content of the metadata should be targeted at the specific requirements of the user group. Two main observations are that in creating the metadata for services it seems that no attention is given to the way users search. In our task we specifically asked to look for Natura2000 areas. A number of data sets contain these areas but they are hidden inside a layer as a legend class and no keyword is included to make the data discoverable. The second observation is that metadata is presented to the user without any explanation. Designers and developers do not acknowledge that most users are not familiar with the structure of the metadata, nor what elements are included in the profile and therefore do not know where to look or what to expect. Almost every discovery portal throws XML formatted pages of metadata records to users. None of the testers within our group appreciated this. These pages were clicked away immediately when accidentally shown to the user.

Almost all testers were positive on the performance of the discovery portals. In addition we observed that the users showed understanding that rendering maps can take time and had a high tolerance as long as they were informed that work was in progress (by a spinning wheel or the like).

**6 Conclusions and recommendations**

Given the language constraints and the concise task the differences between the discovery portals are relatively small. Nevertheless the way the portal is structured is very important. The marks given by the participants reflect which discovery portal succeeded well.

Referring to the three variables for success we conclude that for all portals indexing and underlying techniques are well implemented. The content of metadata is a point of concern. We recommend that much more attention is given to the user requirements and the discoverability of the data sets when creating metadata. But most of all the design and implementation of the client interface should be improved. In

the opinion of the authors especially the novice user should not need to have any prior knowledge on metadata structure, profiles, or anything technical like the numerous abbreviations (WMS, MFS, WMTS etc.) which are frequently used. They should first get access to the most important information, such as a short non-technical description, contact information, the (on-line) resource, a (pre)view, limitation for use and other restrictions. The developers should identify which information is regarded by users as most important or most used. These items should be presented first. The advanced user should still have easy access to the complete metadata, but as we noticed this is currently implemented for most of the discovery services.

We conclude that a usability test carried out with use of the Think Aloud Protocol is a good way of getting a thorough assessment of a portal in a short period of time. Performing the tests is time consuming, but compared to for instance questionnaires presumptions of the researchers do not, or to a smaller degree, determine the outcomes. It gives valuable information that can, if taken on board, improve the tested portal. This analysis was exploratory and we suggest further research into different user profiles and requirements from different professional groups, such as policy makers.

Finally more research into solving the obstacles that were identified should be carried out with a larger number of participants. We recommend that besides assessing the usability of the user interface also attention should be paid to adapting the complex content, expressed by the metadata, by a simplified presentation of the content according to the user requirements.

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