

# **USABILITY PROBLEMS OF WEB MAP SITES**

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## **Abstract**

The aim of the study was to evaluate the usability of web map sites through different usability methods. The following map sites were evaluated: Google Maps, MSN Maps & Directions, MapQuest and Multimap.com. Half of the evaluations were carried out with expert evaluations, during which usability engineers and cartographers examined the sites by paying attention to their features and functionality. Additionally, usability tests were carried out in a usability laboratory. The usability problems found were compared both quantitatively and qualitatively, and grouped according to their severity for the use situation. The most common usability problems found were related to the user interfaces, maps, and direction, address and place searches of the map sites.

## **1 INTRODUCTION**

Recent technological developments have provided new tools and techniques for interface and interaction design of web map sites. Consequently, many people use these sites for locating places and businesses, and for planning visits to unfamiliar places. Figures gathered from the web mapping sites' own web pages give an indication of their popularity; for example, MapQuest (2007) site states that it has over 40 million unique visitors monthly. The Multimap (2007) maintains a unique user base of over 10 million, ranking consistently in the top 10 websites by traffic in the UK. Web map sites are often freely available, and not only provide the map, but different map tools, and map related services. However, the use of the map sites is not always straightforward, and the sites may not always fulfil user needs. The problems on sites may have a negative effect on the information obtained and may reduce their future use.

User-centred design (UCD) can be seen as a way to help design products that take in to account the new environments and user requirements. Making systems more usable may have noticeable benefits for users by guaranteeing easy-to-use systems, which are less stressful for the user. UCD can provide financial benefits through reduced production and support costs, reduced costs in use, and through improved product quality (Earthy, 1996).

### **1.1 Usability evaluation of on-screen maps**

Beverley (1997) studied the benefit of a dynamic display of spatial data-reliability from the user's point of view with a test using map data for decision-making. Harrower et al. (1997) evaluated the design elements and communication quality of Internet maps for tourism and travel in a user survey. Studies have also been conducted on map animation and interactive tools (e.g. MacEachren et al., 1998), learnability, memorability and user satisfaction with

specific geovisualisation tools (Andrienko et al., 2002), and on the usability of zoomable maps with and without an overview map (Hornbaek et al., 2002).

Arleth (1999) studied the problems of screen map design and listed them; the map area was too small and both the legend and instructions too dominating on the screen. According to the study, the design process would be more manageable if it were divided into two phases concerning the map interior (the map elements, symbolisation etc.) and the map exterior (the tools and functions for using the map). Leitner and Buttenfield (2000) investigated the effect of embedding attribute certainty information in map displays for spatial decision support systems by having test users perform specific tasks with test maps. Harrower et al. (2000) used a focus group method and structured user testing to find out how novice users understood and used the geovisualisation tool designed to support learning about global weather. Ahonen-Rainio and Kraak (2005) described a study including iterative design with improved map prototypes and testing for visualising geospatial metadata.

Improving usability was the aim of Agrawala and Stolte (2001), who studied how route maps are used analysing the generalisations commonly found in hand-drawn route maps. Ishikawa et al. (2005) evaluated climate forecast maps using an empirical study with test users and observed that in many cases qualified and motivated test users failed to interpret the maps in the way that the map designer had intended. Richmond and Keller (2003) carried out an online user survey to assess if the maps on tourism websites met the expectations of the users. Jahn and Frank (2004) proposed an additional aspect for usability attributes: information quality (IQ), which aims to describe the importance of the data needed by the user and enables data quality to be adapted in an optimal way to meet user needs. Van Elzakker (2004) carried out user tests, including a think aloud method and a questionnaire, in order to investigate the selection and use of maps of users exploring geographic data. Koua et al. (2006) studied test subjects' ability to perform visual tasks in the data-exploration domain, and emphasised that the use and usability assessment of implemented methods and tools is an important part of understanding the visual tools used for data exploration and knowledge construction.

