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Evaluating the suitability of Web 2.0 technologies for online atlas access interfaces

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Abstract

Since first using online atlases, there have been many developments in Web technologies. One of the most obvious developments is the transition to Web 2.0, which enables users to participate and communicate in a collaborative manner. The vast majority of currently existing online atlases do not include functions of Web 2.0, which could lead users to participate and to communicate. Some of these Web 2.0 functions, which could be adapted to online atlases, are recommendations, user comments, tag clouds, blogs and RSS feeds. Before implementing these functions in an online atlas, it is essential to know how users could possibly react to them and how useful they might be for an online atlas.

This research focuses on evaluating the suitability of these functions, especially recommendations and user comments. In order to evaluate their suitability, a usability test is carried out, including 30 test persons. A prototype with different interfaces is developed for usability testing, which simulates an online atlas of Austria. Some of the interfaces include Web 2.0 functions in different position so to compare test persons' behaviors in different interfaces. In addition to the usability test, test person are also asked to fill out a questionnaire in order to obtain information about how they feel about and rate these new opportunities.

Kurzfassung

Seit der Entstehung von online Atlanten haben sich die Web-Technologien stark weiterentwickelt. Einer der größten Fortschritte war der Übergang zu Web 2.0, das Benutzer zu interaktiven Teilnehmern macht. Die Mehrheit der heutigen online Atlanten machen sich die Möglichkeiten, die durch Web 2.0-Technologien entstehen und Benutzern eine aktive Teilnahme ermöglichen könnten, noch nicht zunutze. Einige dieser Funktionen, die auch für online Atlanten adaptiert werden könnten, sind Empfehlungen, Kommentare von Benutzern, Tag Clouds, Blogs sowie RSS feeds. Bevor diese Funktionen jedoch implementiert werden können, ist es von großer Wichtigkeit, deren mögliche Wirkung auf potentielle Benutzer sowie deren generelle Adaptabilität für online Atlanten zu eruieren.

In dieser Masterarbeit wird die Eignung dieser Funktionen für online Atlanten, mit besonderer Berücksichtigung von Empfehlungen und Kommentaren, untersucht. Zu diesem Zwecke wird ein Usability-Test durchgeführt, bei dem 30 Testpersonen teilnehmen. Ein Prototyp einer Website wird entwickelt, der einen online Atlas von Österreich simuliert. Einige der Interfaces beinhalten Web 2.0-Funktionen, die unterschiedlich positioniert werden, um so die Reaktion der Testpersonen auf diese Positionsveränderungen eruieren zu können. Zudem werden die Testpersonen gebeten, einen Fragebogen auszufüllen, um deren Einschätzung bezüglich der neuen Möglichkeiten, die sich durch Web 2.0 bieten, für online Atlanten festhalten zu können.

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Content

1 Introduction

Nowadays, there are many regional and national online atlases available and the number of them is constantly increasing. For existing online atlases, instead of having different technologies, there are two commonly used map accessing methods.

One of them is searching maps by typing keywords in a search box. According to the system designers' decisions, entries may be searched either in predefined keywords for each map or map titles or in the text information of the maps. After getting search results, users can choose the desired map and can then get access to them.

The other commonly used method is selecting a map theme from a hierarchical themes list which is used together with varied Graphical User Interface (GUI) elements. According to their themes, every single map is listed under a more general topic and users can access the desired map by following the steps from general topics to more specific topics.

In this research, the suitability of new technological developments for online atlases will be evaluated and alternatives will be studied for map access interfaces in an online atlas.

1.1 Problem Description

Many new developments emerged in Web technologies since first using online Atlas Information Systems (AIS). Some of these developments are about assisting users during using websites and supporting them in order to find the most suitable items in a shorter time with giving them advices by analyzing their behaviors. Similar to that, recommendations are provided according to other users' behaviors (e.g. Amazon recommendation application: Amazon's algorithm compares users' activities on the site with the activities of other customers, and then recommends other items that may interest the user, as well [URL 1]).

Within the concept of Web 2.0, users are not only information consumers anymore but they also have the opportunity to add or change the information provided on a website. It enables the users to cooperate; they can communicate with each other by writing comments about products or materials or directly communicate with

each other by sending messages.

Such methods are not commonly used in online atlases yet and the suitability and effects of these developments' use in online atlases are still being researched.

In the context of this thesis, the following questions will be answered: How do the recommendations effect the time users spend on an online atlas website? Do the users of online atlases take editors' advices into account? Do the users of online atlases take other users' activities into consideration? Do the users have a preference between these two? Do the comments of other users change the users' own activities? Do the users of an online atlas tend to write comments?

Hypotheses for these questions are:

- Recommendations attract users' attention in an online atlas and cause users to spend more time on the website compared to the same system without recommendations.
- Users take recommendations by system designer advices and by other users' activities into consideration and the ones by other users' activities more than designers' advices.
- Users tend to comment and other users' comments are interesting for them and have an impact on their behavior.

1.2 Research aim and motivation

The aim of this research is to evaluate the suitability and effects of new Web 2.0 opportunities for online atlas by empirically evaluating the topic.

The motivation of this research is to find new adaptable opportunities for online atlas designers to improve their interfaces, in order to provide easier and collaborative usage for their users.

1.3 Methodology

In order to answer the above defined questions, an empirical evaluation will be carried out within this research. For that evaluation, an online atlas prototype is developed which simulates an online atlas running on a Web browser. This

prototype will be presented to the test person in PDF format and each test person will have to complete five tasks on a clickable PDF interface. For the given tasks, there will be different interfaces which allow the comparison of the users' behaviors and reactions to different interfaces concerning goals of this research. A questionnaire will also be filled out by test persons in order to obtain information about their feelings and ratings.

1.4 Structure of the thesis

After this chapter, in Chapter 2, the basics of the relevant cartographic issues are explained. In Chapter 3, existing and commonly used map access methods are explained. Afterwards, in Chapter 4, Web 2.0 technologies, their use in online cartography and the ideas of new opportunities for online atlases will be explained. Chapter 5 gives a brief explanation of usability testing concept and introduces the test that will be carried out within this research. The results of the usability testing and a short evaluation of the results can be found in Chapter 6. Chapter 7 includes conclusion, discussion and further research.

2 Basics

Technological developments allowed further innovations with respect to the production and use of atlases which have centuries of history: From paper-form atlases to electronic atlases (CD-ROM/DVD) and now online atlases.

In order to understand the current situation and use of atlases and to evaluate how current products can be advanced, this chapter covers definitions for the terms atlas, electronic atlas and Web atlas. In addition to these definitions, a classification of these different types of atlases, differences between them and the relevance of Geographic Information Systems (GIS) and AIS/electronic atlases will be explained.

2.1 Atlas

According to the World Book Encyclopedia (WBE), in Greek mythology, “Atlas” was one of a group of gods called Titans. He was the son of the Titan lapetus and a sea nymph named Clymene, and the brother of Prometheus. After losing in a war against Zeus and the other Olympian gods, Atlas was punished by Zeus, forcing him to stand and support the sky on his shoulders forever (as cited in Lechthaler et al. 2005).

Abraham Ortelius' Theatrum Orbis Terrarum (Theatre of the World) is considered to be the first true atlas in the modern sense. It is a collection of uniform map sheets and a text bound to the form of a book which was engraved on copper printing plates. The atlas was first published in 1570, it consisted of seventy maps on fifty-three sheets with accompanying texts which were logically organized to represent continents, groups of regions and nation-states, and was published until 1612 [URL 2].

The word “Atlas” was first used by Gerard De Cremer, known as Mercator (1512-1594), in the title of his work “Atlas sive Cosmographicae Meditationes de Fabrica Mundi et Fabricati Figura”. In this context the word “Atlas” stands for a worldwide consideration of the matter (Bollmann & Koch, 2001).

According to Bollmann & Koch (2001), in the 19th century, the term “Atlas” had a more universal character and it was understood as a series of single maps which portrayed the whole earth within a certain system. Since the mid-20th century, graphics, photos, aerial and satellite images and explanatory texts were included

beside maps. In the middle of 1990's, first electronic atlases were published in the form of a CD-ROM (Cron, 2006).

Nowadays, an atlas work is defined as a target and purpose-oriented, systematic set of maps in book form or a set of single maps in loose-leaf form or data for the electronically presentation on a monitor. Every atlas also has a regional aspect beside its systematic aspect, offering static presentations like maps, texts, tables, photos and graphics as well as computer-aided dynamic elements such as languages, sounds, animations and videos (Bollmann & Koch, 2001).

2.1.1 Classification of Atlases

The structure of atlases helps to assign them to atlas categories and produce them for certain targets and purposes. According to formal and factual features, Bollmann & Koch (2001) distinguish atlases and give some examples regarding to the following topics listed below:

- Output medium and presentation form (*Paper atlas, tactile atlas, electronic atlas, multimedia atlas*)
- Format and scope (*Giant atlas, hand atlas, book atlas, mini atlas*)
- User oriented purpose (An atlas with general education like *look-up atlas, encyclopedia atlas, school atlas*, An atlas with technical education like *geological atlas, hydrological atlas, climate atlas*, An atlas with individual or group-specific demands like *travel atlas, auto atlas, hiking atlas, ski atlas*)
- Representation area (*World atlas, country atlas, regional atlas, city atlas, space atlas, moon atlas*)
- Thematic contents (An atlas with complex thematic content like *universal atlas, environment atlas, history atlas*, An atlas with specific issues like *orographic atlas, sea atlas, climate atlas, population atlas*)

2.2 Electronic Atlas

Like in all other areas of cartography, technological developments also provided new opportunities for the production and use of atlases and brought them into electronic form.

The term “electronic atlas” is used for the atlas medium which is in a sense a geoinformation system, having a purpose-oriented theme and representation on a monitor. Electronic atlases have callable information to obtain from graphics, photos, tables, animations etc. beside their optically visible information. They enable users to change cartographic parameters through interactive interventions (Bollmann & Koch, 2001).

According to Elzakker and Siekierska & Taylor, electronic atlases can be simply defined as “an atlas developed for use primarily on electronic media” and it is defined by the Dutch Cartographic dictionary as “an information system set up for the interactive consultation of digital cartographic databases concerning certain area or theme and containing data which are comparable in terms of level of generalization and the resolution at which data were collected” (as cited in Ulugtekin & Bildirici, 1997).

Electronic atlases are available on mediums such as floppy-disks, CD-ROMs and DVDs or accessible via Internet as online atlases. The first prototype of an electronic atlas “The Electronic Atlas of Canada” was published in 1981. The first electronic world atlas “Atlas of the world” was released in 1986 and the first regional atlas “The Electronic Atlas of Arkansas” was published on CD in 1987 (Bollmann & Koch, 2001).

Due to the fact that electronic atlases tend to become more complex, Kraak & Ormeling (2010) propose using the term “Atlas Information System (AIS)” instead.

Ormeling (1995) proposes three main functions of AIS: providing background information, showing other graphical views of the data and showing additional material.

- *Providing background information* which can be statistics of maps, pictures, explanatory texts, tables, graphs, drawings etc.
- *Showing other graphical views of the data* which allows producing different maps than the published ones with the same data by applying different classification systems, changing the number of classes or using different class boundaries.
- *Showing additional material* with the help of their capacity and cost advantages compared to paper atlases which cause limitations on the number of views, selected areas, topics and time issues in paper atlases.

2.2.1 Classification of electronic atlases

Kraak & Ormeling (2003) classify electronic atlases according to their level of interactivity and analytical potential into three categories: view-only atlases, interactive electronic atlases and analytical electronic atlases.

View-only electronic atlases can be considered as a digital version of paper atlases without extra functionalities. Their advantages compared to paper atlases are the lower costs of production, easier distribution (CD-ROM) and opportunity to update them.

Interactive electronic atlases enable their users to manipulate the data sets, change the color scheme, adjust classification methods or extend the number of classes. According to Gartner et al. (2005), users become more or less cartographers because they influence the result of cartographic data transfer which may cause cartographic data representations to be unattractive, illegible and might not fulfill the desired information tasks. In order to prevent such cases, they propose the concept of “Restrictive Flexibility”. In this concept, a so-called system control should support the efforts of system users in the process of map making.

Analytical electronic atlases use the full potential of the electronic environment and are able to make computations on areas, on themes or on themes within specifically determined boundaries with much of the GIS functionality. Beside the map object query function, users can combine data sets which gives users the opportunity to produce new themes except the themes selected by atlas author where the main focus is still assessing the spatial information and the visualization of the result (Kraak & Ormeling, 2010).

Borchert (1999) classifies electronic atlases according to their storage media into three categories:

- Web-Atlas
- CD-ROM / DVD Atlas
- Combination of them. Some of the CD-ROM / DVD atlases can automatically connect to the Internet for accessing updates or additional information.

According to their dimension, Borchert (1999) and Schneider (2002) classify electronic atlases into three categories:

- 2-D atlases
- 2,5-D and 3-D respectively
- Combination of them

and according to their type of media:

- Map based atlases
- Atlases based on map-like media (Aerial and satellite images, photos, panoramas, etc.)
- Atlases with other media than map or map like media (images, graphics, etc.)
- Combination of them

Ormeling (1995) classifies AIS based on their objectives, where some categories continue or expand the role played by paper atlases, as below:

- National AIS (topical comparisons)
- Historical AIS (temporal comparisons)
- Reference/Economic/Physical – World AIS (geographical comparisons)
- Educational AIS (topical/geographical comparisons)
- Navigation/Management AIS (comparisons with reality)
- Physical planning AIS (topical/temporal comparisons)

2.2.2 Differences between paper and electronic atlases

It is possible to make a comparison between paper and electronic atlases and find out differences between these two types of atlases according to their features.

Borchert (1999) states flexibility, non-linearity, dynamics, mediality, actuality, extendibility, accessibility and resolution as the main characteristics of electronic atlases which differentiate them from paper atlases.

Ormeling (1996) studies differences between traditional analogue and electronic atlases by assigning atlases to electronic atlases which use new technologies in the sense that they have an interactive or even analytical character. That is the reason why view-only atlases are not included in electronic atlases. A summary of his study is shown below:

Paper atlases / view-only atlases	Interactive atlases / analytical atlases
Static	Dynamic
Passive	Interactive
Maps only	Maps and multimedia
Limited / selective	Complete
Fixed map frames	Panning and zooming possible
Compromise for all types of use	Customized
Maps as final product	Maps as interface

Table 2.1: Differences between paper and electronic atlases (Ormeling, 1996).

2.2.3 Relevance of GIS and AIS/electronic atlases

It is well accepted that there are similarities between GIS and AIS/electronic atlases considering their opportunities which allow users to explore, measure, match(visual), compare, overlay and combine the geo-information (Lechhaler, 1996, Lechthaler et al., 2006). Despite these similarities, there are big differences between GIS and AIS. According to Lechthaler, the aim of AIS is to develop and display a legible, graphically designed and scale dependent geo-data/-information whereas in GIS the major interests are analyses, searches and queries of data and visualization of the achieved results (as cited in Lechthaler, 2006).

Lechhaler, Spanring and Katzlberger (2006) differentiate GIS and AIS as listed below:

	GIS	Interactive / Multimedia AIS
Purpose	Without, application admits any kind of data handling (retrieval, manipulation, analysis)	Always (view extension, format, theme/content, certain user group, output medium, …)
Application	Static	Interactive, dynamic
Use of interface	Complex	Interactive, level of complexity depends on target user group
Users	Experts	Non-experts / experts
Computing time	Rather long, depends on target question, extent of database	Rather short, especially if offered atlas map conform to the target question
Control by	Users	Author, who sets flexibility and restrictions

Main focus/tools	Handling of data (retrieval, manipulation, analysis), presentation	Visualization of elementary geo-data (geometry, thematic) after cartographic rules, with/without handling of data
Data	Unprepared	Edited (selected, adapted or changed to suit the target theme)
Output form	Graphics, tables, diagrams, text, maps	Maps (2.5D/3D), graphics, tables, diagrams, text, images, speech, sound, animation, video-clips
Output medium	Screen, paper	Screen, paper

Table 2.2: *Differences between GIS and AIS (Lechthaler et al., 2006).*

Using GIS as additional data input is getting more and more interesting ,if an appropriate interface can be provided, correspondingly to the growing content of multimedia / electronic atlases where powerful interactive atlases should be able to analyze, process and model multi-dimensional (2D/3D) and spatiotemporal data (Bär & Sieber, 1999).

Bär & Sieber (1999) propose three different approaches in order to develop a powerful interactive atlas using GIS:

Multimedia in GIS: with predefined functions for data acquisition, pre-processing, data management, manipulation and analysis and integration of multimedia to them which provides a time dimension and more realistic representations of spatial objects (Fonseca et al., 1992, Bär & Sieber, 1999). Limited multimedia functionality, not allowing a system-independent overall atlas graphics design and a lack of the integration of powerful tools with an intuitive and user-friendly interface are the disadvantages of this approach.

GIS in Multimedia: with a conceptual framework which is not primarily data-oriented or expert-driven, but basically focusing on communication, human-computer interaction, and (media) integration. According to Schneider and Blat et al., in order to integrate even any low-level analytical functionality, data structures and GIS techniques have to be defined and implemented by the author (as cited in Bär & Sieber, 1999). Predefined interactivity and user-centered presentation, current applications of the interactive and expert atlas type (Ormeling, 1995) are limited.

GIS and Multimedia Cartography: a variant of the *GIS in Multimedia* approach which aims to overcome the cartographic limitations of the GIS-based approach

while preserving most of its analytical functionality. In order to use spatial data from GIS in a multimedia atlas, this concept requires an interactive step to prepare them and provide means for cartographic generalization, symbolization, geo-referencing and map object identification. This way, cartographically edited map graphics will replace original raw GIS data in a database in the multimedia atlas system.

2.3 Web Atlas

The increasing power of computers and the easier access provided by the web make a winning combination and the number of web atlases is increasing too (Kraak & Ormeling, 2010). The growth of the Internet audience (Peterson, 2005) enables the distribution of atlas content via Internet to many people (Lechthaler, 2006).

Jenny et al. (2006) describe web atlases as follows: “Web-based AIS are client-server applications that rely on the Internet to transmit all data and program code. The client component is integrated into a Web page and uses a Web browser as the host application.” Users do not need to install any software applications on their computers for web-based AIS.

Compared to paper and CD-ROM / DVD atlases, Kraak and Ormeling (2010) point out the update capability of web atlases as their strength where some atlases also have the ability to connect to additional data servers which allows users to obtain real time data. According to them, another advantage of web atlases is while users searching for topical data on specific areas, they might access to website of a national atlas and reach the relevant topic with results that the system provides that answer the geographical and topical requirements. Despites its advantages, Jenny et al. (2006) mention the obstacle of distributing large data sets in web atlases because of the Internet’s limited bandwidth.

