Gathering of Requirements on WebGIS Development – the Example of Bikeway Mapping Application

HANA KOPACKOVA, HANA JONASOVA, IVA MIKESOVA, JANA HEJLOVA
Institute of System Engineering and Informatics
Faculty of Economics and Administration,
University of Pardubice
Studentská 84, 532 10 Pardubice
CZECH REPUBLIC
Hana.Kopackova@upce.cz Hana.Jonasova@upce.cz

Abstract: - The article presents results of original research concerning proposal of WebGIS application with cycling topics. The main contribution of the proposal is in gathering of user requests on content and functionality. According to focus of this application, expected users will not have analytical and technical skills. Therefore the application needs to have user friendly interface, only limited amount of data and clearly defined functionality. Proposal of intended application is built on conceptual level so it is not dependent on the way of implementation.

Key-Words: - WebGIS, GIS, Mapping application, Requirements, Bikeway, Cyclist, Usability

1 Introduction

Geographic information systems (GIS) differ from WebGIS in many ways. Not only the remote access makes the difference, even necessary equipment and the experience of users distinguish these two technologies. The concept of Internet GIS or WebGIS is based on the usage of GIS and Internet technologies. Using the Web GIS, users do not need to purchase and install expensive GIS software in order to get spatial information. The WebGIS allows users to request a service, which includes data and analysis tools, from anywhere using the Internet. With the WebGIS it is possible to generate dynamic pages that support decision making onto topics of interest.

Classical GIS applications allow data editing, they can provide cartographic functions, complex spatial analyses, etc. On the other hand they suppose knowledge of geography, cartography, analytical skills, programming and more other [1], [7]. Although the usability of GIS products has improved significantly in recent years, they still require users to have considerable technical knowledge to operate them [13]. Due to this fact, non-expert users have problems mainly in navigation of an interface. Concepts and language that support the system’s architecture is not understandable for these users [3], [4], [5]. Usability testing of WebGIS applications, which is now in the center of concern of many groups of scientists, helps with building of user-centered applications [11], [6].

Papers concerning proposal of portal for cyclist can be found in large quantity and diverse quality, for example [12], [2]. Mostly they deal with implementation of such WebGIS application from the technical point of view. No or insufficient scope is given to gathering of users requirements. About what and how will be done in this application decide developers and managers of the application. The aim of our research [9] was to find users’ needs prior to creation of particular application.

2 Methodology of research

Within the scope of research were defined partial steps that had to be fulfilled: gathering of requirements, analysis and verification of results, specification of content and functions.

2.1 Requirements gathering

Collection of data was divided into two phases. Firstly, it was necessary to do a detailed analysis of the existing portal for cyclists, not only in the studied regions. The most used portals for cyclists of the Czech Republic, selected portals in Switzerland and Holland, were analyzed and compared. During the comparison, the accessible functions, accessible data layers of the points of interests, appearance of the user’s interfere and software solution were valued. The main reason was
finding the functions and data layers, which exist nowadays in portals for cyclists. On the basis of these analyses the criteria for suggested web application were formed and also the requirements on the data layers and functions, which respondents of the related questionnaire inquiry could choose from.

2.1.1 Structure of questionnaire
Information, which might be gained from the questionnaire inquiry, was divided into three groups:
- Information connected to the respondent – cyclist,
- Information oriented to functions of portal for cyclists,
- Information towards the required content of portal for cyclists.

First group of information about the person and customs of respondent – cyclist – was found out for better knowing of potential portal for cyclists users. The output of these pieces of knowledge should be categorization into certain group of cyclists according to the characteristics of each type of cyclists. The respondent should have also categorized himself/herself into the given group. This categorization was then compared to characteristics, which he/she mentioned. There were also put generalized questions such as age and gender of the respondent.

Other surveyed information was oriented to the functions of portal for cyclists, which potential users would need. The questions were asked to find out the functions which the respondent had already used and also assigned the rate of preference to the functions, which were found out at the existing portals for cyclists.

The last group of information was related to the content of the suggested portal for cyclists. It will be found out, which data layers of the points of interests could be useful and interesting for the users.

2.1.2 Specification of target group
The target group was the existing and also potential users of the web pages related to cycling.

2.1.3 Schedule and means of investigation
The method of anonymous, non-addressed written questioning for collection of data was used. In respect to the expected amount of respondents and expenses, the electronic version was chosen. It means that the questionnaire was put up at the existing portals for cyclists and web pages oriented to cycling. The other was an e-mail sent to inquire the logging in some of the portals for cyclists and filling in the questionnaire. Collection of data ran in April 2011.

2.2 Transformation of requirements into conceptual model of bikeway mapping tool
Requirements obtained in undertaken investigation will be sorted into three categories:
- data requests
- functionality requests
- preferred user interface

Requirements on functions will be demonstrated through the use case, user interface will be represented graphically.