## **2 METHOD AND PROCEDURE**

The aim of the study was to carry out a usability evaluation for web map sites. Four web map sites were evaluated in the study: Google Maps (2007), MSN Maps & Directions (2007), MapQuest (2007), and Multimap.com (2007). These sites consisted of an

interactive 2D map with zooming and panning options. Additionally, users were able to search for different locations and directions for routes.

Evaluations were carried out following a use scenario 'A tourist is planning to visit London'. Half of the evaluations were conducted as usability tests in a usability laboratory, where each user performed predefined test tasks with two of the web maps. The other half were expert evaluations carried out by eight cartographers and eight HCI experts (or usability specialists), each of whom went through one map site. Altogether 24 participants were involved, and 32 different evaluations were carried out in the study. Each of the four map sites was evaluated by eight separate participants (four test users and four experts).

The problems identified were grouped under four different categories according to the severity of the problem encountered (Nielsen's, 1993): 1) a catastrophic usability problem, 2) a major usability problem, 3) a minor usability problem, and 4) a cosmetic usability problem. The paper focuses on discussing the qualitative findings of the study.

### 3 RESULTS

Altogether 403 usability problems were found (*Total\**, Table 4). However, some of the usability problems were found with several methods. When counting only unique problems encountered, altogether 343 problems were identified: 69 in Google Maps, 83 in MSN Maps & Directions, 92 in MapQuest and 99 in Multimap.com (Table 1).

**Table 1.** The number of usability problems found with different evaluation methods.

Usability tests	Carto eval.	HCI eval.	<i>Total*</i>	No. of individual problems
Google Maps (GM)	38	17	25	80
MSN Maps & Directions (MD)	57	21	18	96
MapQuest (MQ)	50	26	32	108
Multimap.com (MM)	71	32	16	119
<b>Total</b>	<b>216</b>	<b>96</b>	<b>91</b>	<b>403</b>

The problems were classified under different categories based on how severe their effect was on the use situation. In total 33 *catastrophic* problems were identified, in addition to 138 *other major* problems, 127 *minor* problems and 44 *cosmetic* problems.

### 4 USABILITY PROBLEMS

The usability problems identified were grouped under categories: *user interfaces, maps and map tools, search operations, and help and guidance*. As there is no room to discuss all of them in this paper, the discussion here focuses on the most severe problems related to the *maps* and *map tools*. The results are presented in more detail in another paper by the same authors (Nivala et al., submitted). At the end of each problem description a reference

is given to the map site(s) in which the problem was encountered (i.e., GM=Google Maps; MD=MSN Maps & Directions; MQ=MapQuest; MM=Multimap.com).

#### **4.1 The user interface**

The first impression is important when entering a web map site. Despite this, there were a lot of problems related to the map sites' 'home pages', which were often overloaded with different types of information (adverts, links, images). This made the site look messy and prevented users from finding relevant information on it (MD, MQ, MM). Map sites' home pages were criticised for not indicating that they were about maps at all; i.e. there was no image of a map (MD, MQ). Participants commented that sometimes the sites seemed to be more interested in drawing user attention to different advertisements than helping them to find locations (MQ, MM). The layout of the UI was also criticised; for instance, the search box was considered too small and its location wrong, because it was not in the centre of the screen (MQ). Some users did not find the search box at all (GM, MM).

#### **4.2 The map**

Although the map was naturally the main focus in these sites, sometimes the actual map took quite a small amount of the space on the web page (MD, MM), which made it difficult for users to get an overall picture of locations. Some maps were criticised for looking like they were designed to appear as paper maps, instead of web maps (MM). The maps were criticised to be messy, confusing, restless and awful looking (MD, MM). Some maps were regarded as being sketch-like (MM), old fashioned (MD), or the map projection looked weird to the participants (MM).

The use of colours was not always the most efficient; the background colour of built-up areas was unreadable and the text was not optimal for contrast (MD). Similar colours were used for different features; for example, it was difficult to distinguish between shopping areas and hospitals (MQ). Colours were also criticised in general (MM) and in specific cases (MM: a motorway illustrated with a blue line - "Looks like a river"). Some colours were considered unintuitive (MQ: built-up area marked in light green). Some maps were overloaded with information and/or colours (GM: overview map of London, MM, MQ). The categorisation of streets for different scales was also seen inappropriate (MQ).

Sometimes the map was considered being too general (MD, MQ) and the information on the overview map was seen insufficient to support decision-making (MM, MD: on the 5th closest zoom only the names of biggest sites, on the 2nd closest level only a few street names were visible). The participants would often have liked to have more information

about public transportation included on the maps (railway stations, airports, timetables) and different types of tourist attractions and landmarks (GM, MD, MQ, MM).

Texts were not in the correct locations all the time (GM), and were not visually pleasant or not legible, even at the biggest scale (GM: hybrid map, MD). The placement of road names was also bad at times; they could not be linked to the correct roads (MD). Some symbols caused problems because they were ‘standing out’ in relation to the other symbols, especially if it was not clear what they were and why were they emphasised (MD, MQ, MM). Many symbols were misinterpreted: ‘red squares’ as a location of search result (they were actually museums, the user had to zoom up to the closest scale to read their names) (MD), or a train track visualised by a dotted line (a walking track) (MM). The users also tried to click or point at the symbols to get information about them (MD).

Some maps had problems with different zooming steps; symbols (MD) or texts (MQ) appeared and disappeared randomly between different scales. Sometimes the step between map scales was too large (MQ), and in many cases the visualisation between different scales was distinctively different (MD, MQ, MM). This made it difficult to make a connection between a large-scale and an overview map and to keep track of a specific location at different scales.

Sometimes it was impossible to find information about where the map data was from and when was it gathered (MQ). The data were also insufficient or inaccurate, because some airports and hotels were shown on the map from a specific location, while the others were not (GM, MM). This raised a question: “Who decides what is included or not in the map? Is it based on who is paying, e.g. their hotels to be listed for user queries?”

### **4.3 Map tools**

There were many problems related to the map tools. There was either no legend for the maps, or the participants were not able to find it (GM, MQ, MM, MD). Some users had problems realising that they could actually carry out searches on the map (GM, MM). Mistakes in design were also observed; for example, the map size buttons did not work if a route was shown on the screen, although they appeared as active buttons (MD).

At times parts of the map were covered by zoom buttons and scale bars (GM). A tiny scale bar was also considered to get lost on the map window (MQ, MM). Panning was considered problematic; the steps were too big and the participants lost idea of where they were (MM). If panning was slow and there was no feedback, users thought that they had missed the button the first time and clicked it again (MQ, MM).

Estimating distances was sometimes difficult, since several users did not realise that there was a scale bar (MD, MM). One scale bar only showed miles, while some of the users only understood the metric system (MM). It was also criticised that the scale bar could only be used for rough estimation of distances (MD, MM). Some users preferred a grid on the map to which they could compare different distances (GM, MQ).

In addition, a link to print the map was needed (MQ, MM), as was an option to save a search or system state and to return to it easily (MQ). One user commented that there was no indication of where the north is (MM). Users also wanted to add markers on the map in order to make re-finding a certain location easier (MQ). Some sites provided an option to change the map area, but users either did not realise this or did not understand how it worked in relation to the zoom button (MD). It was also annoying for the participants that setting the map size did not stay for the next query (MD). Some participants wanted an option to customise the map by checking 'boxes' to show or hide data layers or symbols (GM, MD). This was considered relevant, especially as the maps were overloaded with different objects (MM). An option to highlight classes of objects (tourist attractions, hotels, restaurants) was also called for (MQ).

Participants were confused about the different types of zooming possibilities and their relations to each other (MM). One user did not realise that there was a zoom function at all (GM). Sometimes the zooming function was criticised as being old fashioned (with the scale numbers) and confusing for ordinary users (MD, MM). Zooming was also considered problematic when there were neither steps nor animation when switching between different scales (MD, MQ) and users lost the location that they were looking at earlier when zooming. With one site zooming moved the search result out of the map window, because the search result was not centred on the map at the beginning (MM).