Recent developments in online mapping have caused dissenting opinions on atlases concerning earth viewers’ (e.g. Google Earth, Google maps, Yahoo Maps etc.) relevance to an atlas: if they can be thought as an atlas or not. Not only earth viewers, but also search engines’ (e.g. Google) relevance is being discussed: can search results in images of a geographical place be called an atlas or not? As mentioned in the previous parts of this research, atlases are purpose-oriented, systematic sets of maps which have regional aspects. In general, earth viewers’ regional aspect includes the whole world, having different levels of detail in

different places. They can be thought as a world map, having zoom function in order to reach views in different scales but also as map sets which are grouped in different scales in each zoom level. Their purposes or topics are modifiable according to the users' choices by using different layers. That is why they can be taken into account as they have purpose which also matches the idea of the user-oriented Web. As for now, there is no unanimous opinion on calling earth viewers atlases and this definition may also vary from person to person.

3 Map access methods

The main interests of this research are online atlases and the determination of new suitable opportunities for them. These opportunities are based on Web 2.0 technologies and aim better interfaces for the users, predominantly by accessing maps and providing interaction between them. Before explaining the new opportunities and ideas for online atlases, it is essential to review current methods in order to understand which fields are not considered or could be improved.

In order to access a map in an online atlas, there are currently two main concepts in use. One of them is selecting the desired map from a hierarchical list, where topics are grouped under each other according to their relevance and specificity. This method is in use with varied GUI elements in different online atlases. The other method is searching maps with a search engine on online atlas sites, which searches entries in their databases in predefined keywords for each map or map title or in the text information of the maps. The interaction between users is not in use yet. Users can only interact with atlas authors by giving feedback or asking questions.

In this chapter, existing and mainly used map access methods will be explained and examples will be given.

3.1 Existing access methods for online atlases

3.1.1 Hierarchical structure

Plaisant (2005) defines hierarchical structure as follows: “Hierarchies or tree structures are collections of items, in which each item (except the root) has a link to one parent item”.

Stopper et al. (2012) distinguish between two hierarchical trees:

- *Top-Down Hierarchical Tree:* The data is organized into a hierarchy, with the main concepts at the top and other concepts below. For this form of layout, the graph should a) not have any cycles, or b) include the nodes that are participating in cycles in an order (Rodgers, 2005). As it is shown in Figure 3.1, for the cases where nodes participate in cycles, it is not possible to reach node 3 after node 1 and following nodes 2 and 4. The only way to reach node 3 is from node 1.

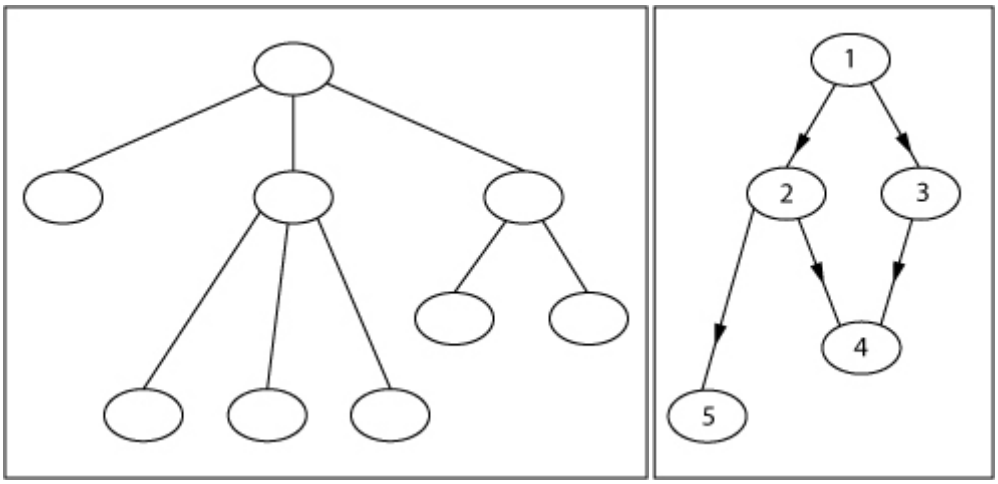

Figure 3.1: Top-Down Hierarchical Tree (left) and Ordered cycle (going back is not allowed) (Stopper et al., 2012).

- *Radial Hierarchical Tree:* The focus node is placed at the center of the display and other nodes are arranged in concentric rings around the focus node. According to its shortest network distance from the focus, each node takes place on the ring where closest neighbors are on the smallest inner ring and their neighbors on the second smallest ring and so on (Yee et al., 2001). It is possible to move directly from one child node to another one without passing the focus node.

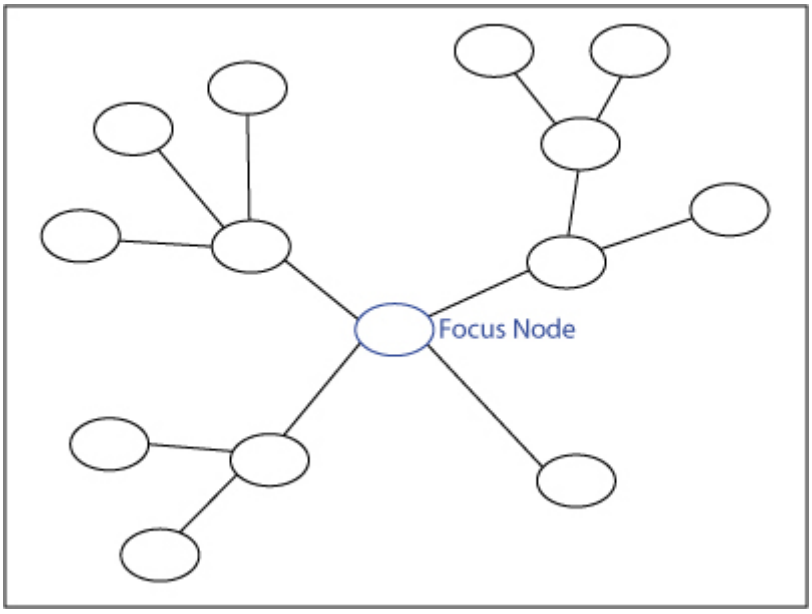

Figure 3.2: Radial Hierarchical Tree (Stopper et al., 2012).

3.1.2 Graphical User Interface (GUI) elements for hierarchical structures

According to Norman, GUI is a type of computer human interface on a computer which solves the black screen problem that early computer users had (as cited in

Jansen, 1998). Back then, only experts were able to use computer applications. Now, the user issues commands via the GUI to applications by using GUI characteristics such as windows, icons, menus and push-buttons (WIMP). Jansen (1998) says “A good GUI makes an application easy, practical and efficient to use, and the marketplace success of today’s software programs depends on good GUI design.”

Controls (or widgets) are elements of GUI and the foundation-stone of graphic-interactive communication between software and user. These controls have become part of every style guide on the market which defines rules and recommendations on how to use certain controls in certain situations [URL 3]. In a program, these elements are tied with functions and executed by activating controls via mouse clicks (Cron, 2006).

These elements can be grouped as follows: *Input elements* (entry field, slider, scrollbar, spin-button), *Output elements* (display field, icon, status bar), *Selection elements* (list-box, drop-down list, combination box, drop-down combination box, check-box, radio button, tree), *Action elements* (push button, function-key) [URL 3, URL 4].

Because of their relevance to the access interfaces to maps in online atlases, the entry field from input elements and selection elements will be explained in a detailed way.

Entry Fields are one or multi-line fields where users can put their text data in.

Selection Elements:

List boxes are static lists of items where users can select one or more items. List boxes are permanently visible. Users are allowed to select only one item and the selected item is marked. List boxes, which allow users to select more than one item, should be used if users may want to select more than one item.

Drop-Down Lists are temporarily visible list boxes where users can select only one item. If needed, users can display the whole list box and choose an item from the list. They should be used if the choice is big and can’t be portrayed clearly in area of work in screen.

Combination Boxes are static and a combination of properties of a text entry field and a list box. They enable experienced users to directly enter their values while

not experienced users can select the desired value from the list.

Drop-Down Combination Boxes are combinations of a text entry field and a temporary visible list box (drop-down list). Selecting a value from the list sets the entry field to that value.

Check Boxes offer the possibility to turn an option on and off of and are shown by the presence or absence of a checkmark in the labeled box.

Radio Buttons represent groups of buttons which enable users to select from a mutually exclusive set of options. In a group of buttons, only one button can be set at one time.

Trees are controls which enable users to inspect, manipulate or select items from a hierarchical list that may consist of one or more columns and contain texts, graphics, simple controls or a combination of three of them.
[URL 3, URL 4]

3.1.3 Search function

Search functions allow users who are trying to find a result quickly to filter a Web site's content and show them just what they want to see. A well-executed search facility, which provides users greater control of a site's content, is a big advantage of a Web site compared to printed media. During one search, users go through four basic steps: formulating a query, executing the search and waiting for the result, reviewing the results, and decision what to do with the result (Powell, 2002).

According to Powell (2002), a search engine works like this: gathering a Web site's pages using a process often called spidering. The gathering process starts with a certain number of starting point URLs and goes on from there by following links and saves the pages or parts of the pages for analysis.

Afterwards, the collected pages are indexed (usually this process is called indexing) in order to determine what their content is about. Running this method may vary for each search engine, but basically an indexer tries to find out the meaning of the page by looking at different components of a Web site like its title <title>, the contents of its <meta> tags, comment texts, link titles, text in headings and body text. After analyzing various keywords for a page, it is ranked in relation to other pages that have similar keywords in the database.

Finally, a search page is built where users can execute their queries and get relevant results. A search page generally contains a primary query text box and also other search fields for more advanced queries, enabling users to modify their queries.

Powell (2002) illustrates the general function of search engine as shown in Figure 3.3.

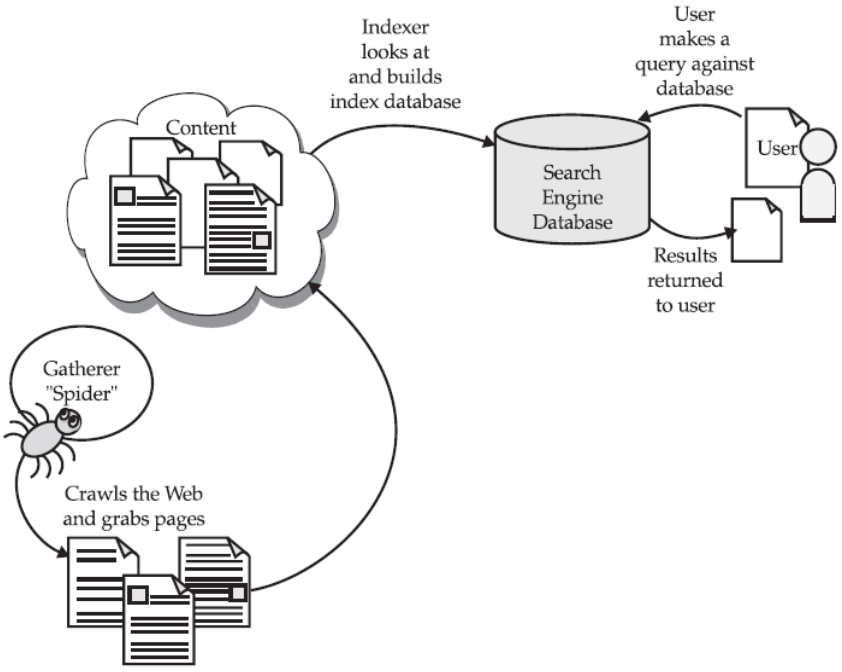

Figure 3.3: Overview of search engines (Powell, 2002).

3.2 Analysis of existing map access interfaces for online atlases

Online atlases are collections of thematic maps that are organized in a hierarchical structure according to their themes and are represented to users with different, above explained GUI selection elements. In addition to this opportunity, users can access a map by using the search function of an online atlas by typing keywords in a search box. The way these methods are used will be analyzed by evaluating five different national and regional online atlases:

ÖROK Atlas of Austria (by Austrian Conference on Spatial Planning) offers users thematic maps of Austria and Europe. A hierarchical structure is used for thematic maps and a representation of lists of maps has tree view and drop-down list character. In the first case, general topics are visible and after clicking a topic, relevant sub-topics are displayed. By clicking any of them, users attain the map title list of selected sub-topics and by clicking the map title, users can access the

desired map. On the map page, users can use radio buttons on the left side to change data content (usually changing data that are from different years).

By typing a keyword in a search box, users start the search operation and get results in different groups. These groups are divided according to where the pages contain the keyword that is typed in by the user (in the map title, text information of maps, keywords for maps, map layers). If search results match users' queries, they can access the map by selecting it from the listed search results or can otherwise repeat the search.

Figure 3.4: *Representation of the map collection and search box in ÖROK Atlas of Austria [URL 5].*

In addition to these two possibilities for accessing a map, all maps on the home page of ÖROK Atlas are presented horizontally in an overview (maps as small images with map titles) and the desired map can be found by scrolling the map images.

On the pages where users look at their desired maps, there are links to other maps under the map frame which belong to the same sub-topic.

Tirol Atlas (by the Department of Geography, University of Innsbruck) offers thematic and topographic maps of the region of Tyrol. On their home page, there are links for thematic maps and topographic map pages in order to access these maps. In addition to that, general topics of the atlas are presented on the home page and linked to text information pages where users can access relevant maps via the links on these text information pages.

On a thematic map page (themes are structured in hierarchy), at the beginning general topics are represented in a list box, providing the number of topics in parenthesis. By clicking on a topic, a second list box is displayed that includes sub-topics and the number of maps they consist of. After selecting a sub-topic, users can access a map set or text information. On a map set page, there is a drop-down list which includes map titles and by selecting map titles, users can access different maps.

Like ÖROK Atlas, when users make queries with keywords by using the search box, they get their results in a list. This list is grouped according to the keywords' location on the page (in map set, map, map set text, map text).

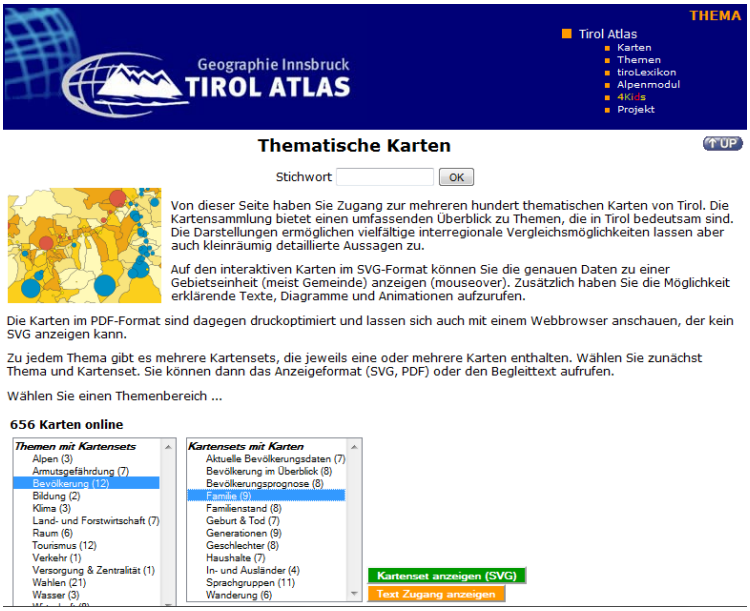

Figure 3.5: Representation of the map collection and search box in Tirol Atlas [URL 6].

The Atlas of Canada (by Natural Resources Canada) offers its users thematic and topographic maps of Canada. General topics of thematic maps are listed on the home page and users can reach sub-topics either by clicking on general topics or using the mouse on the drop-down menu property of the list. If users click on a general topic, they are directed to a new page which consists of all of the sub-topics and map and text information links of these sub-topics. In case of clicking on a sub-topic which is displayed by mouse over drop-down list, users are directed to a new page with specific map and text information links only about the selected sub-topic.

Users can access maps by using the search function of the AIS, typing a keyword in the search box. In contrast to the above explained two atlases, result lists are not presented in groups but the page links at the result list are ranked depending

on where they include the keyword. Another difference in terms of search function used by the Atlas of Canada is enabling users to make advanced searches. Users can adjust their searches; for example they can decide if a typed keyword should be searched only in maps or text information pages or in both. Also, in case of entering more than one keyword, users can decide if all keywords should be found in a page, i.e. to appear in the results or if one of them is enough.

As just in ÖROK Atlas, maps that belong to the same sub-topic have links on the map pages under the map frame.

Figure 3.6: Representation of map collection and search box in The Atlas of Canada [URL 7].

National Atlas of the United States (by United States Department of the Interior) offers users thematic maps of the United States. On the home page, there are links to general topics and users can find text information about these topics as well as some sample map links.

On the home page, there are two main options in order to access maps. One of them is to click on “map maker” link, which directs users to the map page of the web site. On that page, users can select their desired theme from the list of topics which is organized in tree view structure. After deciding on the topic, users can select the data they want to use for their maps which is shown in drop-down lists or check boxes. With the map maker option, users prepare their maps more or less completely on their own.

Another option is to click on the “map layer” link that directs users to the list of

general topics which has tree view structures. By clicking on a general topic, users get the list of all of the maps about that topic and can continue to the description pages or the map maker page after selecting a map title. If users continue to the map maker page, they access a map that already exists.

On the home page there is a search option for users, which is provided by Google and is called “Google custom search”. It enables users to search inside a web site. According to the keywords typed by the users, the search engine lists the results. As in the Atlas of Canada, results are not presented in groups but ranked (first keyword in articles, then in map layer info pages, then in metadata). On the map maker page, there is another search function which enables users to make simple or advanced searches. “Simple search” means that users may search features and a place with its name or zip code. Advanced searching helps users with drop-down lists in order to select feature types or state and county names.

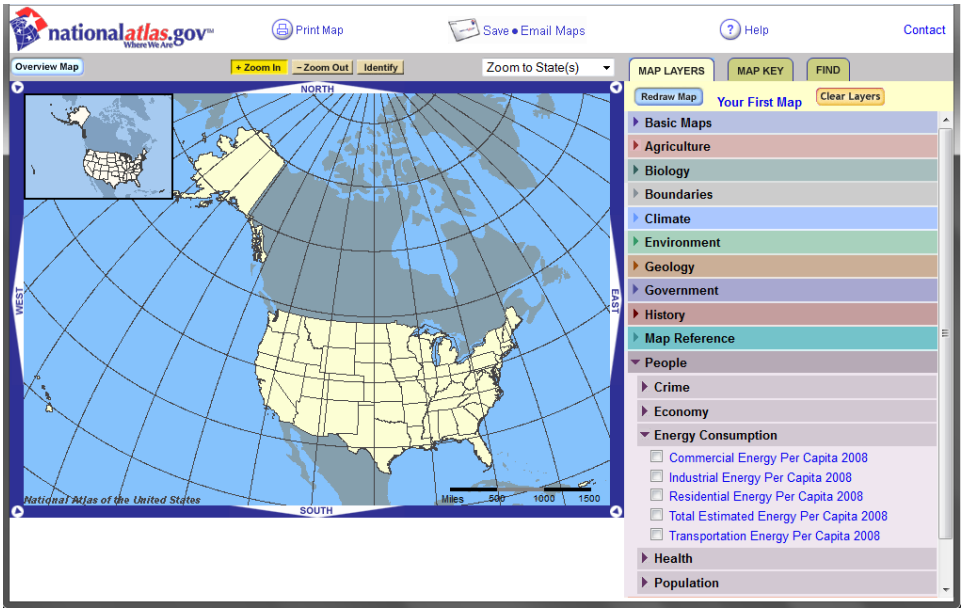

Figure 3.7: Map maker of National Atlas of the United States [URL 8].

Regional Atlas of Germany (by Federal Statistical Office and the Statistical offices of the Länder) offers its users thematic maps about statistical data of Germany. Users are able to access maps by selecting themes which are presented under “choose indicator”. In order to reach a map, users select a general subject area, subject and the base year, all these three options are built and in a listed with drop-down list structure.

In contrast to the above explained atlases, the regional atlas of Germany does not have a search function.

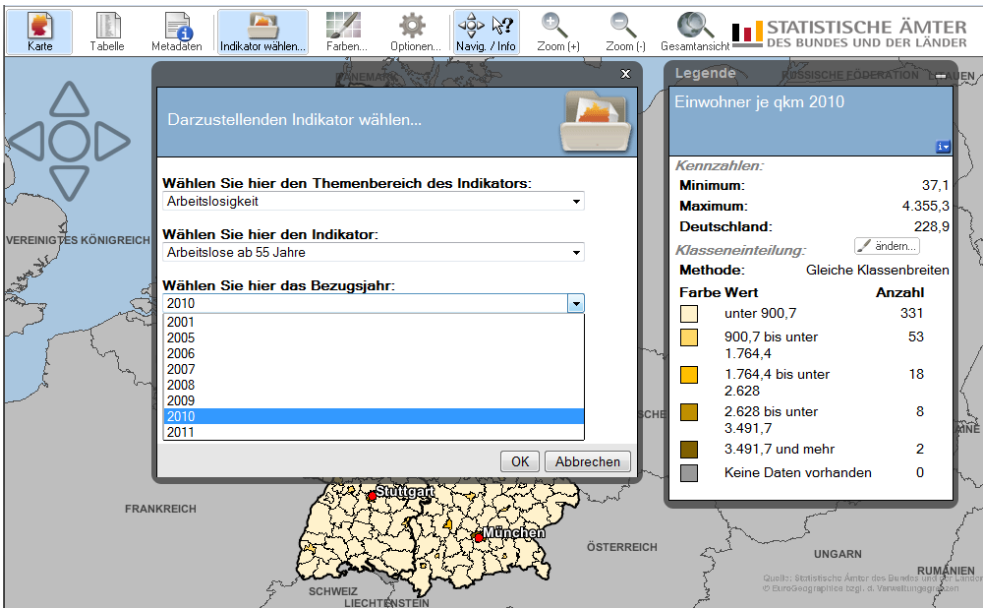

Figure 3.8: *Representation of map collection in Regional Atlas of Germany [URL 9].*

As the above presented examples for existing atlases show, the methods that are used for map access are static and allow users only to reach maps by following a given hierarchy or by making a search. Other than that, there is no option for users to communicate with each other which would actually already be possible with the Web 2.0 technologies.

4 Web 2.0

In addition to the methods that are explained in Chapter 3, new developments emerged in Web technologies that are generally not in use in online atlases, but could be adapted to assist users and enable them to participate and communicate in a collaborative manner. Generally, the concept of these technologies is called “Web 2.0” although there are some objections against that name because it is not a new version of a software. In order to evaluate the suitability of these developments to online atlases, one should first understand what the main ideas of these technologies are and how they have changed the Internet and also Web cartography.

In this chapter, first the concept “Web 2.0”, its technology and applications will be explained. Afterwards, the use and challenges of Web 2.0 in cartography will be described. As an end, new opportunity ideas for online atlases that are provided by Web 2.0 concept will be held.

4.1 What is Web 2.0?

The concept of “Web 2.0” emerged in 2004, with a conference brainstorming session between O’Reilly and MediaLive International. There is not one single definition of what Web 2.0 is. Because of using this term for the first time in that conference, the term is closely associated with Tim O’Reilly. O’Reilly’s (2005a) definition:

> “Web 2.0 is the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences.”

The *Wikipedia* (Wikipedia is considered to be a Web 2.0 application) entry [URL 10] says: despite the fact that the term suggests a new version of World Wide Web, it does not intend an update to any technical specification, but more to changes in the ways software developers and end-users use the Web.

The term “Web 2.0” is now commonly used, with millions of citations in Google, but nevertheless, there is still a big disagreement about what Web 2.0 actually means. Some people consider the term a meaningless marketing buzzword; others accept it as a conventional wisdom (O’Reilly, 2005b).

O’Reilly (2005b) describes the core competencies of the concept of Web 2.0:

- The Web as a platform with services that is cost-effectively scalable instead of packaged software.
- Control over unique, hard-to-create data sources that get richer as more people use them (the architecture of participation – key lesson of the Web 2.0: *Users add value*)
- Trusting users as co-developers: rich user experiences
- Harnessing collective intelligence by using “the wisdom of crowds” (aggregated information from groups of people produces better results than any individuals).
- Leveraging the long tail –the collective power of the small sites that makes the bulk of the Web’s content- through customer self-service: reaching to the entire web, to the edged and not just the center.
- Software above the level of a single device: not limited to PC platform, seamless connection of portable devices to the platform.
- Lightweight user interfaces, development models and business models: simplicity, open source software with little intellectual property protection, design for “hackability” and remixability.

(Gartner, 2009)

With the Web 2.0 concept, users lose their passive role (read-only) as exclusive information receivers and are given an active role (read-write) with the opportunity to add or edit information on websites. According to Best (2006), the characteristics of Web 2.0 are: rich user experience, user participation, dynamic content, metadata, web standards and scalability. According to Lamb, further characteristics are openness, freedom (as cited in Greenmeier & Gauding, 2008) and collective intelligence (O’Reilly 2005b) by means of user participation.

A popular mind cloud (in form of a tag cloud) presenting the principles of Web 2.0 with text involvements is presented by Angermeier (2005) and is shown below:

Figure 4.1: Mind cloud - principles of Web 2.0 (by Angermeier, URL 11).

Cormode & Krishnamurthy (2008) claim that the essential difference between Web 1.0 and Web 2.0 is about content creators. Web 1.0 creators were few and users were only the consumers of the content, while Web 2.0 allows any participant to be a content creator who can maximize content creation with technological assistance tools.

Web 2.0 has a democratic nature where a large number of niche groups (collection of friends) can exchange content of any kind (text, audio, video) and tag, comment and link pages while Web 1.0 had an authoritarian nature. “Mashups” is a popular innovation of Web 2.0 which combines or renders content in different forms.

Another difference that Cormode & Krishnamurthy (2008) state is about the nature of the pages: Web 2.0 often involves dynamically generated pages from multiple sources of information while Web 1.0 had more static pages. The rate of change is also different due to increased interactive features, where in Web 1.0 the content was centrally updated at somewhat predictable frequencies (direct correlation between the popularity of a site and its rate of change: popular sites change frequently) while in Web 2.0, with a lot of user generated content, it is predicted to have incremental additions to the site.

According to O’Reilly (2005), some of the practical differences between Web 1.0 and Web 2.0 are shown below in Table 4.1:

Web 1.0	Web 2.0
DoubleClick	Google AdSense
Ofoto	Flickr
Akamai	BitTorrent
Britannica Online	Wikipedia
Personal websites	Blogging
Publishing	Participation
Taxonomy	Folksonomy

Table 4.1: Practical differences between Web 1.0 and Web 2.0 (O'Reilly, 2005b).

4.1.1 Web 2.0 Technology

Hinchcliffe (2006) claims that the aim of new technique approaches is to help us to develop more easily a new generation of Web applications that are as good as or even better than PC applications. Web 2.0 applications and services are extensively driven by one particular group of technologies: Ajax – Asynchronous Javascript + XML (Johnson, as cited in Anderson, 2007). The term was first coined by Garrett (2005) and he defines Ajax as follows: "Ajax is not a technology. It is really several technologies, each flourishing in its own right, coming together in powerful new ways" and illustrates it as shown in Figure 4.2.

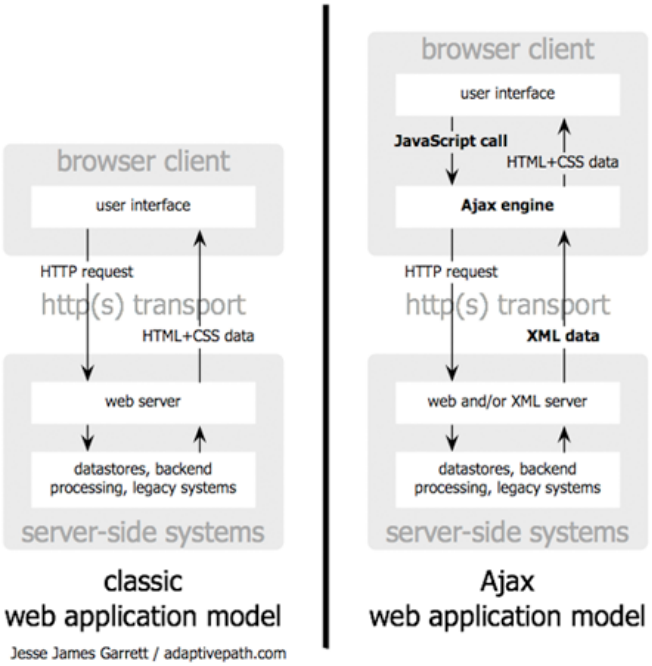

Figure 4.2: The traditional model for web applications (left) compared to the Ajax model (right) (Garrett, 2005).

Ajax incorporates:

- standard-based presentation using XHTML and CSS;
- dynamic display and interaction using the Document Object Model;
- data interchange and manipulation using XML and XSLT;
- asynchronous data retrieval using XMLHttpRequest;
- and JavaScript binding everything together.

4.1.2 Web 2.0 applications

In this part, some examples of Web 2.0 applications will be explained.

4.1.2.1 Blogs

According to Doctorow et al. (as cited in Anderson, 2007), the term “Blog” (combination of words “web” and “log”) refers to simple web pages including so-called “posts”: brief paragraphs of opinion, information, personal diary entries or links which are arranged in reverse chronological order. Blogs illustrate one of the ideas of Web 2.0 which is decentralization, by enabling bi-directional communication (Zentai, 2007), allowing visitors to leave comments or send messages to each other. There are several Blog providers available that enable users to create their blogs without needing profound technological knowledge (e.g. wordpress.org and blogger.com).

4.1.2.2 Wikis

According to the first wiki software developer Cunningham (2002), Wiki is a server software which allows users to create and edit content of a Web page by using any Web browser with supporting hyperlinks, simple text syntax for creating new pages and cross-links between internal pages. Wikipedia is one of the most known examples of Wikis and is a free encyclopedia which is edited collaboratively and according to its own entries, it contains around 21 million articles in 285 languages [URL 10]. The open editing model is often criticized because it may cause low quality writing, inaccurate and inconsistent information. O’Reilly’s (2005b) reply: “with enough eyeballs, all bugs are shallow”.

4.1.2.3 Multimedia Sharing

Storage and sharing of multimedia content is one of the biggest growth areas which follow the idea of the “writable” Web: Users are not only consumers, but also contribute actively to the Web content. YouTube (video) and Flickr (photos) are examples for that kind of popular services with millions of participants (Anderson, 2007).

4.1.2.4 RSS

RSS (also known as Really Simple Syndication) is a family of formats that enables users to reach updates about RSS-enabled websites, blogs or podcasts without visiting the site every time. The information (usually titles, full or short summaries of a text) from websites are collected within a feed that use the RSS format, and “piped” to the user in a process known as syndication. In order to read these feeds, users need to use a software called “RSS reader”, “aggregator” or “feed reader” which can be desktop-based, mobile-device based or Web based. After having a software, users should subscribe feeds which they want to receive and the software will then check regularly for updates to the RSS feed and keep the user updated (Anderson, 2007).

4.1.2.5 Social Network Sites

Boyd and Ellison (2007) explain what social network sites are:

> "We define social network sites as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system.”

In such sites users can share photos and videos, communicate by writing messages or within a chat function, can arrange event invitations etc. Facebook, Twitter and Google+ are the most popular examples for social network sites.

4.1.2.6 Folksonomy

A folksonomy (the combination of the words folk and taxonomy) is a system of classifications that is made from the regular users of the Web, usually by tagging their writings in blogs and photos or videos that they share. Tags can be thought

as keywords for digital objects that are used to describe them. They can be organized into a “tag cloud” where more often visited objects’ tags are visualized with bigger or different color fonts than less visited ones. Tagging is used by websites like Flickr, Youtube or Delicious.

4.1.2.7 Mashup applications

A mashup is a web application that allows users to integrate content from more than one source for their own website. Such content integrations from other sources are mostly done by using APIs (Application Programming Interface). APIs are software-to-software interfaces which are a set of programming instructions and standards for accessing a web based software or a web tool and are released by software companies in order to let other software developers use their services in developers’ own products (Roos, n.d.). Popular APIs for mashups are shown below in Figure 4.3.

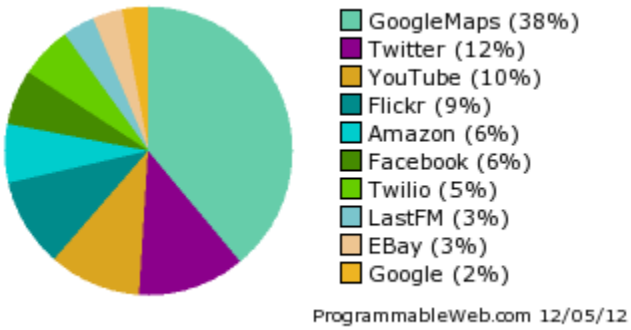

Figure 4.3: Top APIs for mashups [URL 12].

4.1.2.8 Recommendations

First recommendation technology studies had begun in the early 1990’s (Leavitt, 2006) before the Web 2.0 concept arose. Concerning commercial use, Leavitt (2006) explains this approach:

> “The approach uses complex algorithms to analyze large volumes of data and determine what products that potential consumers might want to buy based on their stated preferences, online shopping choices, and the purchases of people with similar tastes or demographics. It is creating new revenue opportunities and increasing both customer retention and the number of shoppers who become buyers.”

Recommendation systems incorporate data mining techniques which are used to find patterns in data and use these to build models, in order to make their recommendations based on the knowledge gained from behaviors and interests of users (Schafer, 2005).

There are different types of these systems depending on their working bases. According to Leavitt (2006) they are:

- *Implicit engines:* they provide recommendations based on multiple users activities during using a web-site (e.g. users who bought product A, also bought product B).
- *Explicit engines:* they provide recommendations based keywords and phrases entered by users so to find the products they are looking for.
- *Content-based systems:* they provide recommendations based on users' previous preferences in the web-site by finding similar items.
- *Collaborative-based engines:* these engines provide recommendations based on users' similar purchase preferences and demographics.

Leavitt (2006) mentions that many recommendation engines use collaborative filtering, which provides personalized recommendations by taking multiple users' information (derived from profiles, questionnaires, activity histories) into consideration and thus finds similar products. There are two main filtering methods: *user-based filtering* and *item-based filtering*. User-based filtering concentrates on history, preferences and similarities among one user and other users. This filtering method is not very efficient for web sites that have many users and products because of its complex analysis and comparison process. According to Linden et al., the item-based filtering method compares products that users bought or rated, to similar products and then provides recommendations and is also efficient to use for extremely large data sets (as cited in Linden et al., 2003).

4.2 Web 2.0 in cartography

Because of evaluating the opportunities of Web 2.0 technologies for an online atlas, the existence and the effects of these technologies in cartography field should be reviewed first.

According to Gartner (2009), Web 2.0 brings out great possibilities for cartography by offering new aspects of acquiring, gathering and publishing geographic

information. Cartwright (2012) says that it has changed the old formal (mainly governmental) model into a less formal and more personal model by achieving these aspects.

Gartner (2009) names possible Web 2.0 applications that have a spatial frame: “search engines considering spatial distance to find results; GeoTagging (virtually referring to objects in real space or on maps); GeoBlogging (enhancing blogs or photos with spatial references); and Web Mashups (combining map data in a collaborative way)”.

The most popular application of Web 2.0 related to a spatial frame is mashups which has also dominance in all mashup applications in the Web as shown above in Figure 4.3. With the help of this application to use APIs; users are able to produce their own maps by overlaying their information as an additional layer of information on the base maps and can publish them via the Web in a collaborative, shared manner (Cartwright, 2012). Concerning map APIs, Peterson (2012) mentions that in 2005, the first Google Map API was introduced and soon after that Microsoft, Yahoo and MapQuest included AJAX-type interfaces to their online mapping services. These APIs consist of functions for establishing maps, scales and positions (map center) of them and any other added information in the form of points, lines or areas to overlay on the base map.

OpenStreetMap (OSM) is another online map provider and has a different nature than other map providers because of the way it is constructed. It is done by individuals collaboratively. According to Chapman et al. (2011), one of the strengths of its organization is providing to anyone free geographic data and mapping either for own purposes or even for commercial purposes only if OpenStreetMap and the contributor of the data are credited. With most of the other mashup applications, users are only able to overlay their data on base maps but OpenStreetMap, besides using existing data as data source for their own mappings, allows users to contribute on the base map that is used by everyone. With the help of that kind of contributions, the base map becomes more detailed.

High costs of acquiring spatial data and quickly outdated data caused map providers to search for new solutions. Google implemented its tool called *Map Maker* in 2008 which allows users to contribute to base map data (as cited in Schmidt & Weiser, 2012). This tool is now available for over 200 countries and regions (in Europe not available yet for all countries) [URL 14]. User-centered approaches seemed dubious to many Web mapping service providers because of

their assumed lack of data quality but Haklay's and Neis et al.'s studies about the quality of OpenStreetMap (a user-centered approach) data compared to data from commercial data vendors showed little difference in terms of quality (as cited in Schmidt & Weiser, 2012). MapQuest and Microsoft (Bing) have recently also started to use OpenStreetMap as a source for their base maps (Schmidt & Weiser, 2012).

4.2.1 Challenges

4.2.1.1 Data reliability

Mashup applications allow users to become the map producers but because of their different individual skills about cartography and the data they use, end products can be useless or unreliable. In order to provide the consumers' confidence against such cases, Gartner (2009) suggests displaying the reliability of producers and data, by "rating" the shared information like it is done in e-Bay where sellers can rate other users or reporting improper contents like in Facebook.

Other than these suggestions, OpenStreetMap organization uses many quality assurance tools in order to achieve higher quality OSM data [URL 13].

4.2.1.2 Ownership of geospatial data

Other than above explained useless or unreliable maps that may be produced with mashup applications, Cartwright (2012) concerns include the ownership of geospatial data where non-public organizations control a big part of geospatial information used by users, for which these organizations invested large amounts of money. These organizations are providing this information now for free but it is a question if it stays the same and if the users who are currently provided data for free, can perhaps be charged a fee for future access.

4.2.1.3 Protection of data

The protection of data is another concern mentioned by Cartwright (2012) because the data is placed on a server and accessible through the Internet. He states that many mapping and geographic data providing sites are protected some way but there are also many cases without a protected database which may cause copied content or downloaded data files illegally or without payment by using tricky

methods (e.g. reaching data from Web page source). The organizations and individuals, who generate Web maps and do not want their data copied, must pay attention on protecting their data.

4.2.1.4 Privacy

Privacy is also an important issue during the use of such applications. If some personal information is needed from a user to access a mapping website, or the user's location information for a mobile mapping application "at location", privacy and security of this information should be guaranteed by the map provider or publisher. In addition to that, by using mobile devices with Location Based Services (LBS) or "at location" mapping applications, in many cases service providers can permanently track the user which has not become a matter of concern yet but may cause problems in the future and decrease the success of such mobile device based usage of maps.

The presence of citizens in images caused another privacy problem: Citizens were also captured without their consent next to inanimated objects during collecting imagery for Google Maps' StreetView function. In order to avoid public concerns about their privacy, Google StreetView has blurred people's faces and also other identifying items in its imagery (e.g. number plates of cars) (Cartwright, 2012).

4.3 New opportunities for online atlases

This part covers the explanation of the above mentioned Web 2.0-based ideas, in terms of their suitability for map access and the general use of online atlases. Recommendations and user comments which also constitute the research questions of this master thesis will be mainly tested. Other than these two, user reactions about blog, tag cloud and RSS feed in an online atlas will also be evaluated during the test. The idea of sharing own data will not be evaluated within this research. The test and its results will be presented in the following chapters.

4.3.1 Recommendations

Recommendations, or in other words recommender systems, which are indispensable for mass customization according to Schafer et al. (1999), are getting more and more important for websites that offer variable domains such as e-commerce (e.g. amazon.com, ebay.com), video sharing (youtube.com), travel

booking (tripadvisor.com), film choosing (jinni.com) etc. Recommendations help to improve sales, understand consumers' needs or providing more interesting items or information for users.

Basically an online atlas is a collection of maps. These maps are stored in databases and are accessed according to user's choices. Therefore, online atlases have similarity to the collection of items stored in an e-commerce website or a video sharing site that includes many videos. A recommendation tool, like it is used for e-commerce web sites can be included in an online atlas which provides more interesting maps to users, even some that they did not plan to look at.

This can be done by analyzing users' previous behaviors (which map themes are interesting for them) or finding maps that have a similar topic to the one they are currently looking at. Such recommendations can be represented to the user on a map page below the current map as system designer's recommendations.

Another way of recommending maps is to recommend maps other users visited after looking at a certain one, i.e. user A looks at map X and the system analyzes at which maps the other users looked at after map X and prepares its recommendations according to these analyses. Recommendations can be presented to the user as "other users also looked at these maps" below the accessed map, which may interest the user.

This way, users can also access maps that they did not plan to look at before but may interest them. Also, seeing maps with similar topics under the current map allow users to access them directly on the current page without having to return to the home page or back page or make a new search.

Other than that, Leavitt (2006) states that businesses use recommendation technology also to collect customer data in order to understand what users choices are and that way improve their sales and provide enough reserves for more popular items. Concerning online atlases, this technology can also help their authors to notice which map topics are more popular among the users so that they can provide more maps about that specific topic which may also interest users.

4.3.2 Blog and Comments

A blog in an online atlas can improve the feeling of being a part of a community for users where authors share news, announcements, ideas or articles that users can

also comment and complete bi-directional communication principle of Web 2.0. Other than commenting on blogs, an option for users to comment on maps can be a new opportunity for online atlases which enables users to discuss on maps and share their ideas.

Concerning e-commerce sites, Kim et al.'s research shows that interactions between online consumers have great influence on consumers' choices and comments impact their intentions directly (as cited in Chen, 2012). Chen's (2012) study shows that comments and recommendations have an influence on online shopping consumers and can give them positive shopping experience and improve their shopping satisfaction. A study supported by TripAdvisor.com (a website assisting customers for their travels) and carried out by Gretzel et al. (2007) shows that nearly all (97.7%) of the respondents who took part in the experiment within this study read other travelers' online reviews and nearly all of them predominantly or somehow agreed on the influence of other users' online reviews during learning about a travel information (94.6%), evaluating alternatives (91.9%) or avoiding places which they may not enjoy (91.8%). This study also showed that 83.0% of the respondents feel motivated to post online travel reviews.

In the case of online atlases, comments of other users may change the users' behaviors during using the atlas as well. They might read them to find other maps that may interest them, but which they did not plan to look at before. Another possible effect is that they might change the layer parameters in order to achieve a better view due to other users' reviews. Besides changing behaviors, such a comment option can enable users to exchange their views on maps or rate maps which are prepared by other users (maps that are products of idea of sharing own data).

4.3.3 Tag cloud

A tag cloud can be used in an online atlas to present topics and sub-topics in different sizes and colors. That is calculated according to a topics' popularity among the users or the number of existing maps under these topics. Due to their attractive presentation, a tag cloud can be an alternative to a hierarchical list and could enable users to directly select a different map topic while looking at another one.

4.3.4 Sharing one's own data

As in openstreetmap.com, a system can be developed for users to share their own data in online atlases. That way, the whole work for creating the content of the atlas can be reduced for authors and different maps and data can be included in an online atlas. In order to run such an option, there have to be some restrictions and rules settled by the system authors concerning data and data sources and the way how to upload these data to the system. Quality assurance tools like the one's openstreetmap.com uses [URL 13] can also be developed for this aim and they could give immediate feedback to the users about their data. Another control option for these user-modified-maps could be the other users of the system.

4.3.5 RSS feed

A RSS feed system can be useful for online atlases in order to keep users informed of updates, news or announcements without needing to visit the site every time.

5 Empirical evaluation

Within this research, the suitability of new opportunities for online atlases which are related with the Web 2.0 concept will be evaluated by applying a usability test on test persons. Furthermore, the research questions mentioned in Part 1.1 will be answered.

In order to do that, a prototype of an online atlas was developed which simulates almost all functions of a typical existing online atlas, except map navigation tools. In contrast to existing online atlases, it includes new opportunities such as map recommendations, user comments, blog, tag cloud and RSS feed. The usability test tasks were prepared in order to understand the impacts of recommendations and user comments. During the test, test persons' reactions to the blog, tag cloud and RSS feed will also be evaluated. In addition to the tasks to be completed with the prototype, a questionnaire was prepared so to get an idea about test persons' general Internet behaviors and skills, their opinion on the test and the functions that are tested.

Because of applying a usability test for understanding the suitability of new opportunities, this chapter covers definitions about the usability test concept so to understand what it is and how a usability test should be performed. Afterwards, the interface of the prototype will be presented and creation methods and ideas behind will be explained. Then the tasks, their goals and the application of the test will be explained.

5.1 Usability testing

5.1.1 Usability

In order to understand what usability testing is, one should first understand what the term usability means. ISO (1998) defines usability as follows: "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."

According to Nielsen (1993), usability has not a single feature but consists of multiple features concerning a good working system which are learnability (system should be easy to learn), efficiency (system should let users high level of productivity after learning the system), memorability (system should be easy to

remember, so that users can use the system again after a period of time without working with it), errors (system should have a low error rate) and satisfaction (system should be pleasant to use). Usability is usually measured with a certain number of test users which can be representatives of real users or the real users themselves by using the system and completing the predefined tasks.

5.1.2 Usability testing

In order to evaluate the usability of a new or existing product, a usability test has to be applied. There are many ways to do that. Nielsen (1993) states that user testing with real users is the primal method for usability and partially cannot be replaced because of its property of providing direct information about people's interaction with computers and interfaces and the problems that they come up with. According to Nielsen (1993), reliability and validity issues have to be taken into consideration during the preparation of a usability test. Reliability means getting the same results in case of repeating the test and validity means achieving results of usability that one wants to test.

Nielsen (1993) mentions that before starting the test, the purpose of the test and the test plans should be determined. Test plans should include topics such as the aim of the test, time and place of the test, length of the test, information about computer and software, test users, number of test users, experimenters, tasks, test budget, etc. Before performing the test, a pilot test should be carried out in order to find out probable incomprehensible tasks or mismatches between tasks and time. Pilot test users can even be people that are not representatives of the actual users, but real test users should be as representative as possible for the actual users. In order to make users feel comfortable during the introduction of the test, experimenters should underline that they are not testing the users' skills but the system and information about their individual performances will not be revealed.

A usability test consists of four stages: preparation, introduction, the test itself, debriefing. This research includes these four stages.

5.1.2.1 Prototyping

Nielsen (1993) mentions that one should not use full scale implementation of an interface for early user interface designs. Usability evaluation can be established on prototypes which saves time and cost and makes it easy to change the

interface in order to improve the user interface design. Nielsen (1993) explains the idea of prototyping:

> "The entire idea behind prototyping is to save on the time and cost to develop something that can be tested with real users. These savings can only be achieved by somehow reducing the prototype compared with the full system: either cutting down on the number of features in the prototype or reducing the level of functionality of the features such that they seem to work but do not actually do anything."

For this reason, instead of building a real working online atlas website on Internet, a prototype of it was prepared for usability testing.

5.2 Test content and interface

5.2.1 Purpose of the test

The purpose of the test is to evaluate the effects of map recommendations and user comments on test persons during completing the given tasks by using the prototype. In addition to map recommendations and user comments, test persons' reactions to blog, tag cloud and RSS feed are also observed.

In order to evaluate these effects, five tasks were prepared to be completed with varied user interfaces which contain different functions so to compare test persons' reactions to different interfaces.

5.2.2 The Online Atlas Prototype

Because of the advantages of using a prototype in usability testing as mentioned above in Part 5.1.2.1, a prototype of an online atlas was developed for empirical evaluation in this research. The prototype of this research is simulating an online atlas website. The pages of the prototype were prepared with the OpenOffice Draw package which lets users prepare pages with graphics and diagrams and provides an option to link pages. After preparing the pages, the file was converted into PDF file format for its full screen usage opportunity and creating further links (Previous / Next view) with Adobe Acrobat 9.0 which could not be done with OpenOffice Draw package.

The maps that are used in the prototype were taken from the ÖROK Atlas website

by exporting each map as a PDF file. Because of having limited area of work in Draw package, each map had to fit into a reserved place for it and was used as PNG image format. The general appearance of the prototype is as shown below in Figure 5.1.

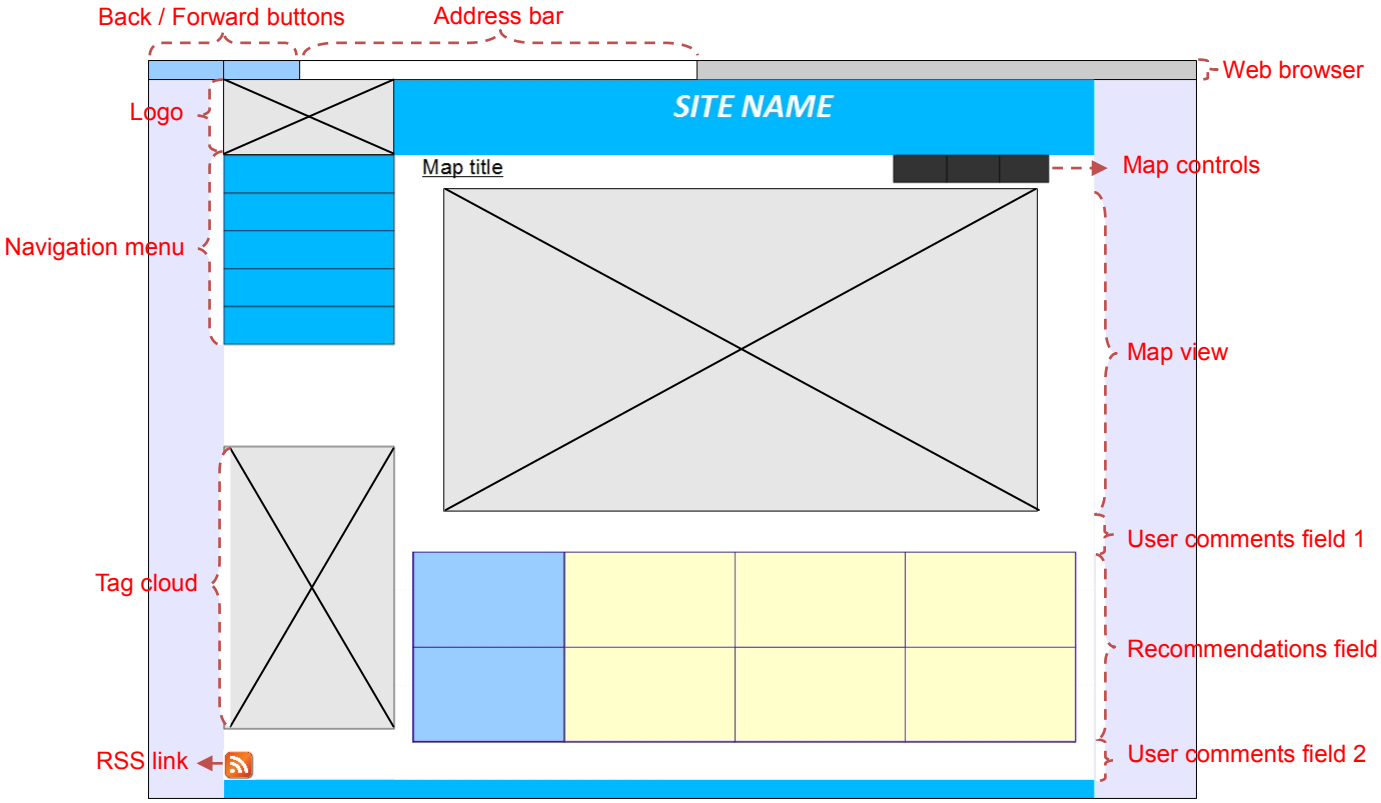

Figure 5.1: *The general appearance of the prototype.*

Due to simulating a website, the prototype has a *Web browser* bar, including an *Address bar* and *Back/Forward buttons*. Address bar shows the current URL and Back/Forwards buttons which were arranged with the Adobe Acrobat 9.0, enable users to go to previous and next views. As *logo*, the logo of the Research Group Cartography at Vienna University of Technology was used.

On the left hand side, there is the navigation menu including links to *home page*, *topics page*, *blog page*, *links page* and *contact page*. The home page link enables users to return to the start page at any time. In topics page, the selected map topics are listed hierarchically so to access maps. For this test, five main map topics were selected from ÖROK Atlas content and in total 22 different maps of Austria were grouped under these topics. For three of them, there are three different view options: municipality, regions and states views. Eight of the maps have regions and states views and eleven of them present data for the whole country.

In the blog page there are three posts by the system author with simulated user comments on them and fields for test persons to write their comments for each share and to reply to other users' comments. The links page was included in the prototype in order to increase the sense of reality of the prototype as well as the contact page. The links presented in the links page and the contacts in the contact page do not work because the test is carried out with the Adobe Reader 9.5 in full screen and in case of clicking a link or contact, the test person would be directed to an external page which would interrupt the test's process.

Under the navigation menu, there is the *tag cloud*. Generally in Web 2.0, tag clouds are organized with the keywords ("tags") which describe objects and the visualization of them is prepared according to the objects' visit frequency. The tag cloud of the prototype includes the topics' and the sub-topics' names as tags. Before applying the test, it was not possible to know the visit frequency of maps. Therefore, the tag cloud was prepared in accordance with the number of maps included in each topic and sub-topic i.e. topics and sub-topics which include greater number of maps are presented with bigger and darker font.

There is a *RSS feed* link below the tag cloud which directs test persons to the subscription page. This page simulates an option for test persons: subscribing the online atlas in order to be informed regularly without needing to visit it.

If users access a map page, there is the *map view* at the center of the page. Maps are PNG image files and each of them has a title above and a legend on them. *Map controls* allow users to access different views of a map. These views differ from the data's covering areas which are municipalities, regions and states.

Map *recommendations* are below the map views. In order to make them more attractive for users, they have different background colors. Recommendations are presented in two groups, each including three maps. One of these groups is system's recommendations which are generally calculated with the users' previous behaviors in a website or their answers to questionnaires etc. This group of recommendation is presented to the test persons as "These may interest you". The other recommendation option recommends maps which are also visited by other users after the current map on the page, like in e-commerce websites "users who bought this item also bought these". This recommendation group is shown as "Other users looked at these maps after the current one".

In following parts of this research, these two types of recommendations will be

named as follow: The recommendations which are prepared according to the system designers' advices as "*System recommendations"* and the recommendations which are prepared according to other users' activities as *"Other users' recommendations"*.

In order to prevent that the position of recommendations influences the decision making of the users, the position of other users' recommendations and system recommendations was changed within the recommendation field i.e. in one case, the systems' recommendations are on the top whereas in another case, the other users' recommendations are on the top. In the prototype, the recommendations are virtual and they were prepared as graphics for each map page because the aim of the test is not to find out a suitable algorithm for recommendations but to evaluate users' reactions to recommendations and comments in an online atlas.

There are two *user comments fields* below the map view. These fields contain comments done by other users (virtual as well) and a field for test persons to write their comments. The user comment field-1 is between recommendations and the map view and the user comment field-2 is under the recommendations. There are two user comments fields to understand whether the positions of comments and recommendations play a role in users' decisions or not. In order to evaluate this, there were different interfaces prepared for different tasks where in some interfaces the user comment field is above the recommendations field and in some below.

5.2.3 Test Tasks

There are five tasks to be completed by each test person in the test by using the prototype. Each task consists of two parts: a) finding a certain map and answering the question, b) visiting at least one more map page after answering the first question. For the first four tasks, there are four different interfaces and test persons complete the fifth task also with the fourth interface. The first interface does not include any recommendations or user comments. The second interface only includes user comments below the maps and the third interface only includes recommendations. The fourth interface includes both recommendations and user comments in different positions i.e. test persons see user comments between the map and recommendations for the fourth task and below recommendations for the fifth task.

The aim of preparing different interfaces is to observe test persons' reactions to

different contents. The completion of the second part of the tasks is the main interest of this test in order to understand users' behaviors after reaching the desired map (target map of first parts of each task).

With the first task, it was planned to observe how many additional maps the test persons look at after the desired map. The second task and the interface of it were organized for understanding test persons' reactions to user comments: whether they change test persons' following behaviors after reaching the desired map or not. The third task aimed to observe test persons' reactions to map recommendations after reaching the desired map and to measure how many additional maps the test persons look at by using map recommendations. This measurement was planned to use for comparing the number of maps test persons visit in different interfaces. The fourth and the fifth tasks were prepared to observe test persons' reactions to an interface including both user comments and recommendations.

With the help of these tasks, it was aimed to find out test persons' priorities concerning user comments and recommendations and whether the positions of them make any difference or not. In addition to that, other users' recommendations and system recommendations are also presented to test persons in different positions within the recommendations field in different interfaces, in order to prevent that the position of recommendations influences the decision making of the users. This way, it was planned to examine whether recommendations from other users' activities really have a greater impact on test persons than the ones from the system or not and if the position of these two recommendations effect their decisions.

In such a usability testing with a couple of tasks, learnability could affect users' behaviors during the completion of the tasks like spending more time after learning how the software/website works. Other than this, test persons could get bored or lose their motivation during the completion of the tasks. Such a case could also affect users' behaviors and they could spend less time than expected in last tasks. Because of the learnability and motivation issues, the tasks and the relevant interfaces for the tasks were given to the half of the test persons with the order as mentioned above (from task one to five). The other half of the test persons completed tasks with an opposite order of tasks and interfaces (from task five to one). By this way, it was planned to balance the test results and to remove effects of learnability and motivation on results.

5.2.3.1 Interfaces for tasks

Below, the interfaces of tasks are presented. In Figure 5.2, the interface for Task 2 can be seen. The interface for Task 1 is not presented additionally because it looks exactly the same with the interface for Task 2 except user comments field.

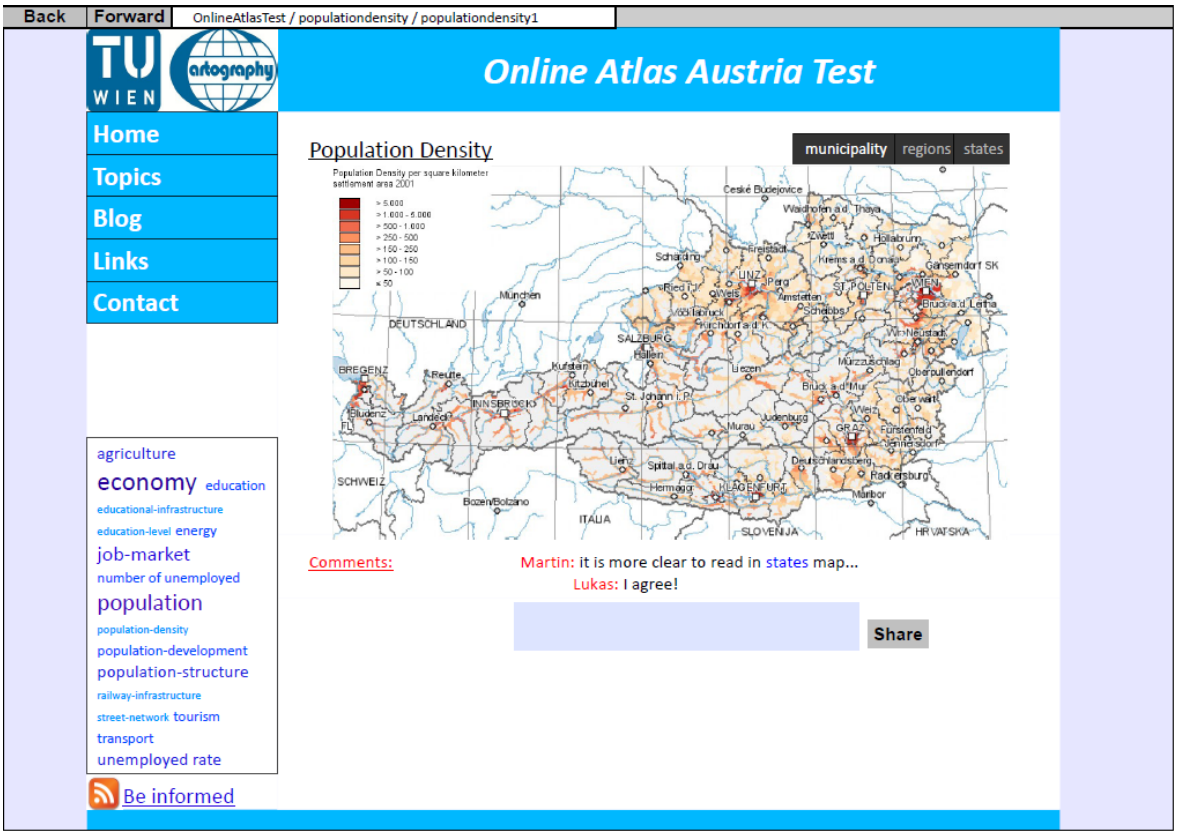

Figure 5.2: Example of the interface that is used for completing Task 2.

Task 3, 4 and 5 have also similar interfaces to each other and they all include map recommendations. Differences between these interfaces are existence and position of user comments field. Interface for Task 3 does not include any user comments field. User comments field is between the map view and the recommendations field in the interface for Task 4. In the interface for Task 5, the user comments field is at the bottom of the page, below the recommendations field. Because of having very similar aspects, in this part only the interface for Task 4 will be presented below, in Figure 5.3. Examples of all of the interfaces for tasks can be found in the Appendix B.

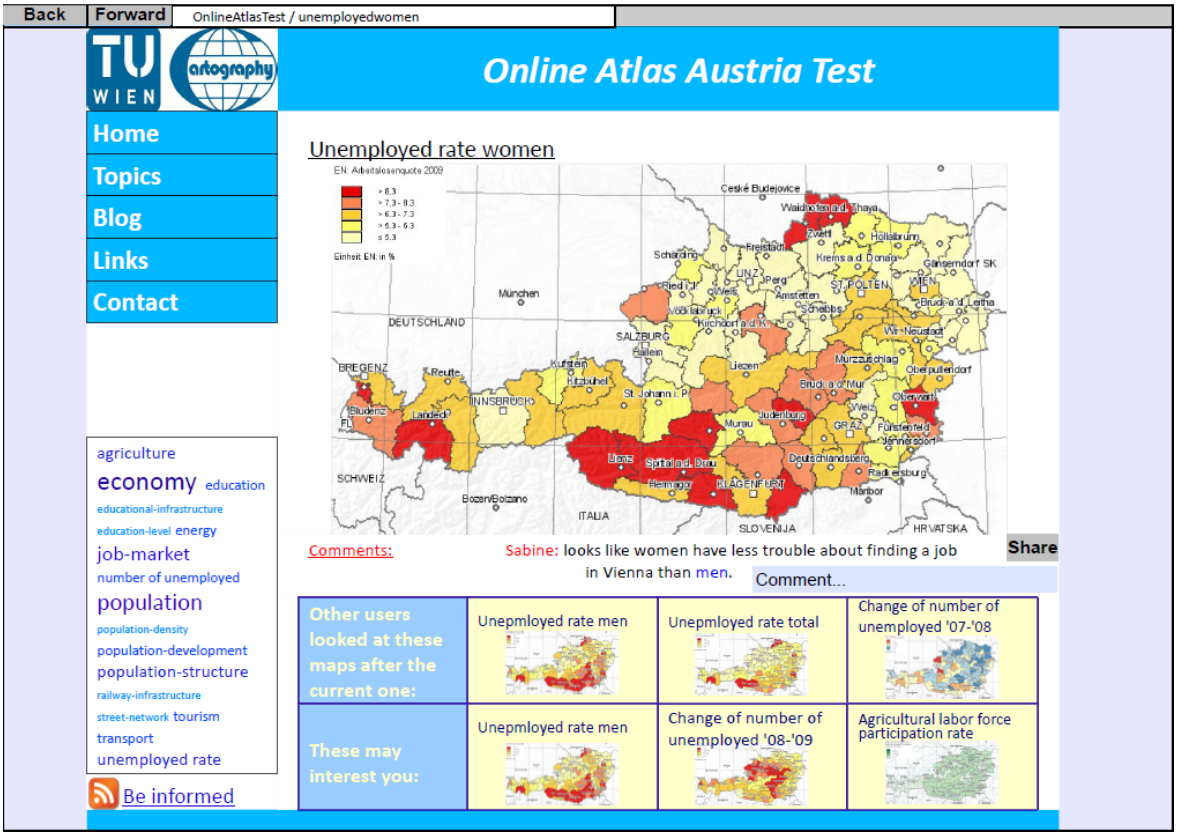

Figure 5.3: Example of the interface that is used for completing Task 4.

5.2.4 Questionnaire

A questionnaire (in paper form) was prepared to be filled out after completing the tasks with the prototype in order to get information about test persons' general Internet behaviors, their Internet skills and to get a feedback about the test interface. At the top of the first page, test persons are reminded that it is not a questionnaire to examine their skills but to improve online atlases. They are informed that they can write their answers also in German and the results will be presented anonymously.

General Internet behaviors part consists of questions about three widely known segments of the Web 2.0 which include recommendations or user comments: e-commerce, social network and online travel booking. Test persons are asked to answer if they generally use these websites and how they rate the usefulness of recommendations and user comments in these websites. In addition to that, there are also questions to find out their familiarity to online atlases, voluntarily web mapping, blogs and RSS feeds.

Feedback about the test interface part contains questions about the map recommendations and the user comments in the prototype. Test persons are

asked if they attracted their attention and if they used them, how they rate the usefulness of them and which one attracted their attention more.

In order to understand test persons' profiles concerning their Internet skills, the *Internet skills* section was prepared. In this section, European Commission's statistical institute Eurostat's questions [URL 15] are used which are used to find out individuals' level of basic Internet skills in European countries. It consists of six yes/no questions. Individuals with one or two "yes" answers out of six are assigned to *low level of basic Internet skills* group, with three or four "yes" answers to *medium level of basic Internet skills* group and with five or six "yes" answers to *high level of basic Internet skills* group.

At the questions which are related with test persons' preferences, there were also free rows prepared where they are asked to write their reasons of choice.

In order to know test persons' general profiles, their ages, genders and educations, these aspects are asked at the end of the questionnaire.

5.2.5 Application of the test

After finishing the preparation of the prototype, tasks and questionnaire, there was a *pilot test* carried out in order to see whether everything works as planned or not. As a result of this pilot test, the number of tasks was reduced from eight to five because of the relation between time and concentration. It was observed that completing eight tasks takes long for a test person and he/she lose concentration and motivation for the last tasks. With the help of the feedback from the pilot test, different background colors were arranged for map recommendations. Typing mistakes were found in the prototype and in the questionnaire and they were corrected. It showed that for some questions in the questionnaire, it was necessary to put an answer option called "not sure" where test persons can choose it when they cannot decide between the other given options. After making these changes, everything was ready to start real testing.

Before testing, each test person is informed about the test. The preparation of these explanations is based on aspects of Nielsen (1993) about ethical considerations for user testing. It is explained that:

- … the test takes approximately 15-20 minutes and that test persons will be busy with a prototype of an online atlas website and will have to complete five tasks.

- … there is a questionnaire to be filled out after completing the tasks.
- … there are different interfaces for the tasks and that they will be changed by the graduand after the completion of each task.
- … test person can explore the prototype first before performing the first tasks.
- … this is a test for testing the prototype, not the test person.
- … each task includes two parts and the second part is the same in every task, asking them to visit at least one more map page but allowing to visit as many map pages as they want without any time limitation.
- … the graduand may ask why they click certain options during the test.
- … it is a new developed prototype and may have problems.
- … test persons can stop the test at any time.
- … the results will be presented anonymously.
- … the screen will be recorded.
- … mobile phones or home phones should be kept turned off.
- … test persons should not ask anything to the graduand during the test except vocabulary (the test interface and tasks are in English but they are performed mostly by people with German mother tongue).
- … they do not have to only complete the tasks but also can visit other pages in the prototype.

Each test person was asked to use the graduand's computer to perform the test. Interfaces were in PDF format and opened by using Adobe Reader 9.5 and presented in full screen view. My Screen Recorder Pro 3.3 trial version was used for recording the screen during the test and these records are used for analyzing test persons' behaviors afterwards. Both interface and screen recorder were prepared before the test starts and testing starts after informing the test persons.

The tasks were given to the test persons one by one. After the completion of each task, interfaces were changed by the graduand until reaching the fifth task (the fifth task is performed also by using the fourth interface). Especially during the tasks with user comments, test persons were asked verbally for the reason of their following behavior, in cases where it was not clear to observe it with the mouse motion.

After completing the tasks, test persons were asked to fill out the questionnaire and then the test finished.

5.2.6 Test persons

In a usability testing, one of the factors for achieving satisfying results is test persons who use the software/product. Decision of number of test persons is an important issue because of its influence on results. For quantitative studies, Nielsen (2006) suggests testing at least 20 test persons to acquire statistically significant numbers. Faulkner's (2003) research supports this claim and its results show that having 20 test persons is enough to find mean 98.4% of usability problems and 30 test persons is enough to find mean 99% of usability problems in a testing. Due to these and many other studies, for this research it was planned to apply the usability testing on 30 test persons with equal gender ratio. There was also one test person used for pilot test. Youngest test person was 18 years old, oldest test person was 48 years old and average age of test persons was 25,4.

The prototype for the usability testing is in English language and simulates an online atlas of Austria. That is why it was considered that this test may interest Austrian citizens more and almost all (except one) of the test persons were chosen who have Austrian citizenship and English knowledge. Other than these two criteria, test persons were expected to have already some basic Internet skills. This information was obtained from the answers of the questionnaire's Internet skills part and test persons with "medium level of basic Internet skills" (11 out of 30) and "high level of basic Internet skills" (19 out of 30) took part in the test. 9 of test persons were students of Geoinformation studies.

6 Results

In this chapter, the results of the usability testing and the questionnaire will be presented. First, the results of the usability testing will be presented according to their relevance to the hypotheses and other interests of this research. Then, the results of the questionnaire will be presented. A general interpretation of all results regarding the hypotheses will be done at the end of this chapter.

In addition to presenting the results, the methods of analyzing them will also be explained.

6.1 Results of the usability testing

As mentioned in previous parts of this research, every test persons' test was recorded by using a screen recorder. In order to understand test persons' behaviors, these recordings were viewed on a video player giving the following results.

6.1.1 Usage of recommendations for accessing new maps

One of the main focuses of analyzing test records was to reveal the usage of recommendations for accessing new maps. This was done by analyzing test persons' activities after answering the first parts of the tasks. They were free to visit as many more maps as they wanted until they decided to proceed to the next task.

In second parts of the tasks, test persons did not access new maps in each further step but also sometimes went back with the help of *Back / Forwards* buttons or other tools and compared the maps. It was also seen that in an interface with map recommendations, test persons used these recommendations as "*Back / Forward*" buttons as well. In such cases, there were some maps accessed more than once.

By analyzing the usage of recommendations for accessing new maps, accessed new maps were counted and repeatedly accessed maps within a task were counted as only one new map. Below, in Chart 6.1, the total number of new map accesses and the usage of recommendations by accessing new maps in each task are presented. The number of new map accesses is the sum of all new map accesses of all test persons after answering the first parts in each task.

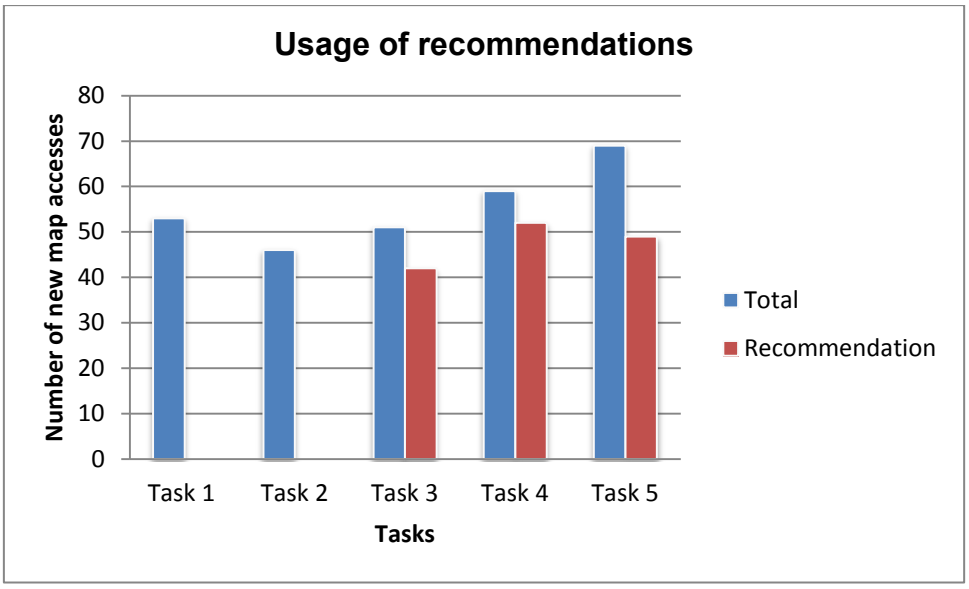

Chart 6.1: Usage of recommendations for new map accesses including all test persons. Interfaces for Task 1 and Task 2 do not include any map recommendations.

Because of having an equal number of female and male test persons (15/15), there was the opportunity to compare their behaviors. In Chart 6.2 and 6.3, women's and men's usage of recommendations are presented.

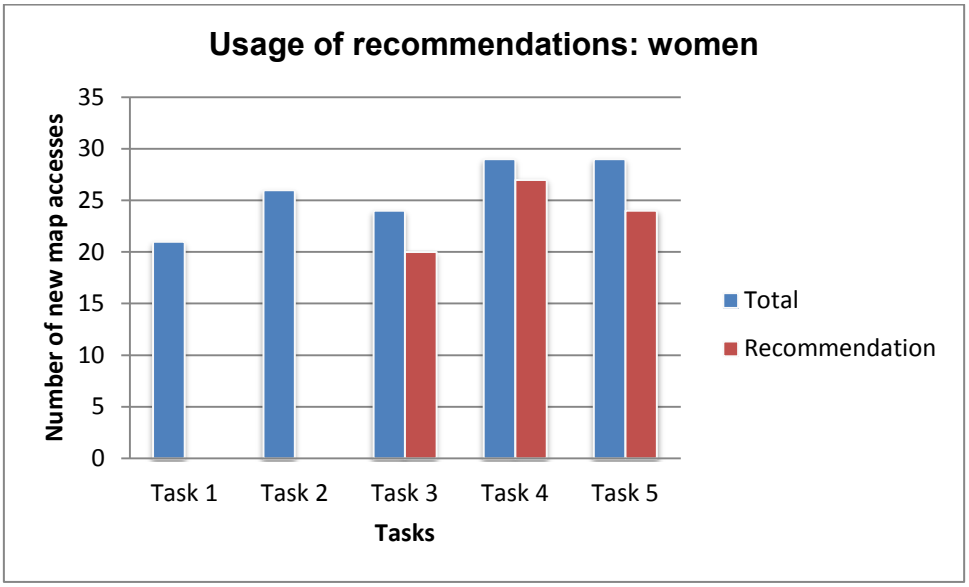

Chart 6.2: Usage of recommendations for new map access – women.

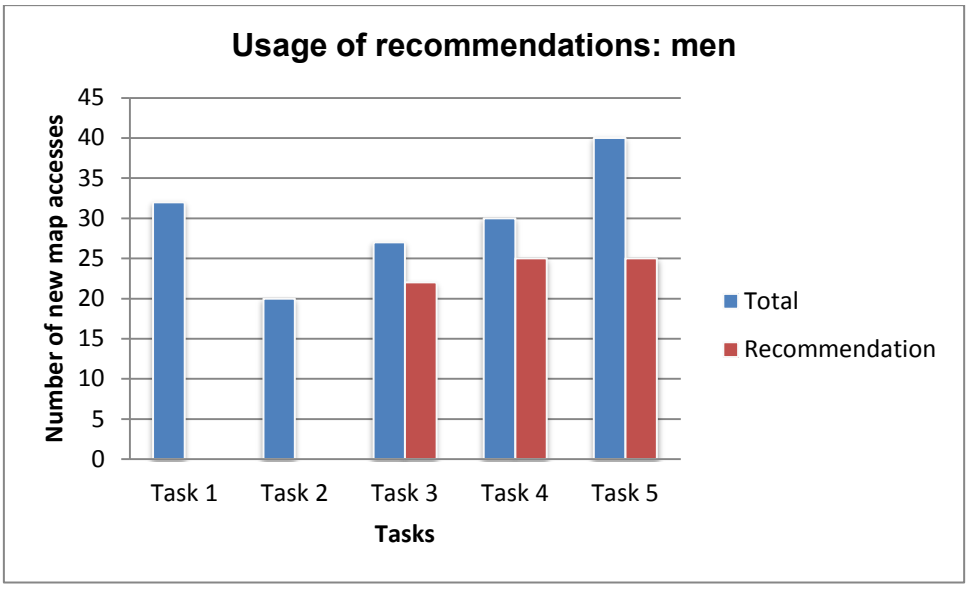

Chart 6.3: Usage of recommendations for new map access – men.

As mentioned in the previous sections of this research, half of the test persons completed their tasks from task one to five whereas the other half from task five to one for preventing effects of learnability on results.

In order to understand the percentage of map recommendations' usage concerning all new map accesses, results of Task 3, 4 and 5 were gathered. Regarding their all new map accesses, it was found out that the usage of map recommendations was 69.31% for the test persons who completed the tasks from one to five whereas the usage of map recommendations was 93.59% for the test persons who completed the tasks from five to one. When all test persons were taken into consideration, then the usage of map recommendations was 79.89% regarding all new map accesses. This percentage and the percentages of women and men are shown below in Chart 6.4:

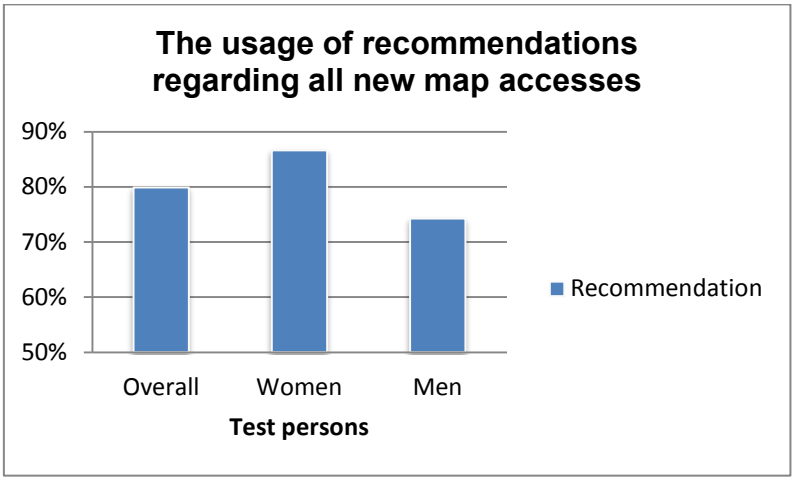

Chart 6.4: The usage of map recommendations regarding all new map accesses where interfaces include map recommendations.

These results show that the users use map recommendations very often for map accesses in an online atlas and that it is useful to include a recommendations tool.

6.1.2 Increase in spent time at an online atlas website

Another main focus of analyzing test records was to determine whether map recommendations cause users to spend more time in an online atlas website or not. In order to determine that, test persons' behaviors in different tasks, which were completed in different interfaces, were compared.

Every user needs a different period of time to read maps or to visit a website. For this reason, the time spent at the online atlas website is not measured in seconds or minutes but in the number of new map accesses.

In order to compare the periods of time users spent on the website, the average of the total number of new map accesses in Task 1 and 2 (interfaces without map recommendations) were calculated. Additionally, the average of the total number of new map accesses in Task 3, 4 and 5 (interfaces with map recommendations) were calculated as well as the average of the usage of recommendations in these tasks. Furthermore, these values were calculated separately for female and male test persons. The results of this comparison can be seen below in Chart 6.5:

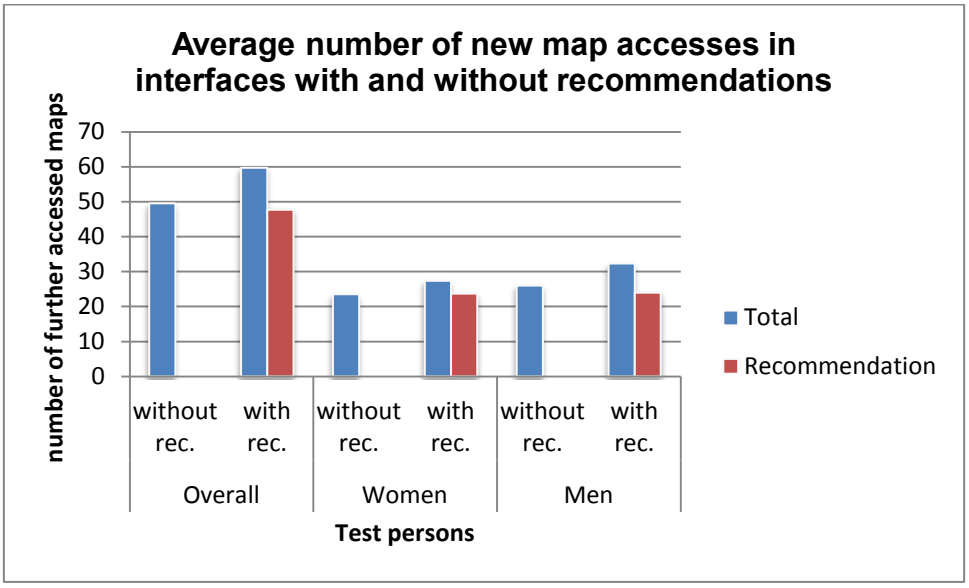

Chart 6.5: Average number of new map accesses in interfaces with and without recommendations for comparing time spent at the online atlas website.

According to the results of this comparison, the time spent at the interfaces with map recommendations increased. This increase was 22.42% for the test persons

who completed the tasks from one to five and 18.18% for the test persons who completed the tasks from five to one, which means an overall increase of 20.54%. This overall increase and increases for women and men are presented below in Chart 6.6.

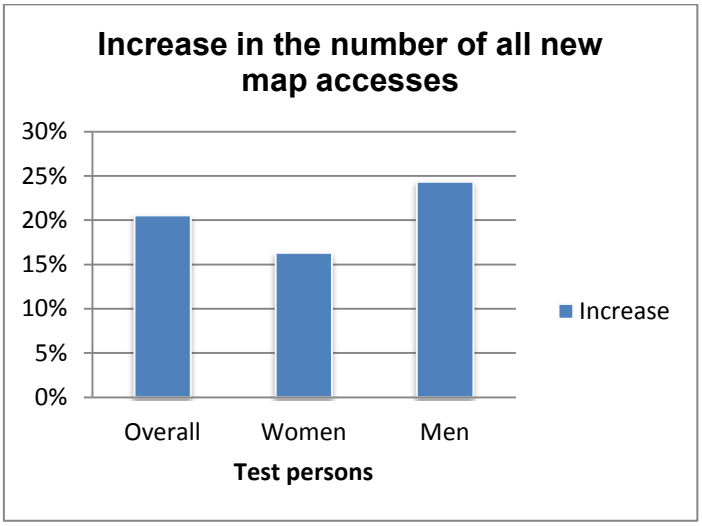

Chart 6.6: Increase in number of all new map accesses with map recommendations compared to interfaces without map recommendations (in percentage).

6.1.3 Comparison of system recommendations and other users' recommendations

Finding out whether users of an online atlas have a preference between recommendations prepared by the system and by other users' activities was another focus of analyzing the test records. In order to prevent that the position of recommendations influences the decision making of the users, the position of other users' recommendations and system recommendations was changed within the recommendation field.

This comparison was done by counting the number of usage of these two types of recommendations separately for accessing new maps. This counting was carried out for each task and for all test persons. The results are as shown below in Chart 6.7.

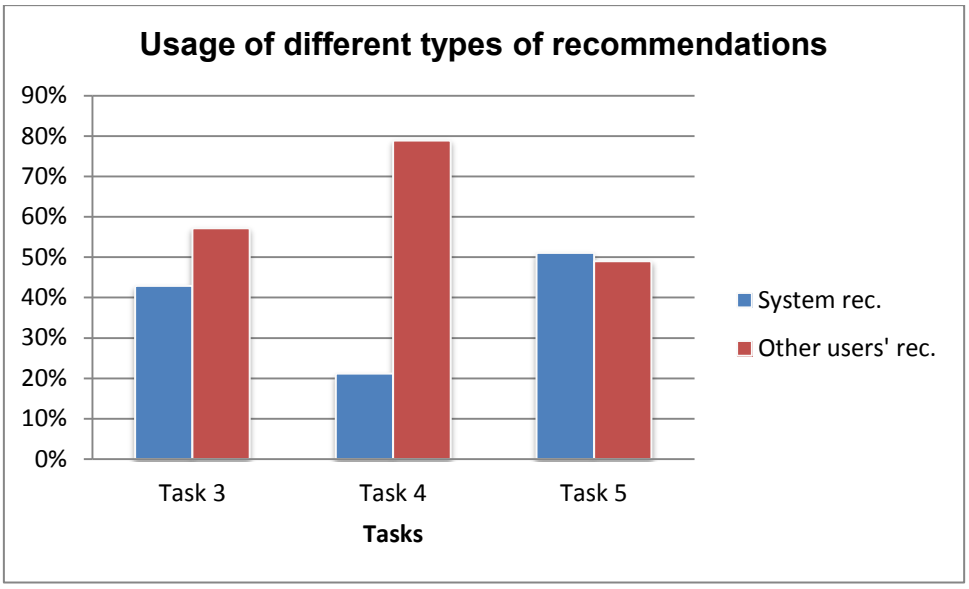

Chart 6.7: Comparison of usage of different recommendation types for new map accesses in different tasks.

Counting all the results of the different tasks, it was found out that the usage of the system recommendations was 32.86% and the other users' recommendations was 67.14% for the test persons who completed the tasks from one to five. The usage of the system recommendations was 42.47% and the other users' recommendations was 57.53% for the test persons who completed the tasks from five to one. Concerning overall results, system recommendations' usage was 37.76% and other users' recommendations' usage was 62.24%. The overall results of this comparison as well as women's and men's preferences between these two recommendation types are as shown in Chart 6.8.

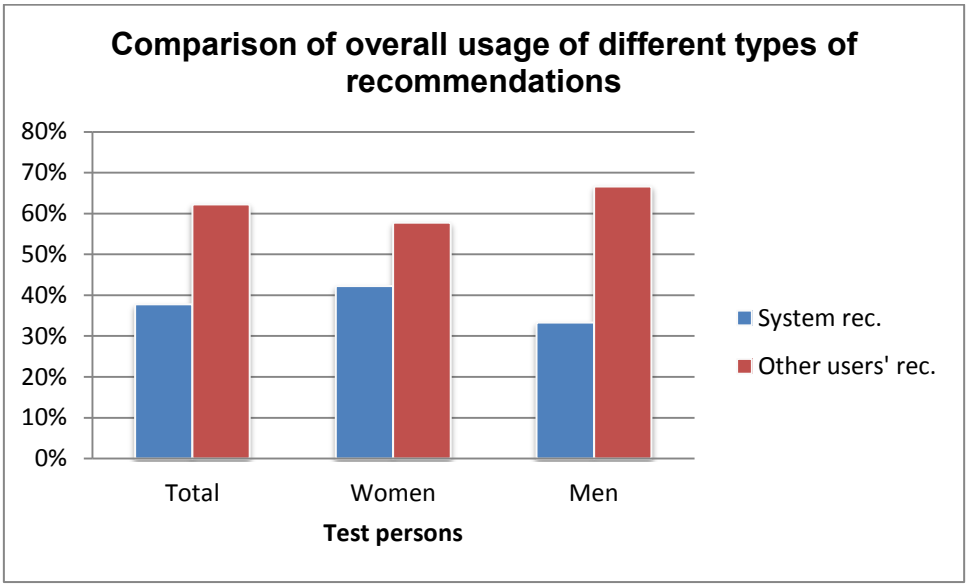

Chart 6.8: Comparison of overall use of different types of recommendations and women's and men's preferences between these recommendation types.

According to Chart 6.8, it can be stated that the users use other users' recommendations more often than the system recommendations. However, Chart 6.7 shows that the users actually do not have such a significant preference concerning these two recommendation types. Their behaviors change from case to case; whereas in Task 3 and 5, usage ratios of recommendations are very close to each other, in Task 4 they are not. This can be due to the interface of Task 4: The maps that are recommended according to other users' activities present topics that are very comparable to the already accessed map which caused users to use them more often than the system recommendations (see Figure 5.3).

6.1.4 Impact of other users' comments

During the analysis, it was aimed to reveal the impacts of other users' comments on users' behaviors and users' tendency to write comments in an online atlas. Interfaces with the tool user comments were used for Task 2, 4 and 5. In each task, the position of user comments was different so to see if it has any effects on users' behaviors.

Deciding whether user comments changed test persons behavior or not was done in two ways: observing if they clicked the highlighted link for a new map in another user's comment or in case they did not clicked the link but accessed that map on their own, by asking their reason for this access during the test. In some cases during the test, it was clear that some users accessed the map mentioned in the other user's comment because of the comment, but not by using the link in the comment. For such cases, these test persons were also considered to be impacted by other users' comments.

In task 2, where user comments were positioned below the map view and there were no map recommendations, 8 (3 women, 5 men; 26.67%) of 30 test persons were impacted by other users' comments and changed their behavior according to these comments.

In task 4, where user comments were positioned below the map view and between the map view and map recommendations, 5 (2 women, 3 men; 16.67%) of 30 test persons were impacted by other users' comments and changed their behavior according to these comments.

In task 5, where user comments were at the bottom, below the map recommendations, none of the test persons were impacted by other users'

comments.

2 of 30 test persons wanted to write comments and one of them actually wrote a comment. The other test person stopped writing the comment because of a phone call while writing and then continued completing other tasks.

It is observed that other users' comments have an impact on users' behaviors and that the position of these comments is very important.

6.1.5 Results concerning Tag cloud, Blog and RSS tools

Despite not being included in the hypotheses of this research, test persons' responses to other Web 2.0 technologies such as Tag cloud, Blog and RSS were also analyzed.

It was observed that 17 (56.67%) of 30 test persons used the tag cloud tool at least once during the test. In these cases, the number of using it varied from 1 to 10 per person.

12 (40%) of 30 test persons checked the blog page. What test persons did there was very different. Some of them only wanted to check what it is, some of them were interested in user comments in blogs, some of them clicked map links in blogs etc.

4 (13.34%) of 30 test persons clicked the RSS feed link but none of them clicked the option "subscribe" on the next page.

6.2 Results of the questionnaire

In this part, the relevant answers to the questions posed in the questionnaire will be presented. Every test persons' answers were gathered in order to acquire quantitative and qualitative information. In the course of the analysis of the questionnaire, it became clear that not all of the test persons answered all questions. In the upcoming parts, the results are represented according to existing answers and to their relevance to the hypotheses of this research.

In questions of the questionnaire, it was aimed to find out the test persons' opinions about map recommendations, i.e. how often they use them, how they rate their helpfulness, their preferences between different types of them and if

recommendations led them to look at more maps. Other than map recommendations, test persons' feelings about other users' comments were also obtained, i.e. if other users' comments attracted their attention, if these comments had an impact on their decisions and their tendency to write comments.

In each subchapter, first the question and then the results of test persons' answers will be presented. The questionnaire and the answers of test persons can be found in the Appendix A.

6.2.1 Usage of map recommendations for accessing new maps

Q. There were some map recommendations below the maps on the pages. Did you use them?

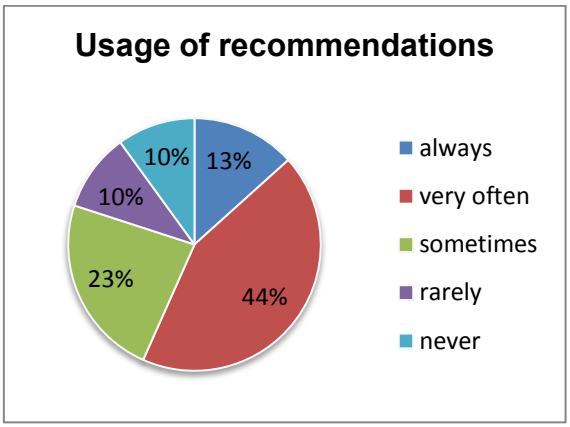

Chart 6.9: Usage of map recommendations for accessing new maps according to questionnaire answers.

Q. How do you rate the helpfulness of these recommendations?

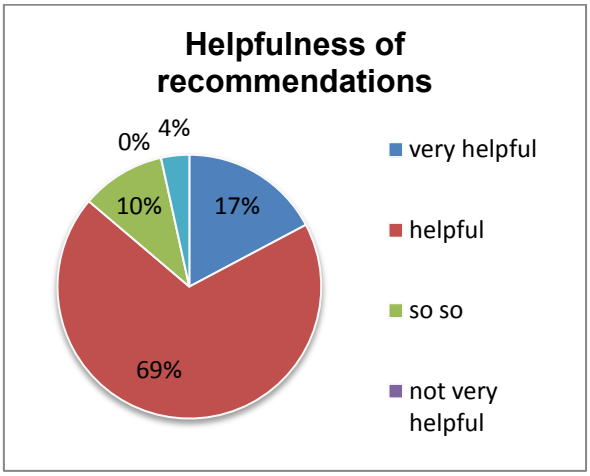

Chart 6.10: Test persons' ratings about the helpfulness of the map recommendations.

Answers of these two questions show that, users used recommendations and they feel that it is a helpful tool.

6.2.2 Increase in number of new map accesses

Q. Do you think the recommendations have led you to look at more maps than you thought before?

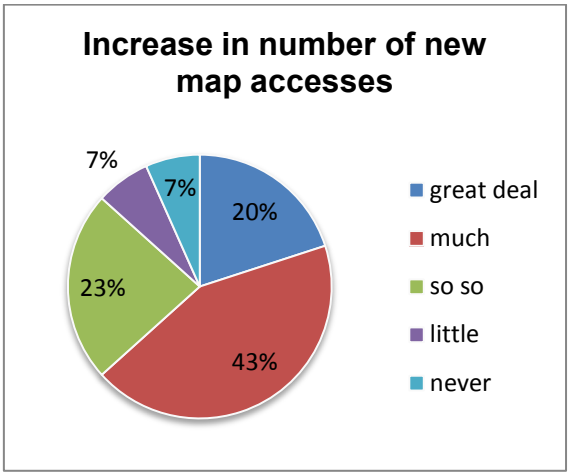

Chart 6.11: Test persons' opinions about how map recommendations affected their further map accesses, i.e. if recommendations increased the number of new map accesses.

A very big part of the test persons (who marked "so so", "much", "great deal" – 86%) think that recommendations led them to look at more maps than they thought before.

6.2.3 Test persons' preference between different types of map recommendations

In order to obtain information about test persons' preferences between the system recommendations and the other users' recommendations, first their general preference in Internet and then, their preference during the test were asked.

Q. In general, whose recommendations or comments do you primarily take into consideration? Why?

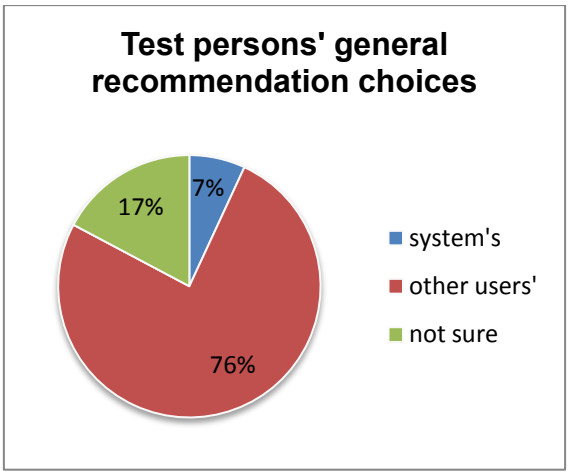

Chart 6.12: *Test persons' preference between system and other users' recommendations when generally using the Internet.*

Answers to *Why*

Other users': 8x more realistic / more trustworthy / more objective
6x because of trusting other users' experiences
2x because they are often more useful

Systems': 1x more subjective

(Answers are summarized and often given answers are presented)

Q. (During the test) Which recommendations interested you the most? Why?

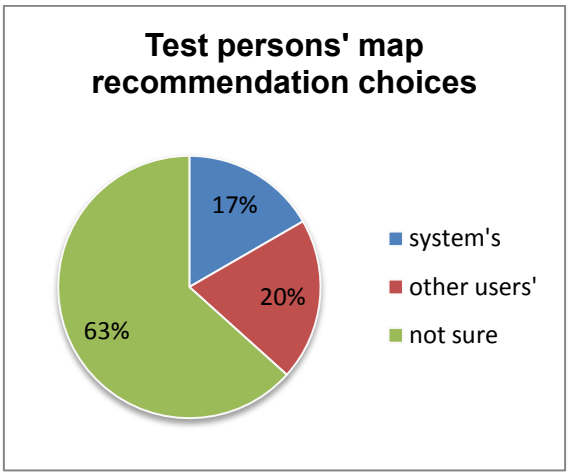

Chart 6.13: *Test persons' preference concerning system and other users' recommendations during the online atlas test.*

Answers to *Why*

Not sure: 1x clicked whatever I found interesting
1x did never use it, that is why no experience
1x users' recommendations are useful but system's are also

	good, giving information about new facts and updates. 1x both were not always topic-related 1x because both were very helpful
Other users'	1x no experts give me honest hints which I may need 1x people's experiences 1x because it is more personal 1x system's could be for benefits of the company
System's	1x systematically relevant to what I was looking at before 1x the system's recommendations were easier to see because of great letters 1x because they were logical recommendations

Chart 6.13 supports the deduction of the Part 6.1.3 and shows that the users are unsure about which recommendation type they used primarily and that the users do not have a significant preference between them.

6.2.4 Impacts of other users' comments and tendency to write comments

Q. Did other users' comments attract your attention?

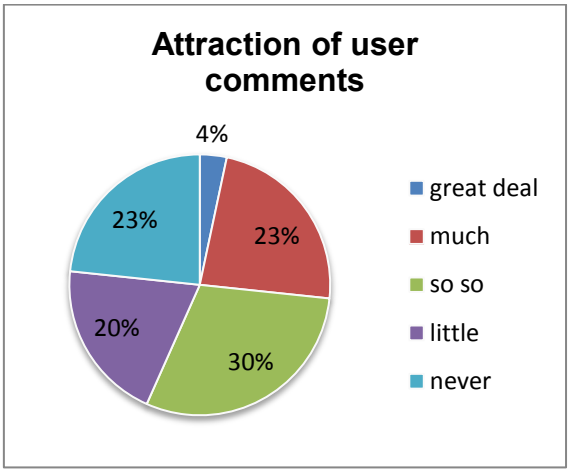

Chart 6.14: Attraction of other users' comments.

Q. Did other users' comments impact your decisions during surfing in the tested online atlas?

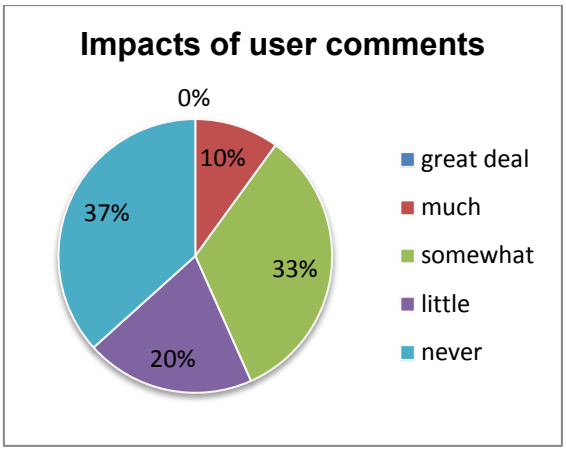

Chart 6.15: Impacts of other users' comments on test persons' decisions.

Q. Did you comment on anything in the tested online atlas? (If yes why? / If no why?)

Only one test person marked "yes". 28 test persons marked "no" and one did not answer this question.

Answers to *Why*

No: 7x I did not know/notice this function
6x because I did not have anything to add / was not necessary
3x not directly part of tasks / I was concentrated on tasks
1x I wanted to but because of a phone call I did not write
1x I never comment anything

Yes: 1x wanted to share my opinion

(Answers are summarized and often given answers are presented)

According to these results, it is seen that other users' comments attracted test persons' attention and had an impact on nearly half of the test persons (chart 6.15, who marked "somewhat" and "much" – 43%). Test persons did not tend to comment that much but a big reason of this can be their lack of knowledge about commenting function.

6.3 Interpretation of results concerning the hypotheses of this research

In this part, first, the hypotheses of this research will be reminded and for each hypothesis, the relevant results of the empirical examination will be summarized and evaluated. Then, the results for other interests of this research will be

explained.

6.3.1 Hypothesis 1

Hypothesis 1: Recommendations attract users' attention in an online atlas and cause users to spend more time on the website compared to the same system without recommendations.

According to the usability testing results, recommendations attract users' attention and the usage of this tool is 79.89% regarding all new map accesses. 17.24% of the test persons think recommendations are very helpful and 68.97% of the test persons think they are helpful.

In the usability testing, it became clear that there is a 20.54% increase in the number of new map accesses in an interface with recommendations compared to one without recommendations. 20% of the test persons think that recommendations led them to look at more maps a great deal and 43.34% of the test persons think that recommendations led them much to look at more maps.

6.3.2 Hypothesis 2

Hypothesis 2: Users take recommendations by system designer advices and by other users' activities into consideration and the ones by other users' activities more than designers' advices.

In the usability testing, it is observed that 62.24% of total used recommendations are the ones prepared according to the other users' activities and 37.76% are the recommendations which are prepared according to system designer advices. Overall, it is seen that test persons used other users' recommendations more than the system recommendations. But, when their activities are analyzed for each task, there is not such a significant difference between the recommendation types in each case. In tasks three and five, the usage rate of these two recommendation types are close to each other and it cannot be claimed that users use one of them more than the other one. Only in task four it is observed that the test persons chose the other users' recommendations remarkably more often than the system recommendations.

One possible reason for this results: In task four, the given other users' recommendations, which users can access after reaching the answer map of the

first part of the task, include maps that are very comparable (opportunity of comparing genders and overall information) to the answer map. That could be an explanation for why users chose this recommendation type more often that the other in this case.

At the same time, the answers of test persons in the questionnaire show, too, that test persons actually did not have a distinctive choice and they selected map recommendations according to what they found more interesting in each task. Test persons' preferences differed from case to case in each task.

6.3.3 Hypothesis 3

Hypothesis 3: Users tend to comment and other users' comments are interesting for them and have an impact on their behavior.

It is observed that test persons did not tend that much to write comments in the tested online atlas (only 2 of 30). Some reasons for that can be extracted from the answers given in the questionnaire where many test persons mentioned they did not know/notice that they could write comments or they did not feel it was necessary, or they were concentrated on tasks etc.

Usability testing's results shows that other users' comments have an impact on test persons' decisions (26.67% of test persons in maximum case). 10% of test persons said other users' comments impacted them much and 33.34% of test persons said somewhat in their answers in the questionnaire.

Apart from that, it is seen that the position of user comments is very important and has a big influence in terms of their attraction on users. Maximum impact of user comments occurred when the position of them was below the map views. In the case where the position of user comments was at the bottom of the page, it became evident that many test persons did not even notice that there were user comments.

6.3.4 Other interests of this research

Tag cloud

According to the results of usability testing, it is observed that tag cloud is a tool used by users during surfing in an online atlas (56.67% of the test persons used it at least once). Their interest in tag cloud indicates that a tag cloud is a good

alternative to the hierarchical list of topics concerning the navigation in an online atlas.

Blog

40% of the test persons visited the blog page in the online atlas test and had varying responses to that page. With the help of the usability testing's results, it is observed that including a blog page in an online atlas is also a good opportunity for system designers in order to increase the number of tools that are interesting for their users.

RSS

In an online atlas, RSS feed option is not very promising according to the results of the usability testing. 13.34% of the test persons clicked the RSS feed link, but none of them clicked the option "subscribe" on the next page.

7 Conclusions

7.1 Conclusion

This research's focus is to evaluate the suitability of Web 2.0 technologies for online atlas access interfaces. Recommendations and user comments were the major Web 2.0 technologies whose suitability is evaluated. A usability testing with test persons was carried out for this evaluation and the results were presented. In addition to recommendations and user comments, the suitability of Tag cloud, Blog and RSS feeds were also observed within this empirical evaluation.

As mentioned before, with the help of an empirical evaluation, hypotheses of this research were examined. **The first hypothesis**, which is about usage of recommendations and their effects on the time spent in an online atlas, **is proved**. Usage rate of recommendations is high and it is seen that recommendations increase users' spent time in an online atlas. Test persons' opinions (gained in the questionnaire) support this hypothesis as well.

The second hypothesis of this research, which is about users' preferences regarding the system recommendations and other users' recommendations, **is not proved**. Test persons' overall activities in usability testing support this hypothesis, where they preferred the other users' recommendations compared to the system recommendations. However, their activities in different tasks show that they do not have a significant preference between these two recommendations types. Their opinions also show that they are not sure which one of these recommendations they used the most.

The third hypothesis of this research, which deals with user comments, **is partially proved**. It is observed that the test persons do not tend much to write comments in an online atlas. On the other hand, other users' comments attract their attention and have an impact on their behaviors. In addition to that, the position of the user comments field is very important regarding its attraction for users; it is best when the comment is positioned below the map view.

Tag cloud and Blog are also useful opportunities of Web 2.0 technologies which are often used by users and can be included in an online atlas whereas RSS feed does not seem to be particularly interesting for users.

7.2 Discussion

Despite finding all the answers to the questions posed in this research, it becomes evident that there are a few points that could be improved. One of them is the design of the recommendations field in the online atlas interface. Visually, both recommendation types were the same in the test interfaces. This can also be a reason for why users feel unsure about their preferences between the types of recommendations and select any map recommendation from the recommendations field. Within an interface where different recommendations types are visually recognizable, users could become more aware of their opinion in terms of whose recommendations they prefer.

Additionally, test persons mentioned that they did not know or notice that they could write comments although they were informed about that before the test. In order to eliminate this lack of knowledge, the opportunity of writing comments could have been underlined before the test. The design of fields for user comments could have been prepared similarly to existing websites so to improve their noticeability.

In usability testing, many different subjects are examined together within a main test interface. Distinguishing subjects and preparing different tests for them, where each test concentrates on only one subject could give more detailed results about the usage of these subjects.

Using a prototype running on PDFs in testing possibly decreased the sense of reality for users a little bit. A prototype running on a Web browser could have been more beneficial and could have increased the usage of some tools in the online atlas interface.

According to the interviews done with the test persons after the completion of the tests, it is seen that many test persons complained that the size of the legend was too small and it was hard to read it. The legends could be prepared a little bigger in order to increase their legibility.

7.3 Further research

Within this research, it is observed that recommendations and user's comments are promising opportunities of Web 2.0 technologies for an online atlas. In order to get more precise results for each of these tools, a similar usability test can be

carried out with improved visual interfaces and a separate examination of each of these tools in the future.

Carrying out this test on the Internet can be more beneficial, especially in a case where these tools are included in an existing online atlas. Such a test could be presented to actual registered users of an online atlas on the home page as "*Test version*" and they could be asked to try it. Testing with actual registered users of an online atlas, interest in Blog and RSS feed can also be expected to be higher.

Apart from that, some other techniques can also be used in testing such as eye tracking method, which can give efficient feedback by analyzing users' behaviors and visual effects of interfaces.

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Appendix

A. The questionnaire and results of test persons' answers

Please don't forget that this is not a questionnaire in order to test how good your skills are. It is for improving current online atlases. Every single information is worth very much. You can also write your answers in German. This is an anonymous test.

General Internet Behaviors

Q. Have you ever shopped online? *(e.g., Amazon, eBay)*

Yes: 86,67% No: 13,34%

Q. Do you take product recommendations into consideration during shopping?

Yes: 73,08% No: 26,92%

Q. How do you rate the usefulness of recommendations in online shopping?

very useful: 15,38% useful: 30,77% somewhat useful: 46,15% not useful: 3,85% poor: 3,85%

Q. Do you have a Facebook account?

Yes: 83,33% No: 16,67%

Q. (If yes) Have you ever used the function "people you may know"?

Yes: 72% No: 28%

Q. How do you rate the usefulness of the function "people you may know"?

very useful: 8,33% useful: 20,83% somewhat useful: 37,5% not useful: 25% poor: 8,33%

Q. Have you ever booked a hotel or hostel online?

Yes: 83,33% No: 16,67%

Q. Did you take other users' ratings or comments during making your decision into consideration about a hotel?

Yes: 96% No: 4%

Q. How do you rate the usefulness of other users' comments?

very useful: 28% useful: 64% somewhat useful: 8% not useful: 0 poor: 0

Q. In general, whose recommendations or comments do you primarily take into consideration?

System's: 6,90% other users': 75,86% not sure: 17,24%

Why? 8x: "more realistic / more trustworthy / more objective", 6x: "because of trusting other users' experiences", 2x: "many comments are better", 2x: "because they are often more useful", 1x: "they are more personal"

Q. Have you ever visited an online atlas Web-site?

Yes: 73,33% No: 26,67%

Q. If yes which one? 15x: "Google maps", 5x: "Google Earth", 2x: "Wikipedia", 2x: "A-Map", 1x: "Google" 1x: "Doris", 1x: "ÖK 50", 1x: "Statistik Austria"

Q. Have you ever contributed voluntarily to a map service? (e.g., openstreetmap.org)

Yes: 10% No: 90%

Q. Are there any blogs that you visit regularly?

Yes: 30% No: 70%

Q. Do you have any RSS feed subscriptions?

Yes: 13,33% No: 86,67%

Feedback about the test interface

Q. Did you feel yourself comfortable during the test?

very comfortable: 50% comfortable: 46,67% ok: 3,33% not comfortable: 0 terrible: 0

Q. There were some map recommendations below the maps on the pages. Did you use them?

Always: 13,33% very often: 43,33% sometimes: 23,33% rarely: 10% never: 10%

Q. How do you rate the helpfulness of these recommendations?

very helpful: 17,24% helpful: 68,97% so so: 10,34% not very helpful: 0 not necessary: 3,45%

Q. Which recommendations interested you the most?

System's: 16,67% other users': 20% not sure: 63,33%

Why? NOT SURE: 1x: "clicked whatever I found interesting", 1x: "did never use it, that's why no experience", 1x: "users' recommendations are useful but system's are also good, giving information about new facts and updates", 1x: "both were not always topic related",

1x: “because both were helpful”. OTHER USERS’: 1x: “no experts give more honest hints which I may need”, 1x: “people’s experiences”, 1x: “because it is more personal”, 1x: “system’s could be for benefits of the company”. SYTEM’S: 1x: “systematically relevant to what I was looking at before”, 1x: “the system’s recommendations were easier to see because of great letters”, 1x: “because they were logical recommendations”.

Q. Do you think the recommendations have led you to look at more maps than you thought before?

A great deal: 20% much: 68,97% so so: 23,33% little: 6,67% never: 6,67%

Q. Did other users’ comments attract your attention?

A great deal: 3,33% much: 23,33% so so: 30% little: 20% never: 23,33%

Q. Did other users’ comments impact on your decisions during surfing in the tested online atlas?

A great deal: 0 much: 10% somewhat: 33,33% little: 20% never: 36,67%

Q. Which one did attract your attention more in the tested online atlas?

Comments: 3,23% systems’ recommendations: 48,39% other users’ recommendations: 16,13% none: 32,29%

Q. Did you comment on anything in the tested online atlas?

Yes: 3,45%, Why? 1x: “wanted to share my opinion/feeling”
No: 96,55%, Why? 7x: “I did not know/notice this function”, 6x: “because I did not have anything to add/ was not necessary”, 3x: “not directly parts of tasks/I was concentrated on tasks”, 1x: “I wanted to but because of a phone call I didn’t write”, 1x: “I never comment anything”, 1x: “too personal”, 1x: “not interesting for me”, 1x: “everything was clear”, 1x: “didn’t think of it”, 1x: “because I didn’t know what to comment”.

Internet skills

1- Can you use a search engine to find information?
Yes ☐ No ☐
2- Can you send an e-mail with attached files?
Yes ☐ No ☐
3- Can you post messages to chatrooms, newsgroups or any online discussion forums?
Yes ☐ No ☐
4- Can you use the Internet to make telephone calls?
Yes ☐ No ☐
5- Can you use peer-to-peer file sharing for exchanging movies, music, etc.?
Yes ☐ No ☐
6- Can you create a web page?
Yes ☐ No ☐

Age: _____
Gender: _____
Education: _____

Thank you for participating…

B. Tasks and Interfaces

Task 1

In which state/s of Austria has the tourism structure changed the most in the recent years?

After this task, please access at least one more map which you like. You can access as many maps as you want…

Interface for Task 1

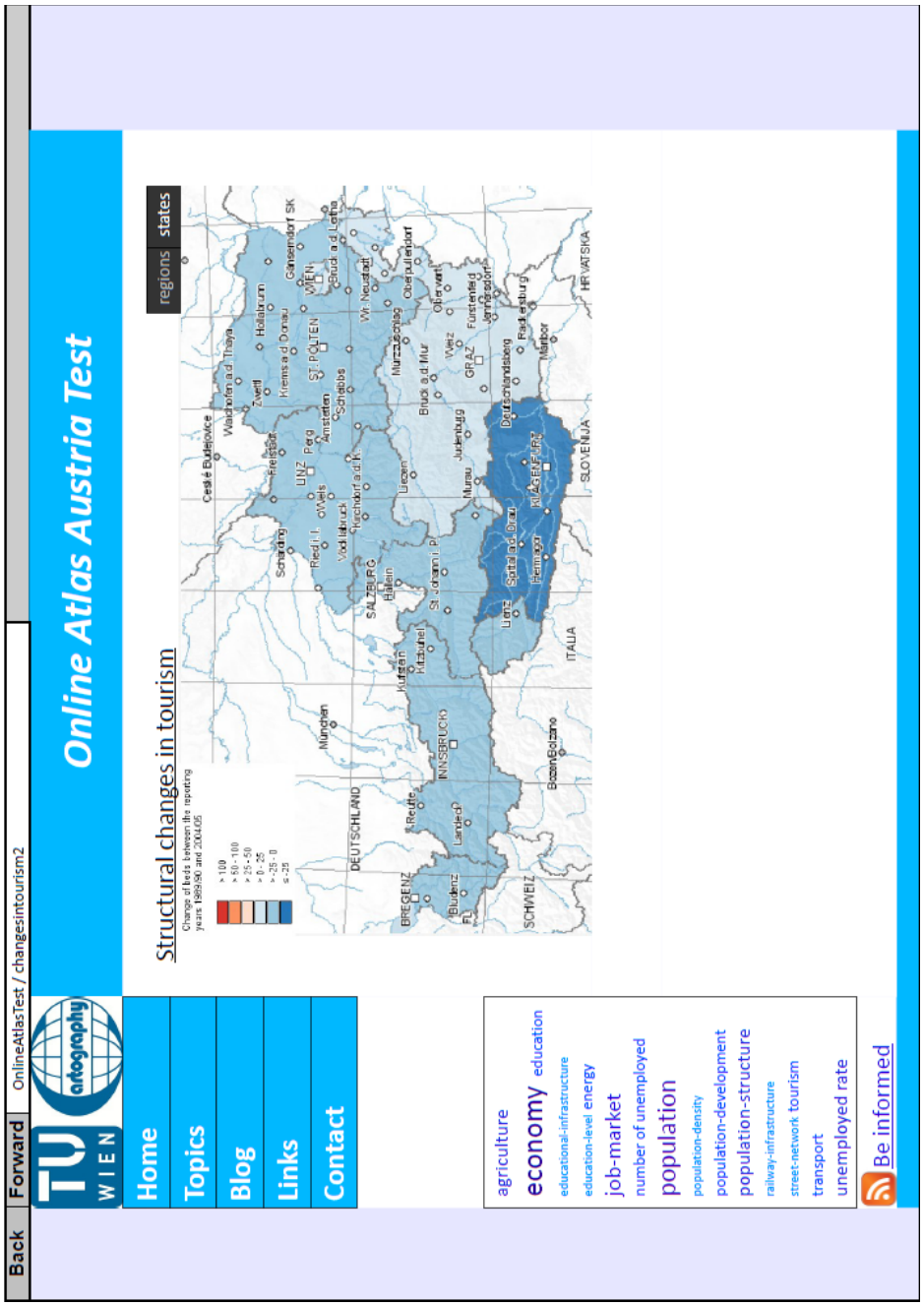

Figure 7.1: The interface for Task 1.

Task 2

Which municipality/s has the highest population density in Austria?

After this task, please access at least one more map which you like. You can access as many maps as you want…

Interface for Task 2

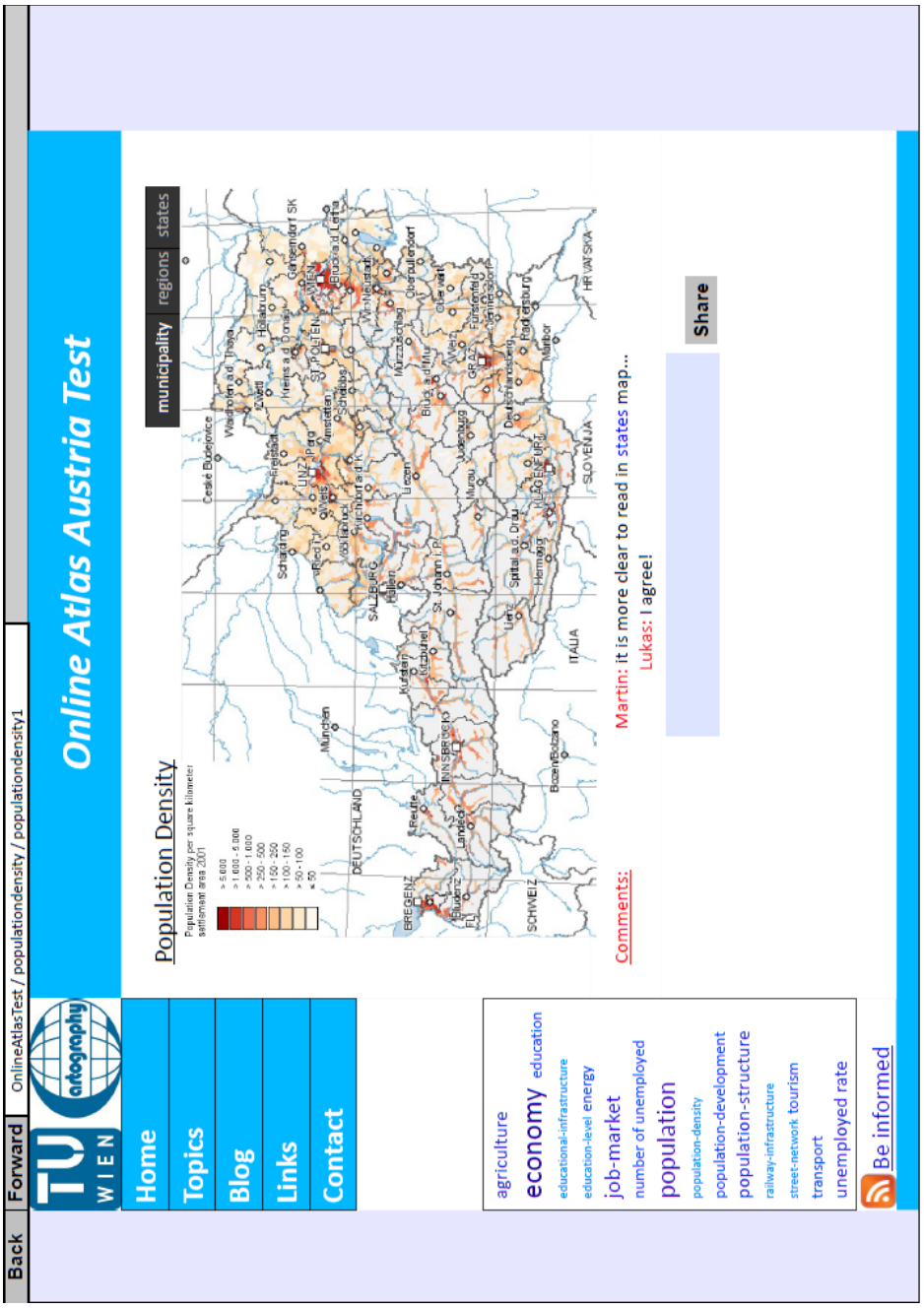

Figure 7.2: *The interface for Task 2.*

Task 3

Which regions have the lowest labor force participation rate in agriculture? (It is enough to show with the mouse cursor)

After this task, please access at least one more map which you like. You can access as many maps as you want…

Interface for Task 3

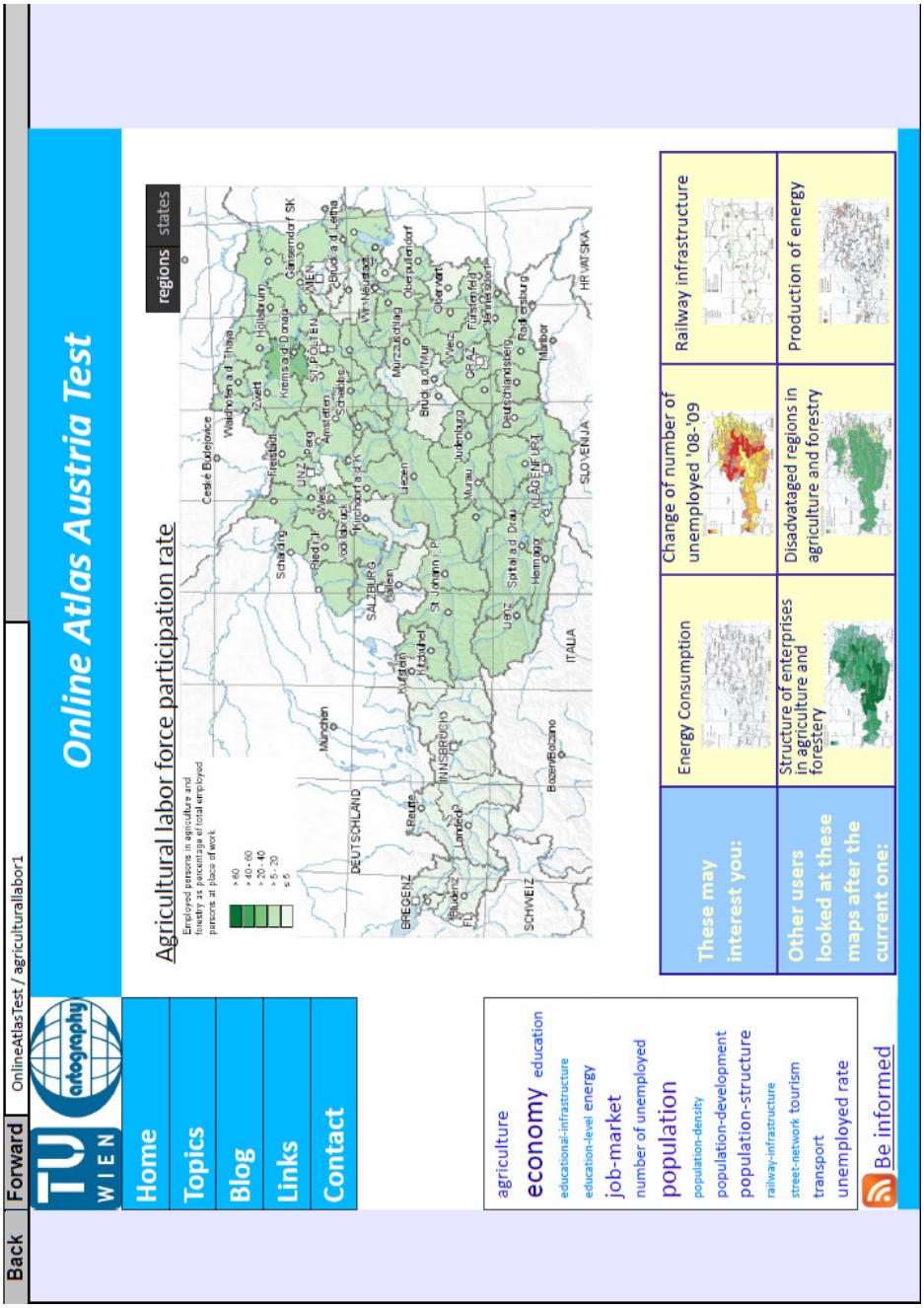

Figure 7.3: The interface for Task 3.

Task 4

In which regions do women have the most employment trouble?

After this, please access at least one more map which you like. You can access as many maps as you want…

Interface for Task 4

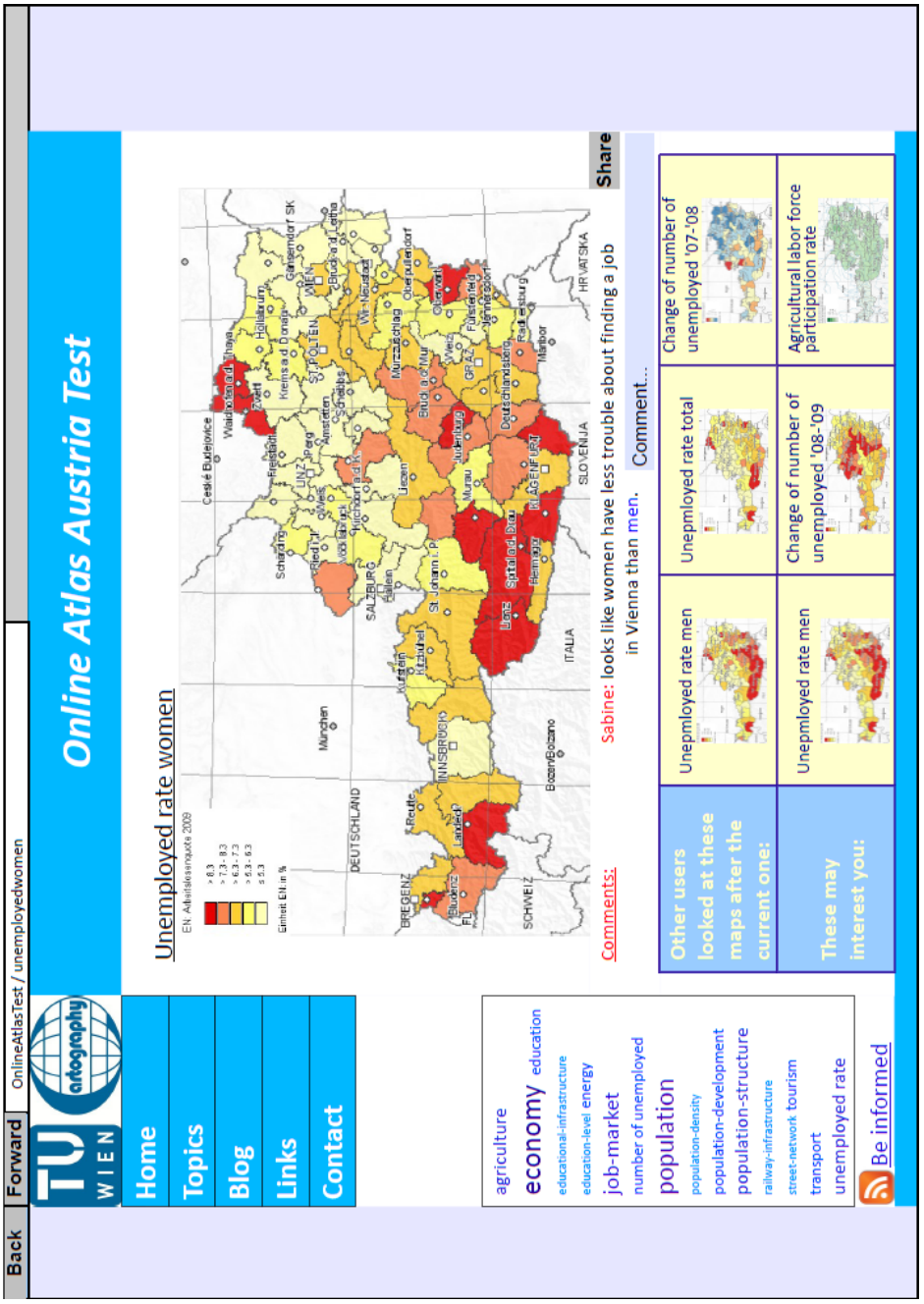

Figure 7.4: The interface for Task 4.

Task 5

Which state/s has the highest absolute population?

After this, please access at least one more map which you like. You can access as many maps as you want…

Interface for Task 5

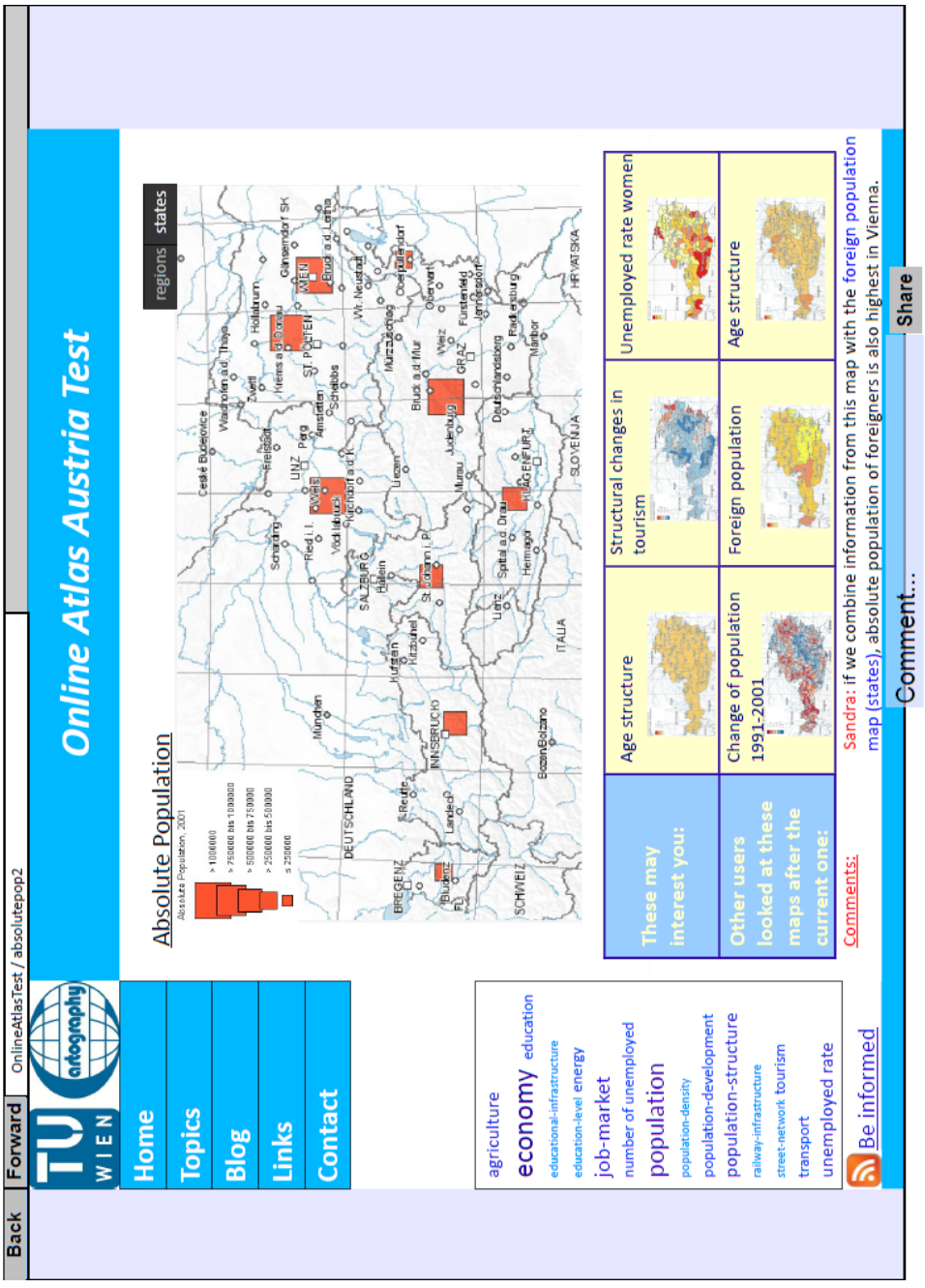

Figure 7.5: The interface for Task 5.