3 Problem Solution
For the analysis were used 5 Czech regional and 3 national (CZ, Switzerland, Nederland) existing portals. Surveyed portals contained 15 functionalities and 32 data layers (each of them at least in one portal). The number of data layers was too high so the aggregation was necessary. At the end was created 13 cumulative data layers used in questionnaire inquiry.

3.1 Results of questionnaire
The questionnaire was tested on 5 respondents and questions were reformulated in order to acquire comprehensibility.

Total number of respondents (249) included 2 incomplete responses that were omitted. 247 questionnaires were used as a source of requirements.

115 of men and 123 women answered the questionnaire. The age of respondents varied; however most of them being 20-25 years old.

The questionnaire included 26 questions. Respondents were divided into two groups according to their answer about using bicycle Internet map applications in the past. First group answered 25 and the second group 19 questions.

Other classification of respondents was done according to type of cyclist:
- commuting cyclist
- long-distance cyclist
- less-experienced recreational cyclist
- more-experienced recreational cyclist
- racing cyclist
- MTB cyclist

As the results, were expected different responses for each group of cyclist and experienced/non-experienced users. More exactly, experienced users were supposed to have different needs of functions,
then people without knowledge of WebGIS. On the other side, differentiation of types of cyclists was initiated by the presumption that each group will have various requirements on data. These presumptions suggested the necessity of personalised webGIS application development.

In Table 1 are results of data selection based on the type of cyclist.

Table 1

<table>
<thead>
<tr>
<th>Name of data layer</th>
<th>Commuting cyclist</th>
<th>Long-distance cyclist</th>
<th>Less-experienced recreational cyclist</th>
<th>Racing cyclist</th>
<th>MTB cyclist</th>
<th>More-experienced recreational cyclist</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural attractions</td>
<td>12,5</td>
<td>12,5</td>
<td>12,5</td>
<td>13</td>
<td>12,5</td>
<td>13</td>
<td>12,67</td>
</tr>
<tr>
<td>Food refreshment</td>
<td>10,5</td>
<td>12,5</td>
<td>12,5</td>
<td>10,5</td>
<td>12,5</td>
<td>11</td>
<td>11,58</td>
</tr>
<tr>
<td>Monuments</td>
<td>12,5</td>
<td>10,5</td>
<td>11</td>
<td>10,5</td>
<td>10</td>
<td>12</td>
<td>11,08</td>
</tr>
<tr>
<td>Hiking trails</td>
<td>10,5</td>
<td>8</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>9</td>
<td>9,92</td>
</tr>
<tr>
<td>Swimming pools</td>
<td>8,5</td>
<td>8</td>
<td>10</td>
<td>8</td>
<td>8,5</td>
<td>10</td>
<td>8,83</td>
</tr>
<tr>
<td>Cycling infrastructure</td>
<td>8,5</td>
<td>10,5</td>
<td>8</td>
<td>6,5</td>
<td>7</td>
<td>8</td>
<td>8,08</td>
</tr>
<tr>
<td>Bus, train stops</td>
<td>7</td>
<td>4,5</td>
<td>7</td>
<td>6,5</td>
<td>8,5</td>
<td>4</td>
<td>6,25</td>
</tr>
<tr>
<td>Accommodation</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>6,00</td>
</tr>
<tr>
<td>Tourist information centre</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>5,83</td>
</tr>
<tr>
<td>Bike rent and bike service</td>
<td>4,5</td>
<td>4,5</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>3,67</td>
</tr>
<tr>
<td>Museums and galleries</td>
<td>4,5</td>
<td>2</td>
<td>3,5</td>
<td>1,5</td>
<td>2,5</td>
<td>5</td>
<td>3,42</td>
</tr>
<tr>
<td>Hospitals and pharmacy</td>
<td>1,5</td>
<td>2</td>
<td>2</td>
<td>1,5</td>
<td>1</td>
<td>2</td>
<td>2,00</td>
</tr>
<tr>
<td>Cinema</td>
<td>1,5</td>
<td>2</td>
<td>2</td>
<td>1,5</td>
<td>1</td>
<td>2</td>
<td>1,67</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Name of function</th>
<th>Users of WebGIS cycling portal previously?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Distance measuring between two points</td>
<td>1</td>
</tr>
<tr>
<td>Route searching</td>
<td>1</td>
</tr>
<tr>
<td>Map scale</td>
<td>2</td>
</tr>
<tr>
<td>Move to the preview of the whole map</td>
<td>2</td>
</tr>
<tr>
<td>Legend</td>
<td>2</td>
</tr>
<tr>
<td>Print</td>
<td>2</td>
</tr>
<tr>
<td>Move to last/next map display</td>
<td>2</td>
</tr>
<tr>
<td>Possibility of switch on/switch off data layers</td>
<td>2</td>
</tr>
<tr>
<td>Possibility to add point to the route</td>
<td>2</td>
</tr>
<tr>
<td>Search in the point neighbourhood</td>
<td>2</td>
</tr>
<tr>
<td>Display of altitude</td>
<td>2</td>
</tr>
<tr>
<td>Interactivity of points of interest</td>
<td>2</td>
</tr>
<tr>
<td>Small overview on the map</td>
<td>2</td>
</tr>
<tr>
<td>Help</td>
<td>3</td>
</tr>
<tr>
<td>Export into GPX</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 2 shows results of relevance of WebGIS functions according to users’ previous experience with such application. 80% of respondents used the WebGIS application in the past. Respondents evaluated single function using scale of 1-4 (1 being the most important). The score for each function was taken, obtained from users, and the median was counted.