Some participants would have liked to point at the area that they were interested in zooming in on (MD). It was found confusing that the map could be zoomed by clicking it, as the cursor did not change when it was pointed at the map (MD). It was considered annoying that clicking it could not centre the map, because it always also zoomed in (MM). It was surprising for the users that clicking the map refocused and recentralised it when they only wanted to point on it (GM).

#### **4.4 Direction, address and place searches**

Following the user scenario the participants carried out searches during the evaluations. Accordingly, a significant number of usability problems were found related to user enquiries and searches for different locations and objects on the map. Of the four map sites

included in this study, one site was distinctively different in that it supported a more ‘free search’ in which the user could type in the search criteria quite freely in one or two search boxes (GM). The other map sites were more restricted and provided users with different search boxes that each required a certain type of text (e.g. country, address, place, etc.). Both search types had their positive and negative sides: free search was considered nice because it is more or less like the way people normally find information when using search engines. The good side of the other search type (MD, MQ, MM) was that people are more used to having separate search boxes for ‘location’, ‘directions’ and ‘businesses’ with map sites, and most of the time people also know what to type in each search box. However, it was criticised that the only way to search for addresses or directions was a text entry, whereas it would be helpful to have the map as an interface as well, i.e. to be able to click on the map for start/end points of a route.

Users wanted to make several separate searches at the same time (multi-searches), so that the different objects would be on the map at the same time (GM, MD, MM). Another problem encountered was that people did not know whether or not the search they carried out was going to include only the area shown currently on the map (GM, MM). It was also confusing that the menu choices for the countries varied for different search options (MD: sometimes countries, sometimes continents). Searching for addresses was not always easy; for example, if an address was entered as used in central Europe (i.e. street name first, house number second), no results were found, since the user has to know that in the UK the house number comes first (MD).

Surprisingly, the most severe and most often encountered usability problems were related to the default settings of the map sites. These actually prevented some of the participants from using the sites, because they could not see why their searches did not give any correct results. For example, the user types in ‘London Bridge’, but the program only gives results from the USA (GM). The reason for this was that not all the participants noticed the USA default, or did not know how to change it (MD, MQ). It was especially frustrating for the users that the search box always went back to the USA default – even though they had already changed the country to something else (MD, MQ).

#### **4.5 Search results**

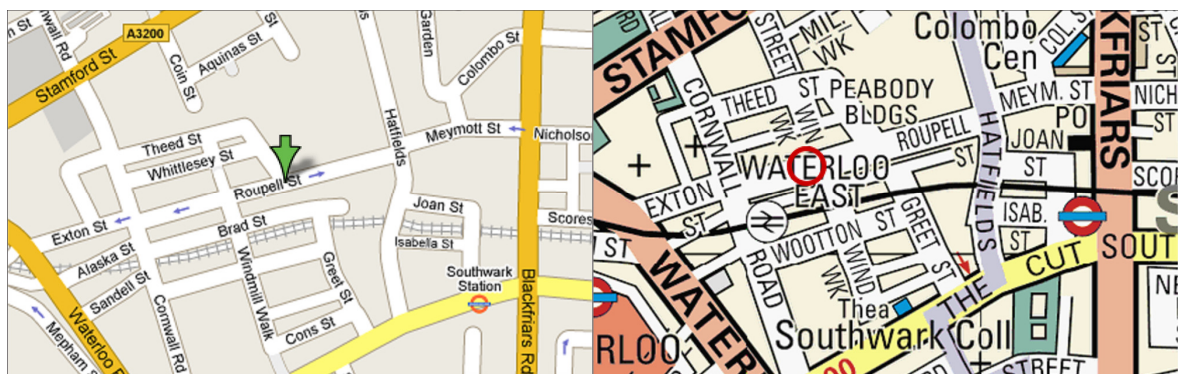
Often the participants did not know how the search results matched their search criteria. With one site the user typed in ‘The London Bridge’ and the search resulted in ‘The Bridge’, which is a different result, but the user accepted this because if only one result matched the search criteria, the result was shown on the map without explanation as to how

it matched with the search (GM). On another occasion the user got a list of ‘Londons’ in the USA and did not realise these were wrong, because the country was not shown to the user (MQ). The participants also tried to search using two or more search criteria at the same time, and as a result got a map with the result on top of it. However, this was not always the correct result, since it sometimes only included one of the search criteria (MM).

The participants criticised that the search results were sometimes ‘weird’, and there was no help available to explain where they came from (e.g. GM: ‘zoo London’ gave the result ‘zoo toy-shop, Leeds’). The users actually had to know very well what they were looking for because some searches gave a huge number of wrong results, although the search was well defined (e.g. ‘Big Ben’ gave results everywhere else except London) (MM). Search results were even more confusing for users when they were based on similar-sounding names, such as ‘London tower’ gave the result ‘Lake Teterower’ (lake in Germany) and ‘Longbridge’ (in Birmingham) (MD). One user got 25 results for a simple road search, because everything that included the searched name or sounded the same was included (‘Tussaud’ resulted in ‘Tosside’ and ‘Thickwood’ being included; ‘train’ resulted in all the names starting with ‘tr’ and ‘th’ being included) (MM). If there was no help available, it was hard to understand why they appeared in the results of specific searches.

#### 4.6 Visualisation of the results

Visualisation of search results was criticised; for instance, when a street result was visualised with a pin instead of linear highlighting (e.g. a colour band) (GM, MD) (Figure 1). Comparing different search results was considered difficult as well, because they were not shown on the map at the same time (GM, MD) or because different search results were shown in different scales (MD, MM). The users had to open another map window to compare a distance between two locations (MD).

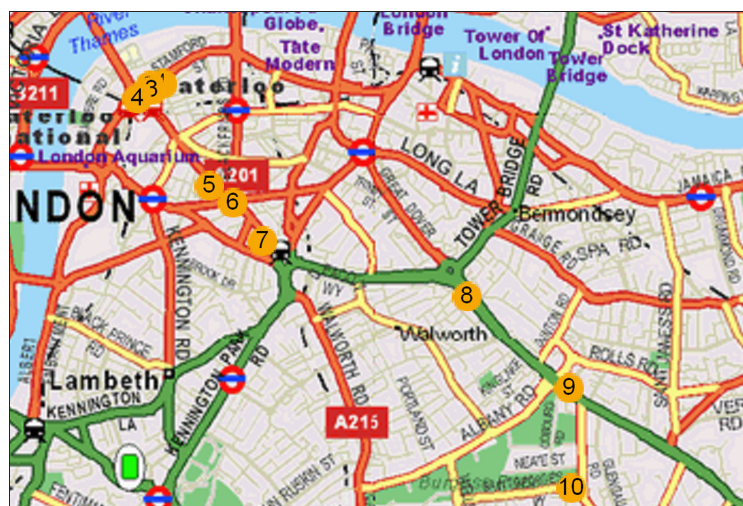


**Figure 1.** Two different types of search result visualisations for ‘RouPELL Street’ query: a) Google Maps (left) and b) Multimap.com (right). Screen shots taken in April 2007.



Sometimes the search results were shown on the map on top of each other, so that the users were not able to see them all, but had to go through them by clicking the result list on the left (GM) or at the bottom of the map (MM). One site only centred the map according to the result, without emphasising the result in any ways (MD). The users did not realise that this was a result, especially because not even the name of the result was shown on that scale (five zoom in operations would have been needed to see the text) (MD, MM). The same problem appeared for the searched roads (MQ); the results were given in a scale in which they could not yet be seen.

The search results were easily lost on a map when zooming in or panning the map (GM, MM), especially if the result was not centred on the map (MD, MM) and there was no indication of which direction to move in to find it. The users commented that there should be an option allowing quick return to the search result instead of constantly having to click back to the search page (MQ, MM). Sometimes the search result visualisation also changed from the first map view to another (from orange quadrangle to a red circle) (MM). Another search result symbol (red circle) was difficult to see on a map, and also got mixed with a subway stop sign (MM) (Figure 1). It was confusing that when users searched for a route they got the result as a text description, not as a map, as they expected (MQ) (the users had to scroll the view to find it). With one map there was only points where to turn shown. These were difficult to see, and more dramatically, visualised differently between different scales (MM) (Figure 2). In addition, the search result was given on the same scale as the map was before the search, and the entire route was not shown on the map (MM).



**Figure 3.** Route visualisation with turning points, which are on top of each other (Multimap.com, 2007).  
Screen shots taken in April 2007.

#### **4.7 Help and guidance**

Error situations are often inevitable with map sites, because users may search something that does not exist in the database, for example. It was observed that there was no proper help provided to users in all situations. Some error messages did not look like a message, and the user did not even notice them appearing on the screen (MM). Sometimes the error message was given clearly, but it was not informative (GM, MM). Some sites gave examples to help users use the searches, but they were also confusing: the help text ‘in London’ worked only for businesses (such as ‘curry in London’), but not for street searches (GM). Sometimes the ‘help’ was not what the user expected: the user needed help for finding locations but the ‘help’ was only a legend for tools (MM).

### **5 DISCUSSION AND CONCLUSIONS**

Usability of four web map sites was evaluated in this study. As a result, altogether 403 usability problems were identified. The problems found were classified into different categories according to the part of the site they belonged to. As map sites are decidedly visual in their nature, distractive advertisements and messy UIs were found. A site that frustrates the user from the very beginning can cause very negative feelings towards it. And this does not only refer to the UI aspects of the site, but also the maps. It was quite worrying from the perspective of the use of the map sites that so many critical comments were given even by ordinary test users about the messy and bad visualisation of the maps themselves. Some of the users actually stated that in a real-life situation they would have given up trying to complete the tasks with some of these sites a long time ago.

Different sites have different objectives in mind, and the use scenario may not correspond exactly to what these sites were originally designed for. However, the experimenters did not find any exact information about to what purposes these sites were designed for, so they made the assumption that tourist use would be one of the most typical use scenarios. It was surprising that one of the most severe problems observed was the default settings of the map sites, as they actually prevented some people from using the sites. It was also critical for the use situation that users were confused as to what the results given for the different searches were based on and how they matched their search criteria. Interpreting maps and locations is a subjective experience; one of the participants commented: “I searched for London, and wondered what the criterion for the centre of town is? And how should the centre be represented on the map?” The use of terms like ‘location’ and ‘place’ was also criticised because they are not objective terms, but always

dependent on who is using the term. As web map sites may be used by many kind of people, the challenge for the future research is to find out how the needs of different user categories could be met.

Some of the participants had hardly used any types of map sites at all, and for them the use of these sites was especially difficult. Some of the users did not realise at all that the map scale could be changed or that searches could be carried out for the different objects on the map. The challenge remains to design map sites that people can use and in which they can make meaningful search queries without getting frustrated or without facing many problems in using them. Another difficulty is to attract people who have never used any type of map sites. How to help them to realise the variety of the map sites and their functionalities and through that make them benefit from using them? The observed lack of guidance on the sites definitely does not help in this situation.

It was an interesting finding that map sites offered links to different services (hotels and tourist attractions), but since these were links to their own web pages, they either had their own map interface, or no map at all. If a user wanted information on how to use the subway to get from one tourist attraction to a hotel, at least three different maps and services had to be opened at the same time: subway route map, map with hotels on it, map with tourist attractions on it, and perhaps even a base map for combining all this information. While having their own maps at different scales and visualisations, it is difficult for users to combine all the information. Although one solution would be to deliver them from the same map service, it might be quite difficult, so another way would be to deliver harmonised maps between different services. This may not actually be all that far in the future, because for example Google Maps offers free map data to be used by different services through different gadgets and applications.

It can be expected that since different usability evaluation methods highlighted a critical amount of usability problems on the map sites, some of these problems might have been avoided by applying UCD methods in the design process before releasing these sites. However, not all the methods used in traditional usability engineering are either suitable, or useful, for map applications. Cartographic design is the key issue in the development of map sites, but the design should be reconsidered to guarantee the usability of interactive and dynamic map applications.

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