As for being the less important were selected two functions; help and export into GPX. Nevertheless these functions cannot be omitted as useless. Help is necessary function that must be available for all users. The choice of help function was probably affected by the fact that 80% of respondents had previous experience with WebGIS application. That is why they do not use help function. Export into GPX format is perceived as useless because our respondents (78% of them) do not use GPS. However, cyclists using GPS system need this function so we decided keep all functions in the proposal of bikeway mapping tool.

Table 2 disprove previous expectations that users without WebGIS experience will have different requirements about functions. Counted medians are absolutely the same.

Obtained results, presented in Table 1 and Table 2, show that it will not be necessary to create personalized form of WebGIS application.

3.2 Transformation of requirements into conceptual model of bikeway mapping tool

Data model created upon user requests determines the content of bikeway mapping tool. As the default layer will be used basic raster hiking map (for example SHOCart) which can be switched over satellite map for example Google. This solution
is accepted to be adequate for the cyclist portal. Important line data layers that will be displayed are two:
- Bikeways
- Hiking trails
Point data layers (points of interest) were selected according to Table 1, so the layer cinema and hospitals was omitted. Order of layers respect users preferences.
- Natural attractions
- Food
- refreshment
- Monuments
- Hiking trails
- Swimming pools
- Cycling infrastructure
- Bus, train stops
- Accommodation
- Tourist information centre
- Bike rent and bike service
- Museums and galleries
Next requirement, concerning data model, deals with interactivity of points of interest. Respondents expressed the interest to have information about points available in tooltips (pop up table). The information should contain basic information, photography, hyperlink to the web site and the possibility to add this point into route (by clicking or as an entry into geodatabase). Necessary condition to fulfill this requirement is to have quality database of points of interest.
Specification of content of WebGIS application was not the only task in this research. The same importance was given to selection of necessary functions. According to Table 2, use case diagram was created for specific functions for this application (bikeways mapping).
The Actor is the user of web application. Use case which is labeled with stereotype <<include>> is covered in superior use case. This stereotype allow repeating use of one use case. Superior use case would be incomplete without this included use case. Stereotype <<extend>> is used for extension of the use case and its application is voluntary. [10]
In the Fig. 1 is the use case of WebGIS application functions.

**Fig. 1: Use case of bikeway mapping tool**
Last task in the research was concentrated on the proposal of user-centered interface. In the Fig. 2 can be seen the result. The name of map is placed on the top with blue color. Search field and help are placed right below the headline. In the third line are functions of the WebGIS and the scroll menu with the type of map. Selection of points of interest is enabled in the left where is the field with checkboxes. This field can be partially hidden with the button „Zájmové body“(points of interest). Only two data layers will stay displayed „Cyklotrasy“(Bikeways) and „Turistické trasy“(Hiking trails). Below this field is placed small overview helping users with orientation. The biggest part of the screen occupies the map field with the scale in the right bottom corner. On the right side are buttons for scale down/scale up and movements of the map. The legend is placed on the right side. In this field there will also be displayed results from the route planning. Other functionalities cover:

- scale down/scale up through mouse wheel
- movements on the map through drag and drop function.

Final user interface is given in Fig. 2.

![Fig. 2: Final user interface of bikeway mapping tool](image)

### 4 Conclusion

WebGIS applications as well as other web pages should be intuitive, understandable and self-explaining so users can use it without thinking [8]. These applications are focused on non-expert users so the interface, functionality and the amount of data should be different from desktop application for experts. In this article we reported the research concentrated on requirements gathering from the end users in order to propose user-centered WebGIS application. As the result of questionnaire we obtained answers on what data, functionality and user interface is demanded. All requirements were analyzed and transformed into conceptual model.

### 5 Acknowledgement

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### References:


