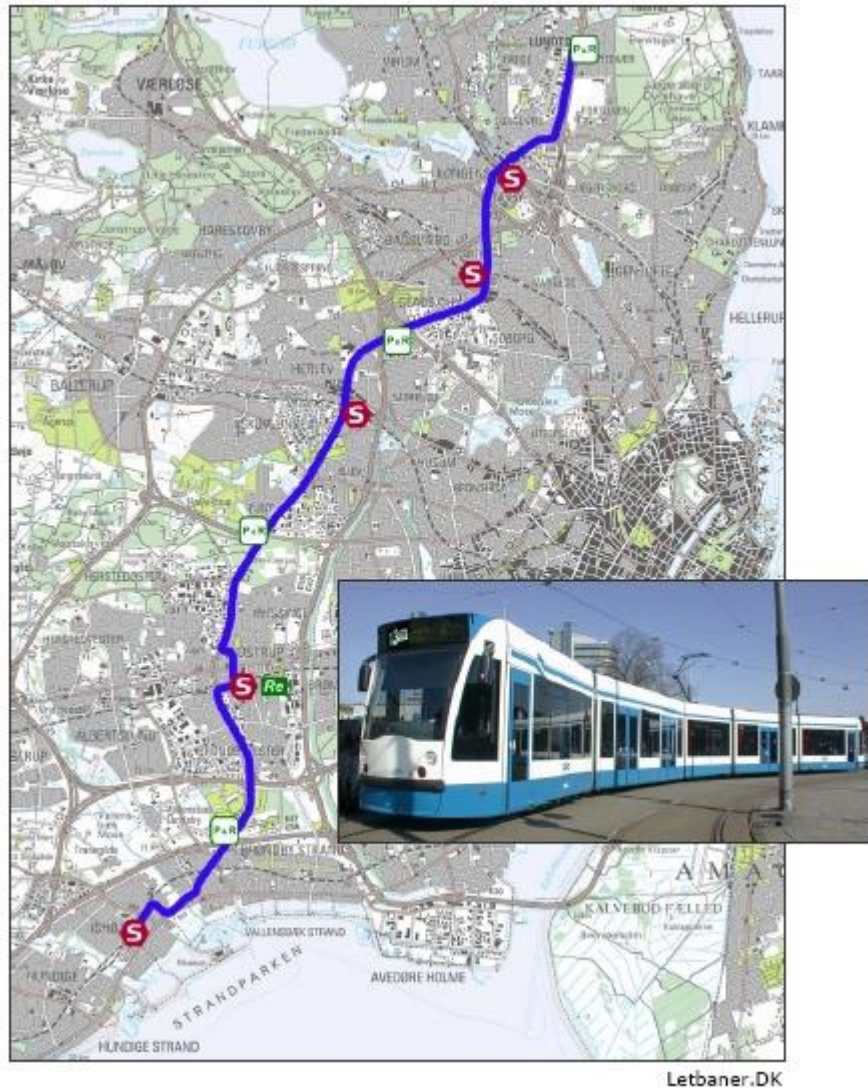




Online public participation and GIS systems

- Proposed solution to a PPGIS system for the “Ring 3” light rail proposal.



Aalborg University Copenhagen

Department of Chartered Surveyors

8. Semester GTM

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Semester: 8. Semester GTM

Title:

Online public participation and GIS systems

- Proposed solution to a PPGIS system for the “Ring 3” light rail proposal.

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Abstract:

With the evolution of internet technology, it has become possible to create public participation over the internet. This project proposes a public participation GIS system, to handle the public participation issues regarding a suggested light rail solution following “Ring 3” west of Copenhagen.

The solution is based on open source software, and uses the possibilities from Google maps as data background, making it expandable and free to use for any case.

Through the development of the application it became clear, that in order to create a successful solution, several key elements was required.

The solution had to be user friendly, to enable the broad public to participate, but also had to offer advanced functions for the trained users. Furthermore the solution had to be technologically secure, to avoid unintended use of the system.

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8. Semester Project 2008

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1 Introduction

With the ever growing focus on reducing car pollution, more and more resources are being put into analysing the need of expanding the public transportation network. The only way to make the citizens leave their cars behind is to provide functional and adequate public transportations means, which the users can rely on.

The infrastructure around Copenhagen has been focused on trains, metro and busses in the later part of the 20.th century. The use of light-rail was cancelled in Copenhagen in the 70's, and no such has been in use since.

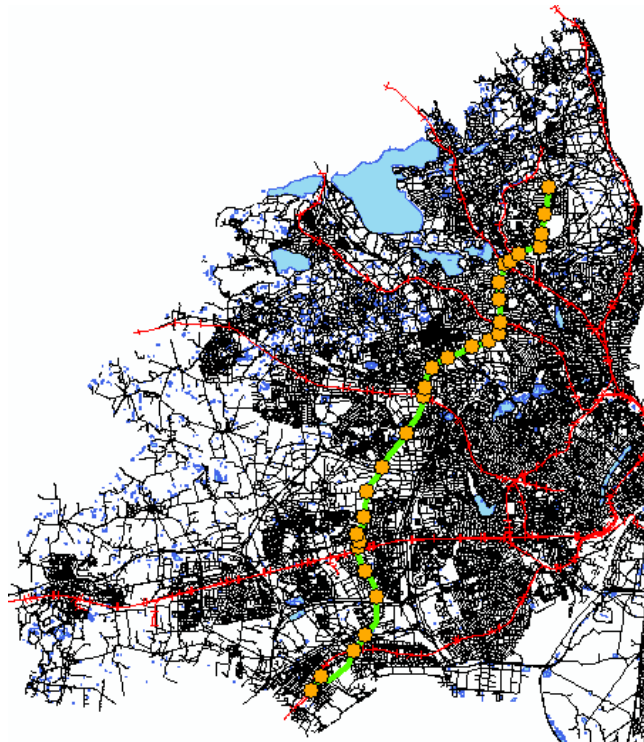


Figure 1 – GIS map of the proposed rail. Source: Aau Geodata library

The pressure on the road network has although been ever increasing since, and this is putting severe restraints on the bus solutions, since this no longer is considered a fast way of transportation.

The infrastructure system around Copenhagen relies on busses to create connections between the 'fingers' of the S-train lines.

Several different proposals has suggested to create new light-rail systems to replace these busses following 'Ring 3' from Brøndby over Herlev to Lyngby – and one of these proposals is now looking like a realistic implementable solution (See figure 1)

The project is today still only a proposal, but the involved municipalities have made a joint statement to work go on with this plan.

Since it is still only a proposal, improvements and suggestions can still be made, regarding all aspects of the process – and a public hearing process could be conducted

The change in the municipality structure had put a temporary pause on the work, but it is now brought back to life by the municipalities, and the many interest organisations working in favour of this proposal

The goal of the project is to evaluate the implementation of a public participation GIS (PPGIS) solution to facilitate public debate about the proposal, where the public can publish and discuss topics and analysis – to create public awareness regarding the proposal.

The result of the project should be a practical and theoretical proposal to implement PPGIS to this case. The goal is that the system must be able to work with a forum solution, where the public can view and discuss the proposal, or study analysis results created by them selves or others.

2 Problem statement

In 1992 the Rio convention opened the environmental debate in public, creating awareness about collective responsibility. With the Aarhus convention 6 years later, the public was granted right to interact in the decision process through public participation. Alongside the development of public participation, the use of computers and online technologies has exploded into something that is almost impossible to live without in the western world today. Almost every household has got at least one computer, and the number of people connected to the internet by high-speed internet connections is growing daily.

The development of GIS systems has benefited from the general technological development, by implementing new concepts as they became technologically possible. In the early 1990 the GIS users was limited to desktop operations on their own computers, working on local projects. With the development of the internet technology, the way of working with GIS changed as well. Today the term distributed GIS covers a wide variety of services working together over the internet. The key elements of these services are that multiple users can share and exchange data freely and thereby benefit from the work of others.

In recent years most of the Danish municipalities has integrated GIS into their online solutions by having a map service on their respective homepages. These are clickable interactive solutions, where the users can see and create thematic maps of their municipality. In this respect the GIS services are available to the public today, but the interactions are limited to being distribution of information only.

The next big step in distributed GIS solutions and public participation is to join these two strong concepts together into one solution, where the public can interact with the municipalities or government through strong online PPGIS solutions.

In Denmark there has only been a limited number of attempts to create PPGIS solutions, so it is a new and relatively untested framework. This means that there is a lack of collective experience, meaning that creating such a system must be done from scratch in a learning process

This project will concentrate on describing the creation of such a PPGIS system, to analyse which components are required, and how the interactions can be conducted in such a system.

This will result in a proposed PPGIS solution to facilitate the debate regarding the case-study. The proposal will evaluate the technological, theoretical and functional aspects of such a PPGIS solution

This main problem of the assignment will be answering the following question :

How can a public participation GIS system be established to facilitate debate regarding the proposal?

To answer this question, the content of the problem must be subdivided into some more concrete questions, in order to make the results more concrete.

2.1 Research questions

1. What are the technological problems of implementing such a solution?

This question will be answered through the actual application. What are the technological bottlenecks regarding interface, security etc.

2. What defines a good PPGIS solution?

Answering this question will be an abbreviation of two aspects. First the design of the system and the technical issues from the previous question, and secondly how user friendly is it to the public. What is required to create a successful PPGIS process

3. How can analysis results be implemented in the solutions to support the decision process

This question will be answered by demonstrating how the solutions functions in terms of publishing the results calculated. Furthermore examples of relevant analysis will be described.

4. How is it possible to design the solution using free software and maps.

This question will be answered by describing a possible setup that will work as PPGIS solution based on free components. The interactions and platforms of the software will be described and tested.

By answering all of these questions, it should be possible to propose a sound framework for an online PPGIS solution, which would be suitable to facilitate debate about such a proposal such as the Ring 3 project. Furthermore the proposed framework will take the different types of users into consideration, making it usable without much prior knowledge.

3 Methodology

The following paragraph will explain the method used to create the elements of the theory and method chapters.

The overall structure of the two chapters can be seen in figure 2.

The theory chapter will be divided into five overall sections. The section ‘evolution of the internet’ is primarily based on courses from the 7. semester, describing the development of internet technology in the past decades. The chapter ‘Internet GIS’ is a run-through of the current state of development of internet GIS technology, and standardization of geographic data. This section is based on the 7. Semester course ‘Distributed GIS’ and the course about SDI in this semester.

The remaining three sections ‘Public participation’, ‘Decision making’ and ‘Public participation GIS’ are all based on the SDSS course from this semester, presenting the history and methodology for Public participation GIS solutions.

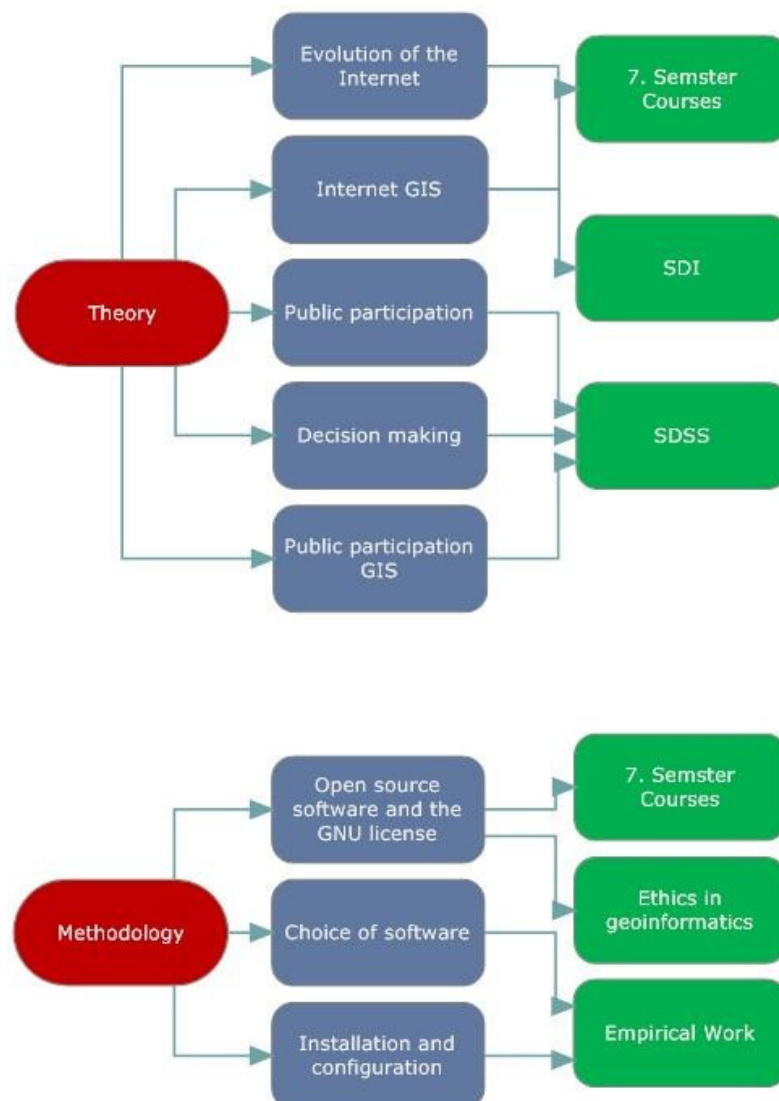


Figure 2 - Methodology tree

In the methodology chapter the descriptions of the choices regarding the software for the application will be described. The section ‘Open source software and the GNU license’ is based on teachings from the 7. Semester, and the ‘Ethics in Geoinformatics’ course from this semester. The ‘Choice of software’ and ‘Installation and configuration’ sections are based only on empirical work, where testing and evaluating software has been the main task.

4 Product presentation.

The product that should be the outcome of this project, is based on a framework proposed by Rinner in 1999 called “Argumentation maps” The idea is to create discussions with a spatial dimension. Each argumentation element should be created with a specific spatial reference to a point or area of interest in a map. The idea is to create a forum solution with an integrated map dimension, so that maps become an integrated part of the discussion. Furthermore the solution should be able to handle the exchange of content between users, so that tools, results and data can be shared within the online community. Figure 3 shows my preliminary draft to the solution

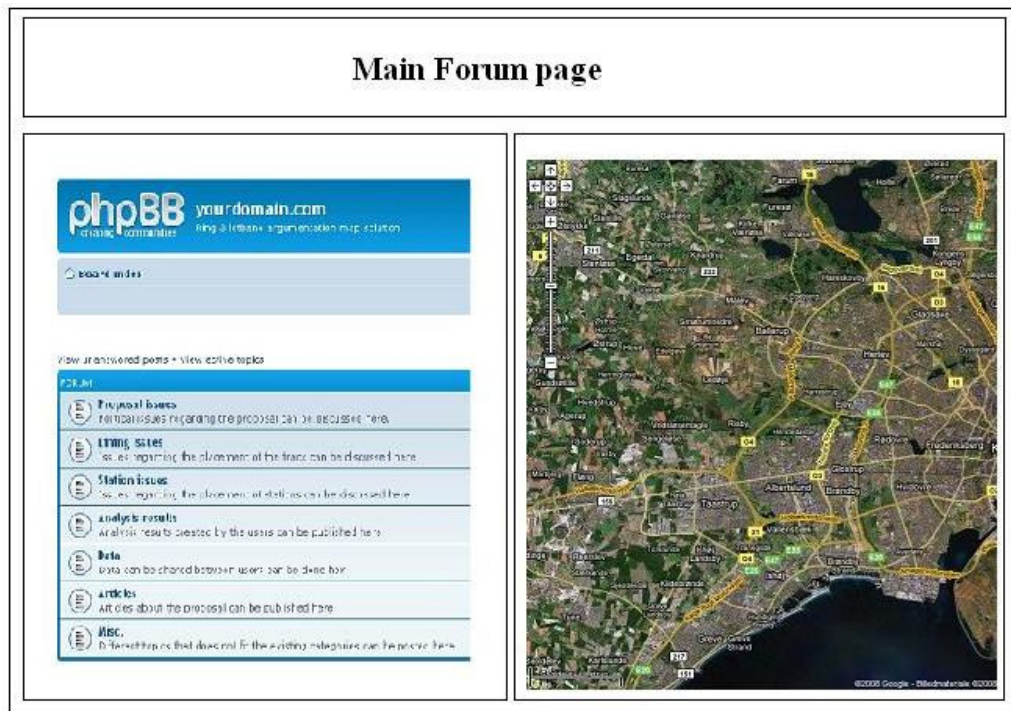


Figure 3 - Preliminary product description

To achieve this I will need to have a running database solution along side a web server, to handle the queries to the database. All of this must be integrated into one standard internet HTML page, with a user-friendly and simple interface.

5 Theory

Chapter introduction

This chapter contains the theory regarding the topics that must be discussed in order to solve the problem statement and answer the research questions.

The chapter will begin with a short look at internet technology to support the following paragraph about internet GIS. This will explain the basic interactions of network structure and internet GIS solutions and explain about client server architecture and interactions between different server types.

Since internet GIS is largely focused on exchanging data and results, a paragraph regarding standardization of geographic data will describe the ways in which geographic data is standardized.

The next parts will be concerning the history and development of public participation in recent years, and means to evaluate degrees of participation will be exemplified here. Furthermore the process of decision making will be examined, giving examples of methods to achieve the best solution to a public participation problem.

Finally all these parts will be integrated into collaborative GIS or public participation GIS, where users can interact in the decision process using the internet as means to debate issues, with a spatial dimension. The concept argumentation mapping, that will be the main focus of this assignment, will be presented here.

5.1 Evolution of the Internet.

The internet or the World Wide Web is a huge collection of databases, servers and applications that enables the user to access services from resources connected to the internet. The main exchange of information over the internet is done through HTML documents and hyperlinks, making it possible for the users to exchange documents, images, graphics and much more.

The use of the internet has become increasingly more widespread with the evolution of technology. With the ever growing number of households having access to unlimited high-speed internet, the influence of internet technology has increased. The general public today can use and access internet services with only a minimum understanding of the underlying structures – and internet surfing, e-trading and online banking has become central parts of everyday life.

The foundation of the internet as we know it today was laid when the US. Department of defence adapted the Transmission Control Protocol / Internet Protocol (TCP/IP) to their decentralized network structures in the 1980's. The development of networking infrastructure and the transmission protocol successfully pushed telecommunication into a new era. Some 30 years later this protocol is still the backbone of internet communications, being used by millions of people every day. (Peng & Tsou 2003)

In the last ten years the way in which the users access the internet has changed dramatically. In the 90's the dominant way of accessing the internet was through a dialup connection, with very limited bandwidth. Today most users have a broadband connection providing them with some quite heavy bandwidths. This means that the users are capable of receiving many services through their internet connection, and is able to browse through large amounts of information every day.

5.2 GIS and the internet

The evolution of the internet was also adapted by the GIS community, looking to take advantage of the many possibilities that the technological development has produced. The internet enables the GIS user to access and share data with other users, to search for applications, and to exchange results and services.

The development has taken the GIS users from working on local workstations with no outside interaction, to sharing data over local networks. With the latest technology, the GIS users are able to use distributed services over the internet.

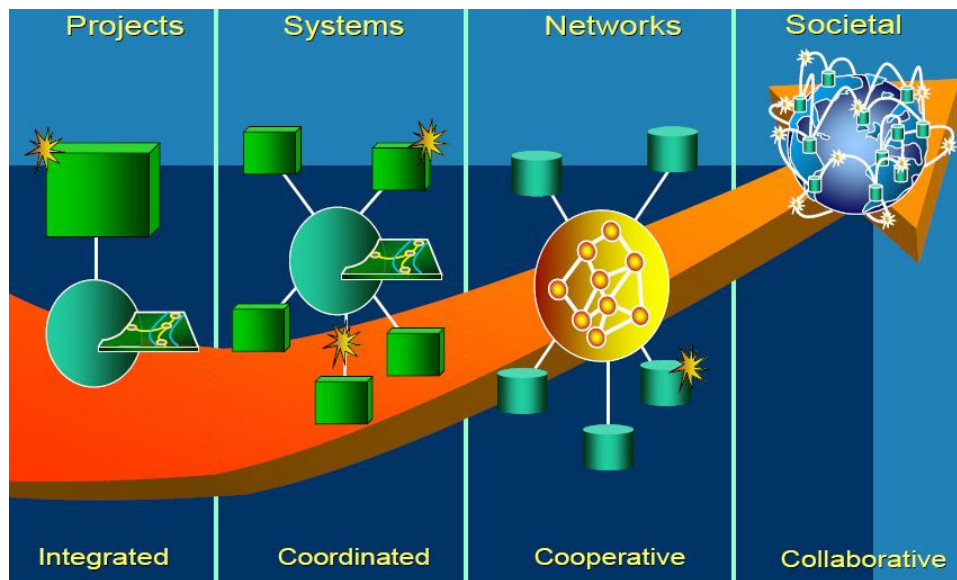


Figure 4 - Development of internet GIS Source: Hansen 2008 Nr.2

Figure 4 exemplifies the development that the use of GIS software has undertaken. At the project level, there was only one user working on one project, having no connection or exchange of data. At the systems level, the project has been expanded, so that many users now are working on the same project, sharing the information regarding the project.

At the Network level, the user is now represented as a database, linked to many projects. This means that there is exchange of data and knowledge between many users that can benefit from data and solutions from other parties on the network.

At the final stage, which represents the frontier of internet GIS today, the societal level, the use and exchange of data and services are now global through the internet - enabling the user to access data and tools, from whoever might provide them.

The term distributed GIS referees to exchange of data, results, computer calculation power, or even sharing programming on other computers.

Distributed GIS Systems applies server/client communication over networks to perform different GIS analysis tasks and assignments.

Today several different notations are used, to describe different ways of approaching internet GIS solutions:.

- Internet GIS – The framework of network based GIS, which uses the Internet to access data and geoprocessing tools.
- Distributed GIS – A broader framework including Internet and mobile GIS solutions, and emphasizes the software characteristics of the solutions.

- Distributed GIServices – Focuses on the on-line process of the task oriented Internet GIS application.

(Peng & Tsou 2003)

The basic interactions in an Internet GIS solution is a solution where a server performs the job of sending either a finished analysis result or the data back to the client. The client will then depending on the approach selected, either carry out the analysis on the local computer, or simply visualize the results that were obtained from the server.

A client is categorized by the amount of processing that is carried out on the local computer. A thin client is a solution where all the processing is carried out on the server side, and the only local job is the visualization of the result.

The opposite is then a thick client, where the data and analysis tools are obtained from the server, but is processed and rendered at the local computer.

In short, distributed GIS utilizes the Internet and other networks to access and transmit different types of data and applications, conduct analysis, and to create presentations of GIS data.

In general, GIS on the internet using client/server architecture consists of three components, which are very similar to most other web services:

- Client
- Application server
- Data Server

The system uses a n-tier client/server model, where one client connect to many different server types, for example a client could connect to one application server, that gathers information and data from several map and data servers which is returned to the client. (Peng & Tsou 2003)

5.2.1 The Client

On the client, the user interacts with the system, in creating different kinds of analysis, and uses resources from the Internet GIS.

The client usually consists of some sort of user interface (or graphical user interface GUI) – in solutions today, the interface is often made from dynamic web interfaces that uses the web technology of Hyper text transfer protocol (HTTP) or Dynamic HTML (DHTML).

- Standard HTTP offers very little user interaction – it is most suitable for displaying graphics from the server in a thin client solution.
- DHTML enables more dynamic user interaction by using JavaScript or Visual basic scripts, which for instances enables user to draw objects or dragging a box around selected objects.

The client uses browser plug-ins to extend the functionality of the browser. A plug-in is a piece of software that runs directly in the browser, giving the user different analysis and selection functions. In this way, several analysis tasks can be carried out on the client side by receiving a task specific tool from the sever, that conducts only the task that the client has requested. (Peng & Tsou 2003)

5.2.2 The Application server

The web server or application server is basically the HTTP server, which main function is to answer calls from the browser and request data from other servers via HTTP. The interaction from the web server can be done in several ways:

- By sending ready-made Hyper Text Mark-up Language (HTML) document or map to the browser.
- By sending application specific applets to the web browser.
- By passing requests to other Common Gateway Interface (CGI) applications, that could process the request further.

5.2.3 The Data server

The database handles the raw data in a relational or non-relational database structure. The application server or the client can then access the data and conduct queries in the data through structured query language (SQL).

The map server accesses the database through a middleware program, that translates the SQL query into the database specific SQL-dialect that is used. The main middleware components are:

- ODBC (Open database connectivity)
- JDBC (Java database connection)
- OLE DB (Object linking and embedding database)
- ADO (ActiveX data object)

Typically the data server is hosted together with the website that it supports, so that the transaction of data is handled in the same location as the application server is located. The request to a database is today often handled by a pre-processor, since it seldom is the actual HTML document that accesses the database. In the examples given above, the Java or active X applets will work as the pre-processors of the data. Other solutions today can be based on many different scripting languages, but the most common ones is the languages that is easily available – like for example PreHypertext processor (PHP). (Hall & Leahy 2006)

The structure of this described internet GIS solution is very similar to ordinary internet workflow. The programmes that are incorporated might not be standard components installed on the clients computers, but the way that the interactions are carried out is based on standard internet communication.

In order to make internet GIS solutions work together across projects, some standardization of the data is required to make the use and reuse of data as simple as possible

5.3 Standardization of geographic data

With the ever growing exchange of data and services, the need to standardise geographic data has become more and more necessary.

The interaction between users can be disturbed by differences in the way that data are created, but to minimize the effect of these problems, standards for geographic data has been created.

Today there are two main sets of standards available for GIS data. The two organizations that provide the standards are the Open GIS Consortium (OGC) and the International Organization for Standardization (ISO). A standard is a formal framework for working with and distributing different sorts of geospatial data, and its metadata to facilitate interoperability between data and software solutions.

The approach of the two organizations varies a little, and the descriptions of them are as stated by Peng & Tsou:

“The main goals of OGC are the full integration of geospatial data and geoprocessing resources into mainstream computing and the widespread use of interoperable geoprocessing software and geographic data products throughout the information infrastructure.” (Peng & Tsou 2003; 257)

“ISO/TC 211 Emphasizes a service-oriented view of geoprocessing technology and a balanced concern for information application and system” (Peng & Tsou 2003; 257)

The two organizations are thus closely linked together, since it is the OGC groundwork that is implemented in the ISO standards.

In the European Union, the Standards from ISO are turned into law by CEN, meaning that the governments and public sector of the European countries must apply with the standards.

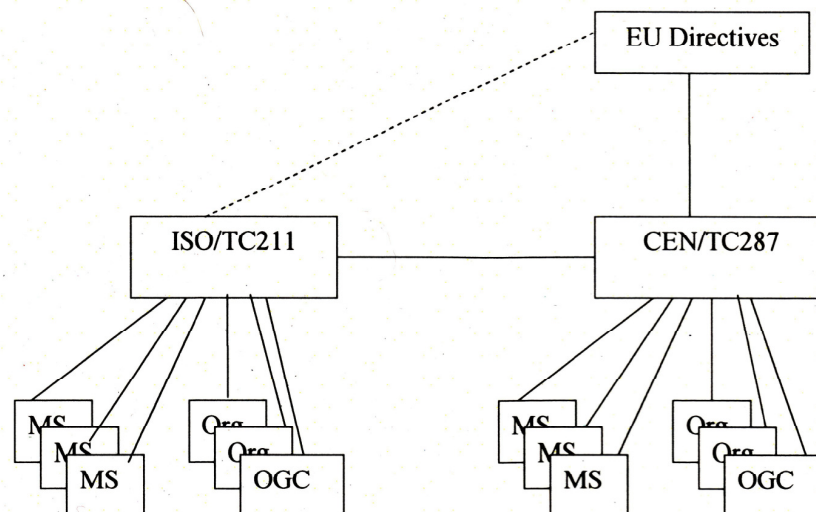


Figure 5 - Interactions between the standardization bodies Source: Hjelmager 2008

Figure 5 shows how a standard is implemented in the European Union. Beneath ISO and CEN, there is the input from the member states, and from OGC. The work is then passed either from ISO to CEN, or directly from CEN to become a directive.

The work of the organizations has created a set of specifications for handling GIS data over the internet. The two specifications will be evaluated in the following paragraphs.

5.3.1 OpenGIS specifications

The OpenGIS specification defines a framework for distributed access to data and geoprocessing resources. The specification includes an abstract specification and a series of implementation specifications for varying distributed computing platforms such as e.g. Java and SQL. The use of OpenGIS standards will enable a software producer to create interoperable distributed GIS solutions, which can access data from different resources within a generic computing interface within an open technology foundation. (Peng & Tsou 2003)

The content of the OpenGIS specification can be divided into three categories:

- OpenGIS model (OGM) – Provides a common object based programming model or method
- OpenGIS services – Defines a set of programs or services needed to access and process data defined in the OGM.
- Information community's model – Collects the OGM and the OpenGIS services into a schema to facilitate exchange between different geographic feature exicos.

(Peng & Tsou 2003)

The OGM provides a common means for digitally representing the earth and earth phenomena mathematically and conceptually. OpenGIS services implement the access to geographic data and the ability to manipulate, share and representation of data between information communities. (Peng & Tsou 2003)

5.3.2 ISO /TC 211 Specifications

ISO / TC 211 are short for the technical committee of geographical information/ Geomatics from the ISO with the main task of creating a family of geographic information standards that is compatible with the other ISO standards.

The ISO geographical standard is known as the ISO 15046 Standard, and it specifies methods, tools and services for data management, processing, analysis, accessing, presenting, and transferring data in digital form between users and locations. (Peng & Tsou 2003)

The ISO standards deliver a framework for descriptions and management of geospatial information and services.

The framework is based on 5 areas to incorporate standardization into geographic data:

- The Framework and reference model – Identifies how components work together. Provides a common basis for data sharing and communication
- Geographic information services – Defines the encoding of information in transfer formats and the methodology for cartographic presentation of geographic information
- Data administration – Focuses on the description of quality principles and quality evaluation
- Data models and operators – Are concerned with the underlying geometry of the globe and how geographic elements can be modelled.
- Profiles and functional standards – Considers the techniques of putting together packages/ subsets of the total sets of standards.

Both specification sets aim to solve the problems of interoperability and interaction between applications, and even though both frameworks deliver broad solutions, several problems need to be addressed in the future, to develop a true distributed GIS architecture for the future. Several issues regarding cross-platform standards, communication platforms and collaborations between software producers, should be addressed in future work in producing a general applying standard for distributed GIS services. (Hansen 2008 Nr. 1)

With the availability of internet and GIS technology, distributed GIS solutions are being implemented into more and more projects and workflows today. The use of the systems is though still limited to people with some GIScience background. Most Danish municipalities have interactive internet GIS portals, where the public can see visualization of geographic data. This is done by implementing network and data structures like the ones described above.

The user sees an applet connected to the data server or map server, that sends the map back to the user for visualization - but there are no interactions with the user in terms of use of the data. (HSH lecture notes)

Public participation GIS today faces the task of integrating the internet and the GIS technology into simple packages that the average user can use, to gain information. The solution must be as simple as possible, but remain strong in functionality – and integrated into a package that is well documented.

To focus on GIS solutions made for public participation, the focus must first be turned towards the participation process, and how group decisions can be made.

5.4 Public participation

With the growing availability of the internet as distributor of information, the possibility for the public to interact and participate has increased.

The public can now retrieve data and information regarding planning and legislation issues interesting for them.

This means that they can elaborate and comment on proposals, a phenomenon called public participation.

The roots of public participation goes back to the late 60'ties, where citizens for the first time became involved in government processes. This was done by creating flyers and posters, where the general public could read about ongoing work.

This way of distribution information was used up until the early 90's, where the focus on public participation changed.

Previously it was very hard to get public involvement in the participation process. If the project did not have a direct personal impact on the people, they did not want to get involved.

This focus changed around the early 90's when focus on the environment increased – creating a new awareness of the fact that participation in environmental issues was required. (Hansen 2008 Nr. 2)

From the Rio declaration it was stated that:

“Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making

processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.”

(Rio declaration 1992)

Alongside this, the Aarhus convention a few years later, granted the public access and rights to view information:

“The Aarhus Convention grants the public rights and imposes on public authorities obligations regarding access to information and public participation as well as access to justice”

(Aarhus convention 1998)

The Aarhus convention had three main elements:

1. Allowing the public greater access to information held by public authorities
2. Providing means to express opinions and concerns of environmental issues
3. Public right to review procedures when the right to participation has been violated.

(Aarhus convention 1998)

On these frameworks, the public participation of today is build. The goal is to expand the rights of the public, and get a broader spectrum of the public involved in the processes by giving them a higher degree of responsibility in their local areas. (Hansen 2008 Nr. 2)

The processes should ideally be created so, that there is no predefined result scenario imposed on the public, but instead the resulting proposal should be defined by two-way communication between the public and the government.

To evaluate the level of public participation, Arnstein (1969) created a latter consisting of eight steps, used to describe the participation in different cases.

In its original form, the ladder looked like this:

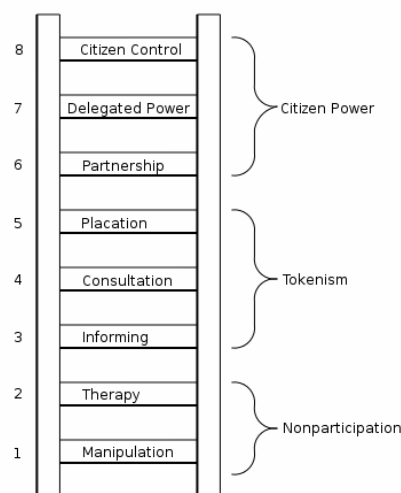


Figure 6 - Participation ladder Source: Arnstein 1969

The bottom steps of the ladder are (1) Manipulation and (2) Therapy. These two steps describe levels of "non-participation" that have been misunderstood to substitute for genuine participation.

Rungs 3 and 4 progress to levels of "tokenism" that allow the have-nots to hear and to have a voice: (3) Informing and (4) Consultation. When they are proffered by power holders as the total extent of participation, citizens may indeed hear and be heard. But under these conditions they lack the possibility of insuring that their views actually will play a part in the process. When participation is restricted to these levels, there is no follow-through, no power which means no assurance of that status quo will be changed.

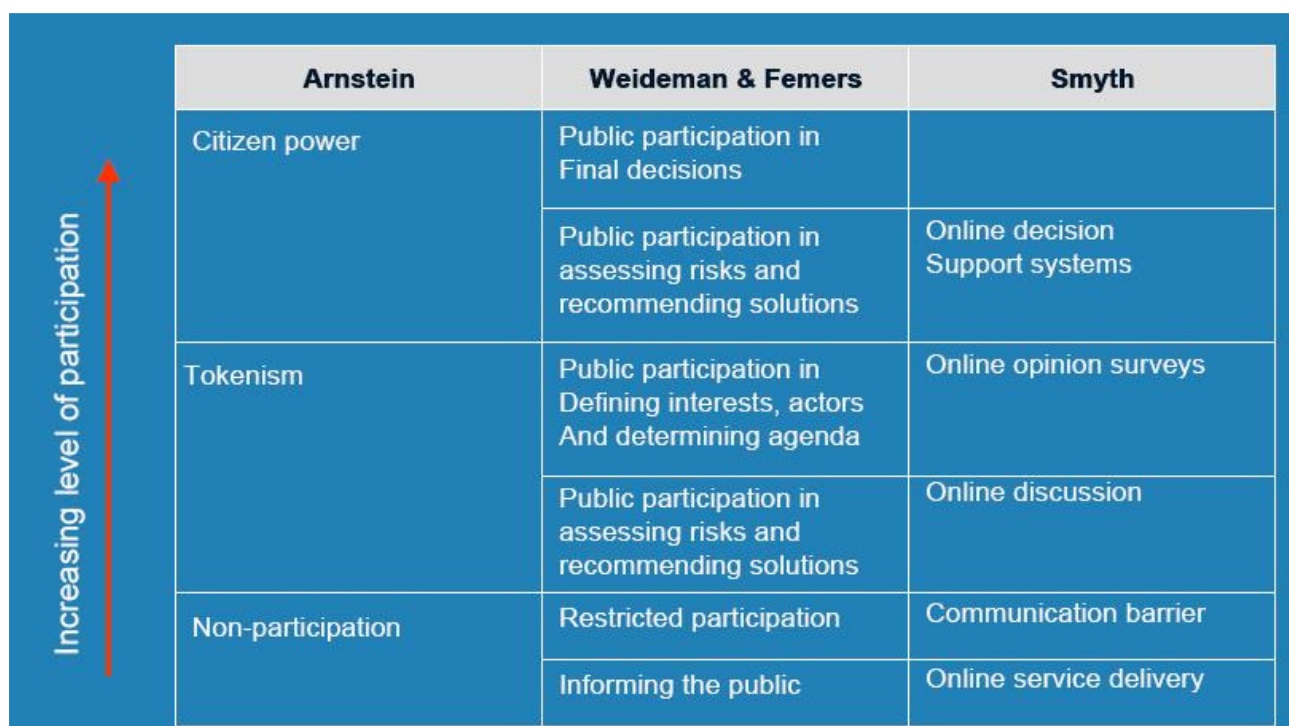
Step five Placation, is simply a higher level tokenism because the ground rules allow have-nots to advice, but retain for the power holders the continued right to decide.

Further up the ladder are levels of citizen power with increasing degrees of real influence in the process. Citizens can enter into step six, Partnership that enables them to negotiate and engage in trade-offs with traditional power holders.

At the highest steps, Delegated Power and Citizen Control, citizens obtain the majority of decision-making seats or full managerial power. (Arnstein, 1969)

The ladder has been re-edited several times since, to adapt to the new conditions of society. The later revisions were done by Wiedeman & Femers in 1993 and by Smyth in 2001.

Figure 7 shows the elaborations of the thoughts of Arnstein adopted by the later revisions



	Arnstein	Weideman & Femers	Smyth
Citizen power		Public participation in Final decisions	
		Public participation in assessing risks and recommending solutions	Online decision Support systems
Tokenism		Public participation in Defining interests, actors And determining agenda	Online opinion surveys
		Public participation in assessing risks and recommending solutions	Online discussion
Non-participation		Restricted participation	Communication barrier
		Informing the public	Online service delivery

Figure 7 - The development of the participation ladder Source: Hansen 2008 Nr. 2

The modifications made by Weidemans and Femers adopts the terms for Arnstein to the elaborate the definitions into clearer relationships between the public and the government. Finally Smyth upgrades the framework to handle the internet and internet technology. At the lower levels, the systems are only created to distribute information. At the higher levels, the public participation

grows by adding discussions, and at the highest level, it involved the public in actual online decision support systems.

5.5 Decision making

The goal of public participation is of course to be able to select the best solution to a certain problem, while making sure that it is reasonable. Therefore the actual decision making process must also be subdivided to understand the process of evaluating a decision.

A well known model for supporting decision processes was created by Simon in 1978. The model is divided into four phases through which planning goes:

1. Intelligence phase
2. Design phase
3. Choice Phase
4. Implementation phase

(Simon 1978)

The intelligence phase is where the project is being created. The current status is analysed and the room and benefits for making the change is evaluated to understand the demands and specifications of the task.

In the design phase, the actual creation of scenarios is carried out. Several different solutions must be created in order to determine which one is the best and most suitable. The decision is then made in the choice phase and carried out in the implementation phase. The interactions of the model can be seen in figure 8:

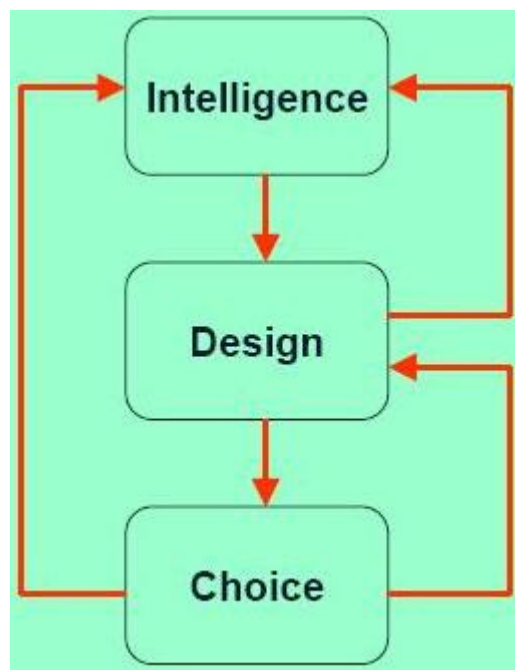


Figure 8 - Decision model Source: Hansen 2008 Nr. 2

The intelligence phase results in a number of designs, which in turn will lead to a decision if the solution is acceptable. At any stage the process can be turned around by taking one step back if the

solution is not optimal. Finally if the choice is not optimal based on the intelligence, then the process must start over. Once the choice is made, the process can move on to the final implementation phase

The core of the decision making process is that there is a set of alternatives, where one has to be chosen. There will always be more than one option to a problem, because the ability to do nothing always exists. (Hansen 2008 Nr. 2)

When making a decision, several things must be taken in to consideration. In a public planning process this could for example be:

- Technical issues – Is it possible within the framework of the project?
- Economic issues – Can we afford it?
- Environmental issues – What is the impact on the environment?
- Social issues – is it socially sound?
- Sustainability issues – Can the project be undone?
- Artistic issues – How will it look and blend in?
- Political issues – Do we need it?

The task is then to integrate all of these issues into the best choice. The problem with any decision is that there always will be different interest from different participants, making it difficult to reach agreement towards what is the best solution.

In order to be able to make the right decision, serious argumentation must be applied to be able to explain the problems addressed and to reason the decisions made.

Many proposed models for group decisions have been proposed over time, building on planning theory. Examples of these have been:

- Brainstorming
- Stakeholder involvement
- SWOT analysis
- Delphi

These are all different methods applied to collaborative GIS solutions today, in numerous forms and ways.

5.5.1 Brainstorming

Brainstorming is a group creativity process designed to generate a large number of ideas to solve a Problem. There are four basic rules in brainstorming. The expected result is a dynamic synergy that will dramatically increase the creativity of the group. The rules are:

1. Focus on quantity: This rule is a mean of creating different ideas, aiming to facilitate problem solving through the maxim: quantity breeds quality. The assumption is that the greater the number of ideas generated, the greater is the chance of producing a radical and effective solution.
2. No criticism: It is often emphasized that in group brainstorming, criticism should be put 'on hold'. Instead of immediately stating what might be wrong with an idea, the participants

focus on extending or adding to it, reserving criticism for a later 'critical stage' of the process. By suspending judgment, one creates a supportive atmosphere where participants feel free to generate unusual ideas.

3. Unusual ideas are welcome: To get a good and long list of ideas, unusual ideas are welcomed. They may open new ways of thinking and provide better solutions than regular ideas. They can be generated by looking from another perspective or setting aside assumptions.
4. Combine and improve ideas: Good ideas can be combined to form a single very good idea, as suggested by the slogan " $1+1=3$ ". This approach is assumed to lead to better and more complete ideas than merely generating new ideas alone. It is believed to stimulate the building of ideas by a process of association.
(Osborn, 1963)

5.5.2 Stakeholder involvement

Traditionally the term stakeholder theory identifies and models the groups which are stakeholders of a corporations, and both describes and recommends methods by which management can give due regard to the interests of those groups.

Modified to suit all planning purposes, the term stakeholders is adopted to mean all interested parties is under influence of the decision made. This can be the individuals, directly influenced by proximity to the project discussed, the interest groups working in the area, the corporations located in the area, and the organizations working for different causes.

The goal is to choose the relevant stakeholders for the decision process. It is not implied that all stakeholders should have the same weight in the process, so the degree of interest and involvement must be determined for all parties, in order to get the appropriate stakeholders.

(NEA 2004)

5.5.3 SWOT analysis

SWOT analysis is an approach that can be used to identify the potential risk and rewards of a scenario or a result in the decision process. The four aspects that must be evaluated are:

- **Strengths:** attributes of the project that is helpful to achieving the objective.
- **Weaknesses:** attributes of the project that is harmful to achieving the objective.
- **Opportunities:** conditions that is helpful to achieving the objective.
- **Threats:** conditions that are harmful to achieving the objective



Figure 9 - SWOT analysis Source: Wikipedia

Figure 9 shows the grouping of the evaluated aspects. There are helpful and harmful factors as well as internal or external factors in this evaluation model.

The SWOT analysis is a helpful tool to determine the causes and effects of implementing a scenario, and if the analysis is conducted thoroughly, it should be able to answer how the strengths can be used, the weaknesses be stopped, the opportunities be exploited, and how we can defend against the threads.

5.5.4 Delphi method

The Delphi method was originally developed to forecast the development of warfare in relation to technology during the cold war. The participant in the survey was asked to prompt their opinion on the probabilities of an outcome, while the other members anonymously could contribute with comments. This process was then repeated several times, until a consensus was reached.

Today this framework is adopted as a participatory group tool for negotiations, building on the individual's judgment and opinions.

Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.

(Linestone & Turoff 2002)

The spectrum of cases where Delphi is applied today is broad, since it can be adapted to any group decision case – but normally the reasons to choose Delphi lies in the properties of the project:

- The problem does not lead to precise analytical techniques but can benefit from subjective judgments on a collective basis
- The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise
- More individuals are needed than can effectively interact in a face-to-face exchange

- Time and cost make frequent group meetings infeasible
- The efficiency of face-to-face meetings can be increased by a supplemental group communication process
- Disagreements among individuals are so severe or politically unpalatable
- The heterogeneity of the participants must be preserved to assure validity of the results, i.e., avoidance of domination by quantity or by strength of personality ("bandwagon effect")
(Linestone & Turoff 2002)

The reason why this method has been so widely adopted is because of the simplicity in use. But to succeed with the Delphi method, the problems addressed need to be very well defined in order to create good group consensus.

All of these methods can be combined and used to facilitate good debate and create consensus about a proposal. Even though the methods might not be implemented in their full form, it is these variations of analyzing and working with problems, which should be an ideal approach to public decision making.

5.6 Public participation GIS

Having discussed the internet GIS technology, the public participation aspects and the analytical approaches to collaboration, these elements can be joined together into Public participation GIS

The first elaboration of PPGIS that will be discussed, is the term spatial decision support systems (SDSS)

An SDSS is an interactive, computer based system made to optimize the effectiveness of solving decision problems.

The basic functions of SDSS can be grouped into:

- Exploring solutions by evaluation alternatives
- Enabling interaction and input
- Providing analysis and data exchange capabilities.

The SDSS software is designed to:

1. Solve structured and unstructured problems
2. Combine analytical models with data storage and retrieval functions
3. Appear user friendly to all with minimum of prior knowledge
4. Be flexible and expandable to other scenarios or processes.

The term SDSS has been developed since the 50's. It started out as Decision support systems (DSS), and evolved during the 70's and 80's into SDSS systems, integrating the spatial dimension into the framework. (Hansen 2008 Nr. 2)

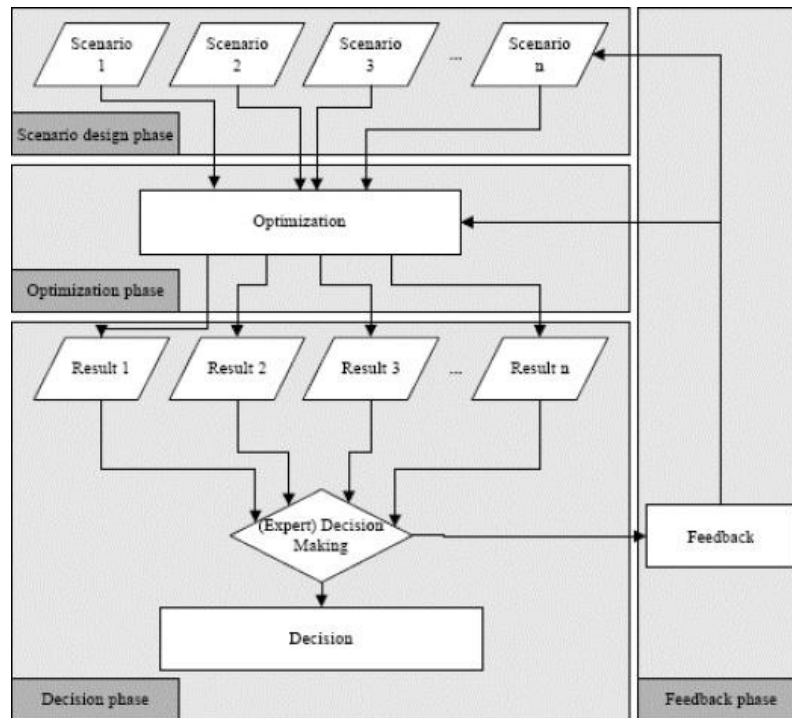


Figure 10 SDSS process Source: HSH

Figure 10 shows the workflow of a SDSS model based on the work on Simon. The work starts out in the scenario phase with the design of any number of scenarios. As mentioned previously, any idea will always have at least two scenarios – the suggested change and the ‘do-nothing’ scenario, where nothing is changed. The next phase then involves the optimization of the scenarios into a number of results. These results will be the foundation of the actual decision. If a decision can not be made on basis of the results, the process must start over by refining the scenarios or the results. (Hansen 2008 Nr. 2)

The growth in research, development and applications has increased rapidly over the last 10 years, and with the evolution of internet and web GIS, the focus has been on linking the GIS services to the SDSS systems.

This has resulted in many new ideas for spatial collaboration systems, being collaborative SDSS, group SDSS, Environmental DSS, and Public participation GIS (PPGIS) Hence the difference in names, the threads are all related to the same type of topics and solutions.

The traditional GIS solutions have very limited capabilities to support the interactions of the design and choice phase of the process. The effort to effectively create real spatial support systems, which integrates the SDSS solutions with the GIS technology, has grown fast over the last years.

The definition of collaborative PPGIS systems that will be focused on in this assignment is:

“An eclectic integration of theories, tools, and technologies focusing on, but not limited to structuring human participation in group spatial decision processes”

(Hansen 2008 Nr. 2)

This definition states the central issues of collaborative GIS solutions, and the essence of the field today. Many new technologies emerge constantly, and these are to be integrated to aid the decision process. Here the technology will be working together with planning and GIS theory, using the newest tools available to give the group of participants the best possible basis for making decisions on.

5.6.1 Groupware Technologies

To support and empower the collaboration amongst parties in a decision process, several different types of groupware tools has been developed. Most of them have roots in ordinary communication, and are working in many different solutions on the internet today.

These groupware tools can be divided into three categories:

1. Information sharing and exchange of ideas.
2. Interactive group decision support
3. Workflow process coordination

5.6.2 Information sharing and exchange of ideas

These types of services are often based on ordinary email service. The strengths of the email correspondence is the ability to locate senders, receivers, and topics, collected in the inboxes of the participants. This means that the transaction history can be easily understood, if the process needs to be reversed.

The email is also very simple to incorporate into any type of system, since the client side technology to send and receive emails is quite simple.

Live chat or messaging services is often built directly on top of an email service. The messaging system exchanges the messages as email through a client. Other solutions use direct transmission through chat channels or pipes.

The common thing is that the messenger services enable two or more users to discuss options in real time, or to seek inspirations from group members. (Li 2006)

5.6.3 Interactive group decision support

These types of decision support tools extend the functionality away from just being exchange of messages.

In most online forum solutions on the internet today, several functions exist providing extended functionality to group decision processes.

One function could be the ability to post ordinary topics where the contributors can reply. Furthermore it should be able to handle voting directly in the threads, and support whiteboard functions, exchange of data and documents. (Li 2006)

5.6.4 Workflow process coordination

Theses types of systems could for example be Content Management Systems (CMS) used to handle and sort information and contents for the group. The system allows joint document folders, email notifications upon news, joint calendar and many other functions.

A good working collaborative GIS system should be able to handle many of these aspects in order, to make the exchange of ideas simple and flexible. But to make the final transaction towards collaborative PPGIS, a spatial dimension needs to be attached, to facilitate the creation of maps and analysis.

An example of the implementation could be done using a spatial version of the Delphi method.

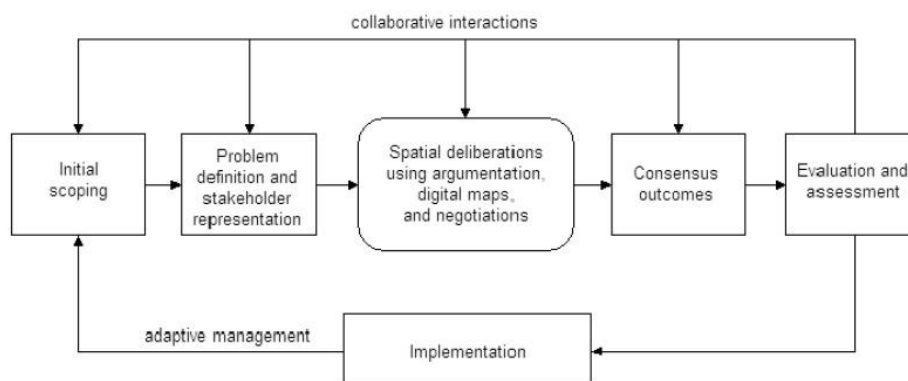


Figure 11 - Spatial Delphi Source: HSH

Figure 11 shows the workflow of this approach. The argumentation is now done using maps and spatial arguments instead of just ordinary argumentation methods. The rest of the decision process is similar to the previously discussed methods, but the way of arguing has changed. (Hansen 2008 Nr. 2)

Peng 2001 suggested a framework for PPGIS solutions, where the efforts to extend functionality to the public could be evaluated for any type of internet solution.



Figure 12 - PPGIS framework Source: Hansen 2008 Nr. 2

Figure 12 shows the framework of Peng 2001. Any collaborative GIS solution can be evaluated after this graph. At the upper left corner, the type of service that is provided is that of a general webpage, where the information level is low, and the abilities to interact is minimal. At the lower right corner, the user is provided with analysis tools to create their own scenarios and or calculate new results. Between these two points the level of service provided to the users increase, but the

demands to the user also increase, since it requires increasingly more skills to take advantage of the high level of service at the bottom right corner. (Hansen 2008 Nr. 2)

Since public participation GIS and collaborative GIS solutions is a relatively new field, much work is being put into developing new ideas and extend functionality.

The main focus in this assignment will be on the argumentation map framework, which integrates maps, debate and data sharing/analysis into one model for collaborative and public participation GIS

5.7 Argumentation maps.

The concept of argumentation maps was proposed by Rinner in 1999 to support the planning processes, and to create a framework for spatial argumentation. The idea is to combine an online discussion forum with an online GIS part, where the threads are linked to geographic locations.

The argumentation map (argumap) model breaks a discussion down into structured parts using the forum solution, and makes a direct link to a map area or object. The type of maps (e.g. Raster or vector maps) has no substantial importance in this matter, since the argument will be associated with an object in the map, and not the map itself. The goal is to make the linking between the arguments and the map a powerful tool for analytical functions and navigation for the stakeholders in the planning process (Rinner 1999)

There are three main components of an argumap solution. At first the users who want to discuss the topics use maps and map elements, secondly the forum solution handling the posting of topics, and third, the GIS solution handling the drawing and rendering of maps. In figure 13 the model for the argumap interaction is shown

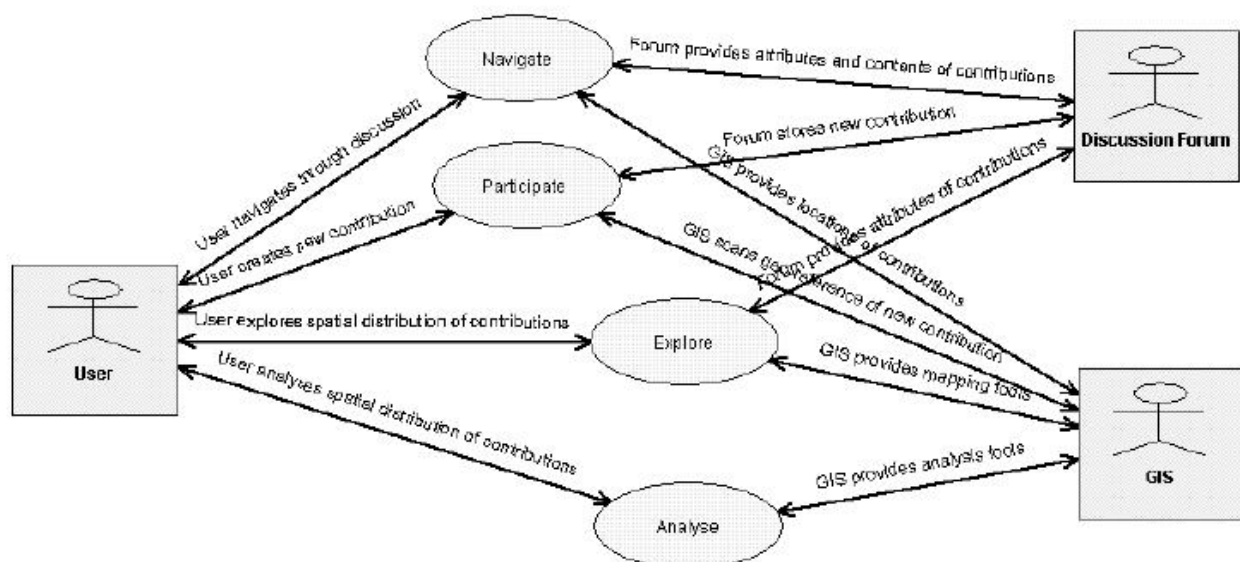


Figure 13 - Argumap interactions Source: Rinner 1999

The user can navigate through existing discussions, create new contributions, explore spatial distributions of existing distributions, or analyse further on existing contributions. The forum provides attributes to the participants, by storing and handling old and new contributions and the GIS tools provides the rendering capabilities and or analysis tools to the users. (Rinner 1999)

The model for the argumentation model is shown in figure 14

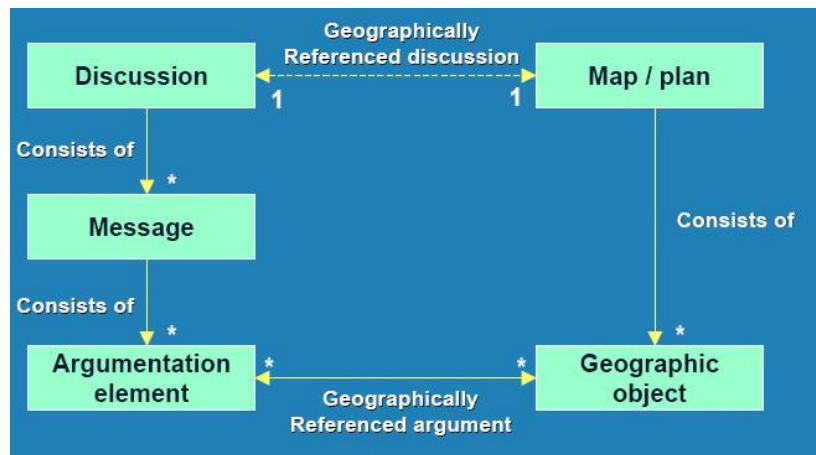


Figure 14 - Argumentation model Source: Hansen 2008 Nr. 2

The figure shows how the discussion elements and the messages are all linked to the geographic objects. The initial plan has a map foundation that the users can see and use, and all commenting on the forum is broken down into argumentation elements having a geographic dimension. (Rinner 2006)

The argumap framework is a good suggested solution to creating a Public participation or collaborative GIS solution giving the users the abilities to create more nuanced discussions on better foundations through the visualization of the maps. If the argumap solution should be place within the framework of Peng 2001, the solution would be located at the lower right part of the figure. Argumaps enables the sharing of data, and probably also analysis tools, which gives the user power to create their own scenarios, and exchange maps.

Many other suggested solutions exists, but very few are actually developed and functional, which means that the implementation has not been done or haven't been successful. Unfortunately I haven't been able to locate a true working implementation of the argumentation map idea – so the goal of this assignment will be to try and implement these ideas.

6 Method

6.1 Introduction

This chapter will be focused on the prerequisites to implement an argumentation map solution in the internet.

One of the primary strengths of the solution that is going to be created is, that it is build on open source software and is platform independent. This means, that it runs on any operating system today, such as Linux, Mac OS or Windows.

The operating choice of this assignment is though still Windows XP, since it is the was made for practical reasons – but of course Giox Linux provided by Jan Kolar, could have provided me with the same options.

The framework for open source software, is characterized by being released under GNU like conditions, in terms of rights use and edit code. The next paragraph will shortly describe the GNU license, since it is a key concept in open source software

6.2 Open source software and the GNU license

GNU is a computer operating system composed entirely of free software development of GNU was initiated by Richard Stallman and was the original focus of the Free software foundation (FSF).

The project to develop GNU is known as the GNU project, and programs released under the auspices of the GNU Project are called GNU packages or GNU programs.

GNU is in active development. Although most components have been completed long ago and have been in production use for a decade or more, its official kernel, Gnu Hurd, is incomplete and not all GNU components works along with it.

For this reason, most GNU users and users of GNU programs use the third-party Linux Kernel..

The GNU General Public License (GPL), the GNU Lesser General Public License (LGPL), and the GNU Free Documentation License (GFDL) were written for GNU, but are today used by many unrelated projects.

The GNU General Public License (GPL) is a widely used free software license, originally written by Richard Stallman for the GNU project. It is the license under which the Linux kernel is released. The GPL is said to grant the recipients of a computer program the rights of the free software definition and uses the term “copyleft” to ensure the freedoms are preserved, even when the program is changed.

The original GPL was based on a unification of similar licenses used for early versions of GNU Emacs, the GNU Debugger and the GNU Compiler Collection. These licenses contained similar provisions to the modern GPL but were specific to each program. Stallman's goal was to produce one license that could be used for any project, still maintaining the possibility for many projects to share code.

Observers believe that the strong “copyleft” provided by the GPL was crucial to the success of Linux, giving the programmers who contributed to it the confidence that their work would benefit the whole world and remain free, rather than being exploited by software companies not having to give anything back to the community. (GNU)

6.3 Choice of software

Under the open source framework, there are many different options when the user has to choose software. As described in the theory chapter, three components must be chosen:

1. Data server
2. Pre-hypertext interpreter
3. Web server.

The desired structure of components in this assignment can be seen on the E-R diagram in figure 15.

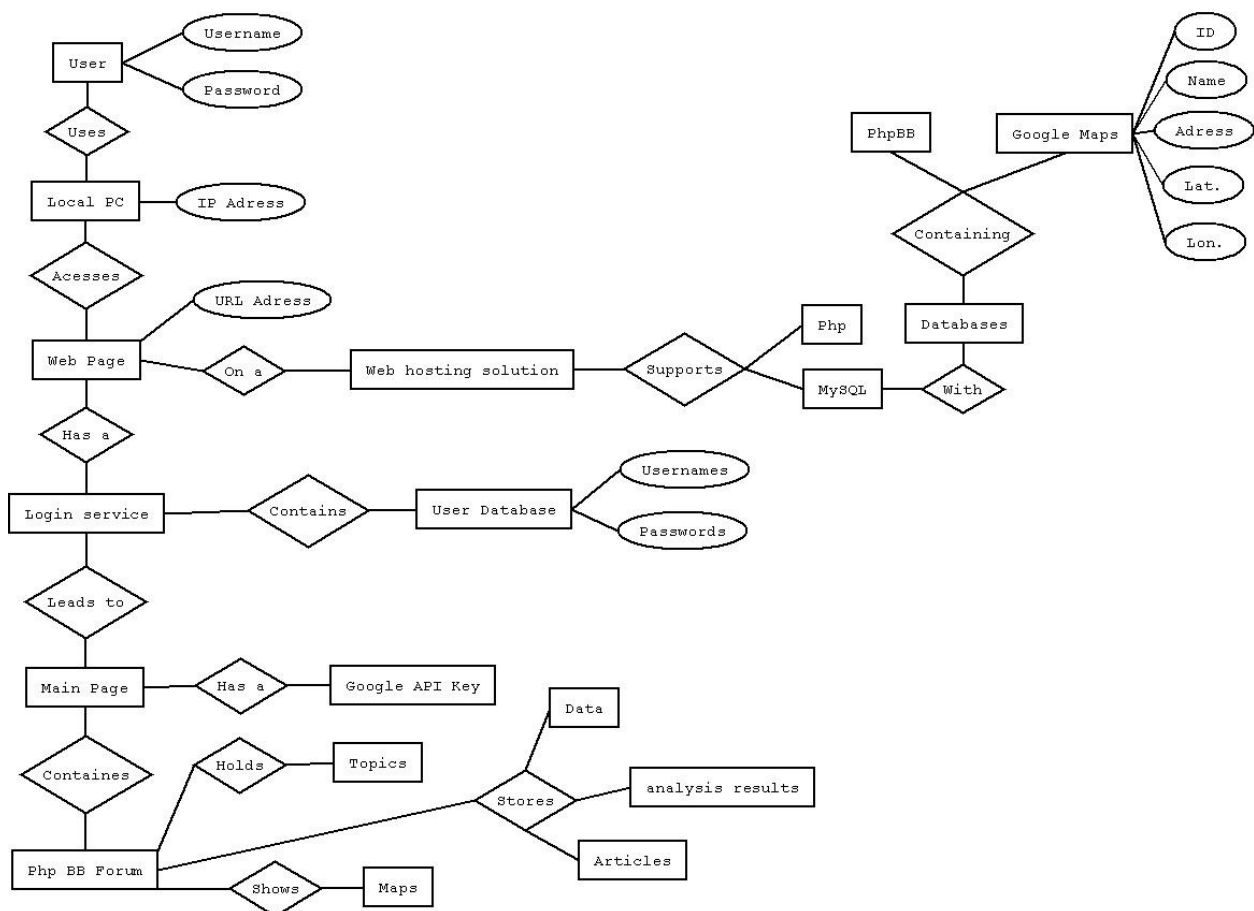


Figure 15 - E-R Diagram of the project

The following paragraphs will be a presentation of the software chosen for the tasks, reasons for the choice of exactly this software, and finally a general description of how the software is available. Furthermore it will be explained how the software components work together to form the interactions of the E-R diagram.

6.3.1 Dataserver

The data server in this construction is the free database solution Mysql. This software was chosen because it is widely used on the internet today, and many webhosting sites support the direct integration of Mysql in their web hotels.

Other open source database solutions could have been applied just as easy, for instance the PostgreSQL database solution, but due to my knowledge of MySql, it was chosen because of prior experience.

Mysql is a relational database management system that is multi threaded, which means that it can handle any number of databases and many simultaneous users. It is considered the fastest free database solution available in terms of handling many requests to the database.

MySQL is registered under the GNU General Public License as free software, though it is not as “open” as some other database management systems, but it is still free to use under GNU conditions. (MySQL)

6.3.2 Pre-hypertext interpreter

To create the link between the database and the HTML format of the web browser, a middleware interpreter is required to translate things like SQL queries into a format understood by the database.

PHP is a widely-used Open Source general-purpose scripting language that is especially suited for Web development, and it can be embedded into HTML.

As it is embedded, it is designed to remain as a kind of code within a code; it is initiated and concluded with the “<?php” and “>” tags respectively. In this manner the PHP code is executed independently of the HTML content as it is executed on the server, and the result is passed on to the HTML.

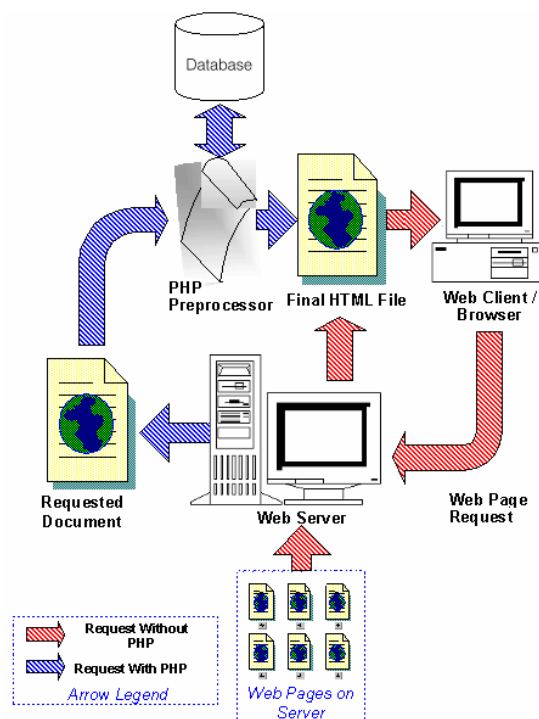


Figure 16 - Php interactions Source: Php

As PHP is the mechanism responsible for communication between the client and the server, it is in this context considered to be the middleware. It is the link between the user defined variables and the attribute data that is to be queried within the database. (Hudson 2006)

These interactions are exemplified in figure 16. The user request the web server in plain HTML, and the web server then passes request in php coding to the php processor releasing HTML back to the user. This means that it is not necessary for the user to have actual php processors installed on the client computer, since the interactions with the client is done only by HTML. (Php)

6.3.3 Web server

The choice of web server was the very in this case, since the Apache solutions is implemented on approximately 70% of all websites today.

It was also distributed under the GNU General Public License for free use, which is attractive to developers, in contrast to Apache's main competitor: Microsoft's Internet Information Service, which operates under proprietary motives.

Apache is designed to provide only the most fundamental functionality for a web server; although its functionality can be extended through additional modules either dynamically or within the original compiling

Apache's principle purpose is to be a web server for content published on the World Wide Web. It is also widely used in the development process where local content can be tested on the web; basically multiple file sharing in many types of networks between many users or client-server relationships. This enables the user to access a simulated internet environment located on the local computer without any requirements for security, which means that testing can be done under secure conditions

(Apachefriends)

6.3.4 XAMPP

To install and configure Php Mysql and apache you need to match the exact version of the programs together since this process differs from build to build. This means that you can do it one way with MySQL newest build, and another way with the previous. So to make sure that everything was correctly incorporated and to save time the obvious choice was to choose a pre compiled build containing all of the programs in one package. The Xampp (X Apache Mysql Php Pearl) offers to install all the software and configurate them together, which mean s that It was possible to get the systems running without having to concern about the versioning problems.

The open source stack XAMPP from Apache Friends is simplifying open source development by making it easier to write and distribute applications in a stable and standardized environment.. The trend of combining them into integrated middleware stacks promises to make open source development more competitive with java application development, at least for low-end applications.

XAMPP is a full-featured AMPP (Apache MySQL, PHP, Perl) package that is one of the few non-commercial AMPP middleware stacks available. With its tight integration, XAMPP makes it possible to run anything from a personal home page to a full-featured production site

XAMPP has advantages in the following areas:

- It is easy to install and set up.

- It contains a number of useful packages that make it easy to do things like generate traffic reports and accelerate PHP content.
- It has been thoroughly tested on the SUSE, Red Hat, Mandrake, and Debian Linux distributions, as well as on Windows and Solaris.

XAMPP is a compilation of free software (comparable to a Linux distribution), it is free of charge and is free to copy under the terms of the GNU General Public License. But it is only the compilation of XAMPP that is published under GPL.

However, the use of the Xampp package is only for development, as it has some severe security issues, which means that if the package is run on a web server, it can be compromised quite simple. This was done to make the operating level of the system as simple as possible. The configuration interface is simple to use, but is the main Achilles heel of the system. When the creation of the project is done on Xampp it should be distributed on the internet through a web host compatible with all the programs but with security measures.(Xampp)

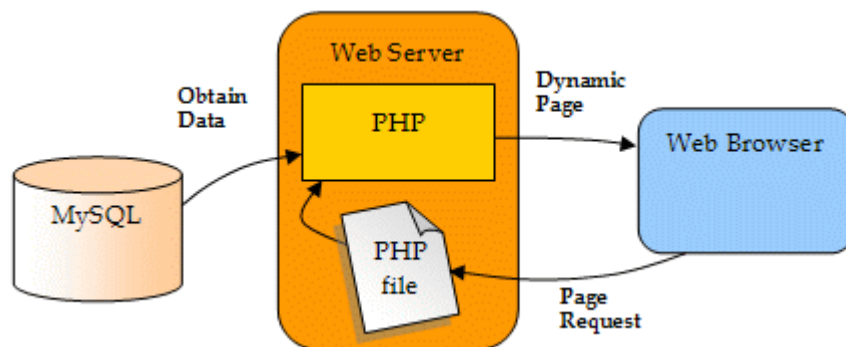


Figure 17 - Component interactions Source: XAMPP

Figure 17 shows the interactions between the components of Xampp, when a user requests a site over the internet. The page request is passed back to Php, as a request php file. The Php program then analyses the request of the user, and makes the corresponding queries to the Mysql database. The data is the returned to php for visualization on a dynamic page being sent to the web browser of the user.

6.3.5 Php Bulletin Board

Millions of people use phpBB on a daily basis, making it the most widely used open source bulletin board system in the world.

It can be modified to maintain contact between smaller groups or family members, or be adopted into a global online solution having thousands of users.

PhpBB can be incorporated into any site running an open source database solution since it can adopt to almost any databases today. Furthermore the server must have Php to handle the coding in which the system is written.

PhpBB's administration panel allows the customization of even the most intricate features without having to edit code directly, while advanced users will value the ease with which phpBB can be integrated or manipulated to fit any purpose..

Because phpBB is released under the GNU General Public License, changes to the code can be made without first having to obtain permission from the phpBB Group.

Few bulletin board software offers a greater complement of features while maintaining efficiency and ease of use.

The system was mainly chosen because of its wide use on the internet today. It is used on so many Danish WebPages today that once you know how it looks, you will see that you have visited PhpBB forums many times.

The screenshot displays the AssortedInternet.com forum interface. At the top, the phpBB logo is visible alongside the site name and 'Client Support Forums' tagline. Navigation links for FAQ, Search, Memberlist, Usergroups, Profile, and message status are provided. A timestamp indicates the user's last visit and the current time. Below this, a table lists forum categories and their respective topic and post counts, along with the last post information. The categories include General, Web Hosting, Pre-Sales, Support & Questions, Feature Requests, and Web Resources/Links. A 'Who is Online' section follows, showing statistics on articles, registered users, and current online users. At the bottom, there are status indicators for new posts, a link to the administration panel, and copyright information for Assorted Internet Ventures LLC.

Forum	Topics	Posts	Last Post
General			
AssortedInternet.com News The latest news and happenings at AssortedInternet.com. Moderators: bteater , bloagdon	4	4	03 May 2003 10:01 pm bteater
Web Hosting			
Pre-Sales If you have any questions about our Web Hosting Services, post them here and we will do our best to help. If you need immediate assistance, we recommend contacting our sales staff at: sales@assortedinternet.com Moderators: bteater , bloagdon	4	6	13 Aug 2003 02:35 am bteater
Support & Questions Have questions, need help? Post your problem here! If you need urgent support for a problem, please visit our Online Helpdesk for fastest service. Moderators: bteater , bloagdon	32	59	04 Sep 2003 04:58 am Jim Fred
Feature Requests A forum where our Web Hosting customers can request new features for their accounts. Moderators: bteater , bloagdon	7	20	10 Apr 2003 09:55 am raisingh
Web Resources/Links Found a great tool on the web? Post a link to it here, and share it with the rest of us! Moderators: bteater , bloagdon	3	3	23 Jan 2003 08:08 pm bteater

Who is Online
Our users have posted a total of **215** articles
We have **64** registered users
The newest registered user is [eric_timepit](#)
In total there is **1** user online :: 1 Registered, 0 Hidden and 0 Guests [[Administrator](#)] [[Moderator](#)]
Most users ever online was 3 on 27 Nov 2002 12:09 am
Registered Users: [bteater](#)
This data is based on users active over the past five minutes
☒ New posts ☐ No new posts ☐ Forum is locked
[Go to Administration Panel](#)
Powered by phpBB 2.0.4 © 2001, 2002 phpBB Group
Content on this site is Copyright (c) 2000-2002 Assorted Internet Ventures LLC

Figure 18 - PhpBB example

Figure 18 shows an example from PhpBB's own website, and is an example of a layout from a thought up internet business. The standard introduction page of the forum gives the users the complete history of the forum. It is fast to gather information about new topics, and new users, and exactly this interface has proven vital for the high popularity of PhpBB.

Having read the documentation on the webpage, it was obvious, that it was a solution possible to implement to my solution because it was easy to set up and configure. Since I have never actually created my own forum solution before, it was important that it was well documented, just like PhpBB actually is.

(PhpBB)

6.3.6 Background maps

To implement the argumentation map ideas in practice a map solution is required to provide the spatial dimension to the discussions. In this case two different options would be available.

1. Local map created from data.
2. Internet mapping solution

1 Local map created from data.

It would be possible to use a rendering software to visualize a background map stored directly in the database covering only the appropriate area of interest.

This could be done by using for instance the Java 'Processing' software or other open source solution like GvSIG, creating a Java applet that would be executed within the browser. The main problem here would be that it would require a lot of coding to create such a solution, since every function should be build from scratch.

Furthermore there could also be licensing issues regarding the data that would be used to generate the map. But in this case sample data from the Geodata library would be sufficient. Had the case been outside Denmark, or any are not covered by data, data should have been purchased.

2. Internet mapping solution

The second option would be to use one of the mapping communities on the internet today. The totally free openstreetmap, where the data is generated by the users driving with gps receivers in their cars. Though free to use, there are quite some limitations to the coverage of the maps, meaning that if a user has not driven a piece of road, it doesn't exist in Openstreetmap.

The most obvious choice here would be the Google maps solution, which is a mapping service taking advantage of the Google Earth orthofotos and a vectorised overlay map of good quality. This system is free to use in non commercial projects, which means that it would be able to be implemented in solutions like an argumap project.

Since Google maps supports Mysql and Php as database and interpreter it is also a very appropriate and simple choice give the timeframe of this project. The tasks that must be carried out to get a working map on the site is much simpler using Google which makes it an obvious choice – creating a new mapping solution from scratch would be a whole project in itself.

6.3.7 Google maps

Google Maps features a map where users can pan and zoom freely in a global map. Depending on the speed of the internet connection, the map will the be collected in real time and visualized for the user.

Users may also enter an address, intersection or general area to quickly find it on the map.

Starting November 21, 2007, users with a Google account can adjust the location of markers for businesses and other destinations. This is implemented because many of the marker functions are user created, which means that the precision of the markers might not be totally accurate.

Google Maps offers five viewing modes by default: Map (topographic and street map), Satellite (satellite and high-resolution aerial photographs), "Terrain" (geographic features in high relief with street overlay), Street View (ground level 360 degree view of certain streets, introduced on May 30, 2007 – not available in Denmark), and Traffic' (traffic congestion maps, also not available in Denmark).

The "link to this page" link on each Google Maps map targets an URL which can be used to find the location on the map in the future. The latitude and longitude can be used as input to NASA World Wind or TerraServer-USA which in some cases have higher-resolution imagery.

Google created the Google Maps API to facilitate developers integrating Google Maps into their web sites with their own data points. It is a free service, currently not containing ads, but Google states in their terms of use that they reserve the right to display ads in the future.

By using the Google Maps API you can embed the full Google Maps on an external web site. Starting by creating an API Key it will be bound to the web site and directory entered when creating the key. Creating your own map interface involves adding the Google JavaScript code to your page and then using JavaScript functions to add points to the map.

The API allows you to display certain content including map images and driving directions on your website subject to the limitations and conditions. The information available through the Service, not limited to map information and photographic imagery, is referred to as the content of the service.

According to the limitations and conditions described in the terms of service, you may use the API to display the Content in conjunction with other information provided to the end users. You are not allowed to access, reproduce, or use the Content for any other purpose.

The API may be used only for services generally accessible to consumers without charge. Accordingly. You may not use the API for any service requiring a subscription or other restricted access or for which a fee is charged.

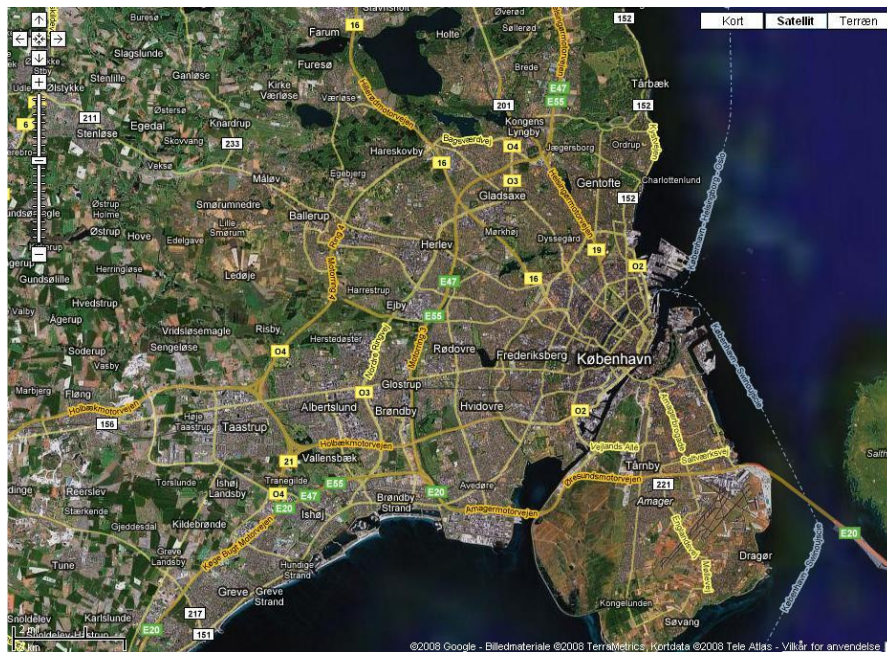


Figure 19 - Google maps example

Figure 19 shows a map of the greater Copenhagen area, where the case study is located. The three buttons in the top right corner displays the available visualizations, in this case being Maps, Satellite, and terrain. The map show in the example is a combined map using both the ordinary map and the satellite images.

In the upper left corner is the Pan/Zoom functionality chosen as standard for Google maps. When you use the API you can modify and change these functions as you like, which means that not every map using Google maps API might look like this.

6.4 Installation and configuration

The next paragraph will be a step by step guide to the installation procedure of all the components used in this assignment.

Installing the Xampp package is quite simple. Once the appropriate installer for the operating system is downloaded from <http://www.apachefriends.org/en/xampp.html>, the program generates all the interactions and connections between the software pieces in the package and collects the configuration and management of the programs into one simple interface.

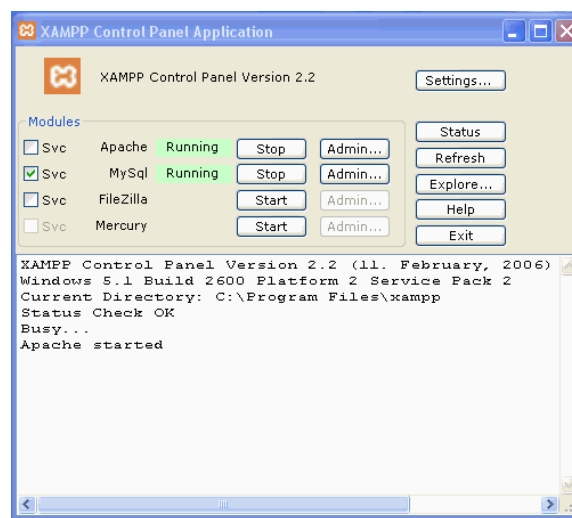


Figure 20 - XAMPP control pannel

Figure 20 shows the control panel helping the user managing the programs. From this console you can start or stop the programs in the package as needed and you can turn the different program pieces into services under windows, by clicking the 'Svc' (Service control). This means that the server for MySQL will automatically be started when ever windows start, while apache will be started manually. This is simply done this was, so that the apache program will not be occupying to many system resource without being used.

Whenever windows starts up with this configuration, the window in figure 21 will automatically appear.

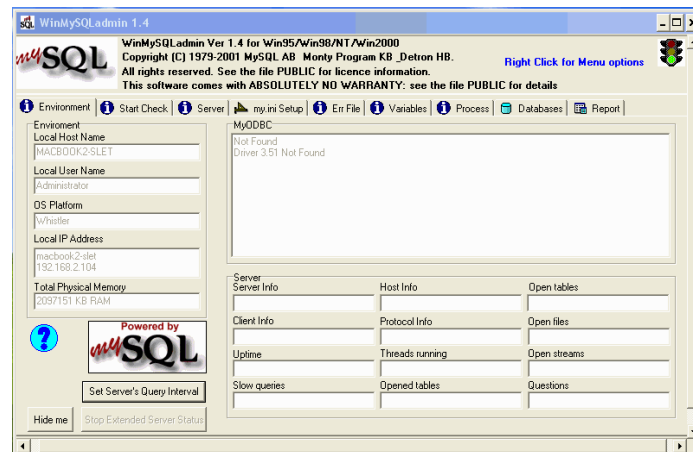


Figure 21 - MySQL status window

The information you can get from this window is general information about the service. The empty window means that there is no active database connections now (at startup), and the stoplight in the top right corner is a status monitor. A green light as shown here means that everything is running correctly, a red light means that the service was not able to start, and a yellow light means configuration problems.

Once the system is restarted after the installation all programs should be running.

To load a php page into the web browser the files need to be located in the \xampp\htdocs\ folder of the installation which apache will use as local host directive.

Here a file named intro.php is located and if the browser is pointed to this file, the apache system will start up and return the webpage shown in figure 22

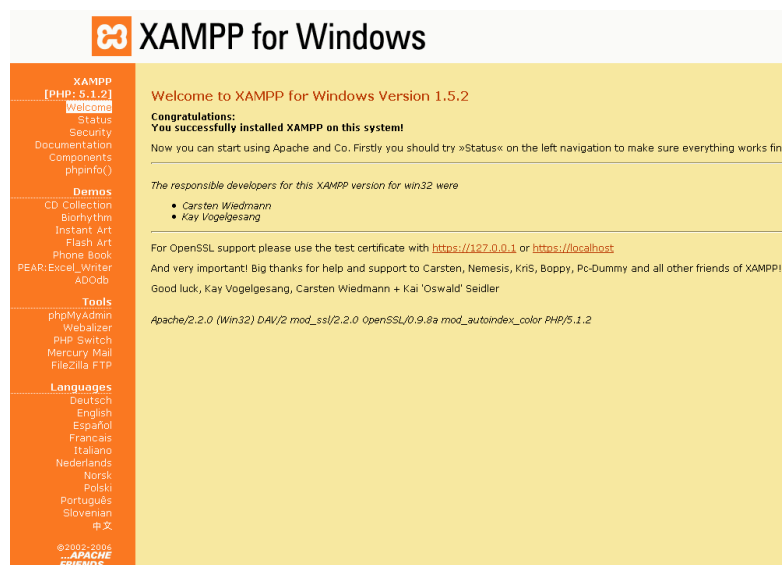


Figure 22 – PhpMyAdmin

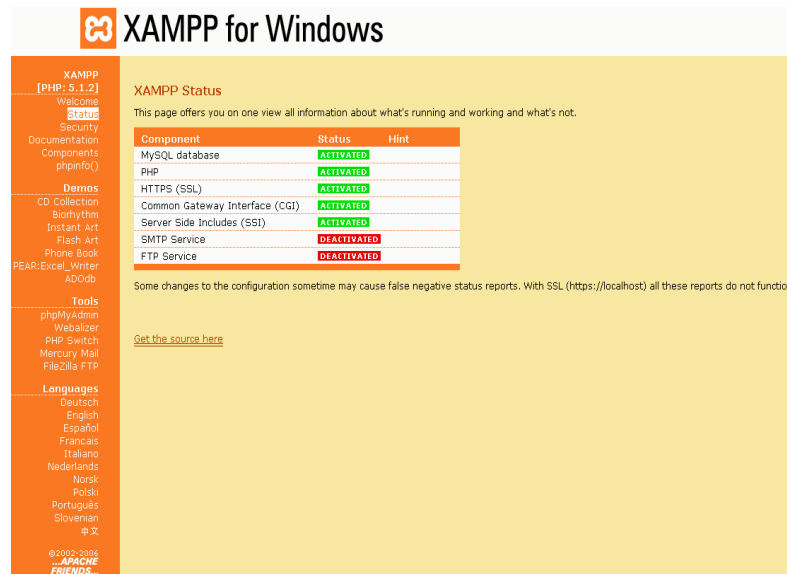


Figure 23 – XAMPP status

This page contains the main info system for the apache services. In the left side a menu provides the access to build in applications such as phpMyAdmin, which is a simple graphical user interface tool used to manage the php functions. From this menu the status of the web server can also be acquired. This is shown in figure 23 where the status of the installed components is listed.

As stated before, the Xampp package is only for development purposes in this form. A look at the menu item 'security' shown in figure 24 shows the importance of this point.

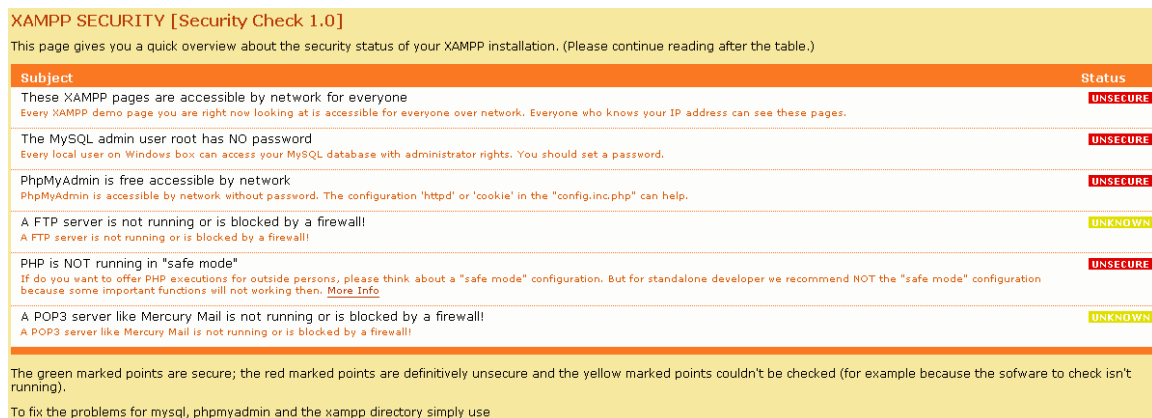


Figure 24 - Apache security

The list shows the user modifications required to secure the system for use on a webhosting solution. The main problems are that the software is freely accessible over the local network and that there is no password attached to the mysql admin functions. This means that anyone can get access to the local network, in fact can alter the settings in the system.

At this point the initial databases required for the installation of the PhpBB solution and for Google maps have to be created. This can be done in two ways in the system. Either it can be done by clicking in the interface, creating the tables, or it can be done by passing SQL statements. The PhpBB database needs to be blank, since the installation is going to build the tables itself. This is done fast by just creating a new database in the interface, and naming it PhpBB.

The Google maps database needs to be filled with a predefined table. So the database is made the same way and the table is made by a SQL statement:

Google maps table:

```
CREATE TABLE `Google` (`id` INT NOT NULL AUTO_INCREMENT PRIMARY KEY , `name` VARCHAR( 60 ) NOT NULL , `address` VARCHAR( 80 ) NOT NULL , `lat` FLOAT( 10, 6 ) NOT NULL , `lon` FLOAT( 10, 6 ) NOT NULL ) ENGINE = MYISAM ;
```

The statement creates the tables after the specifications of the Google maps API. A key field is required in this case the ID field. An address field is required along side the lat. And lon. fields. If the point only have coordinates, the API will geocode the addresses and fill them in – the field cannot be blank.

6.5 Configuring PhpBB

The PhpBB installation folder can be downloaded directly from <http://www.phpbb.com/>

The file downloaded is not a traditional installer package, but is a compressed folder containing .php files, that must be executed on a webserver.

The compressed folder is extracted to the localhost directive used earlier while the file install.php is executed in the browser.

This brings up the installation interface, which is run directly in the browser. First you specify your database settings. Since no security is being used, no password of any kind is required, and the username is just ‘root’ referring to the location of the database. Secondly the name of the database created for PhpBB is specified, and the installation finishes by creating a moderator account, which can be used to change settings in the forum.

The phpBB database was created in the Xampp interface, simply by pressing “create new database”, and giving it a meaningful name. The work of populating the database with tables is automatically done by the install procedure.

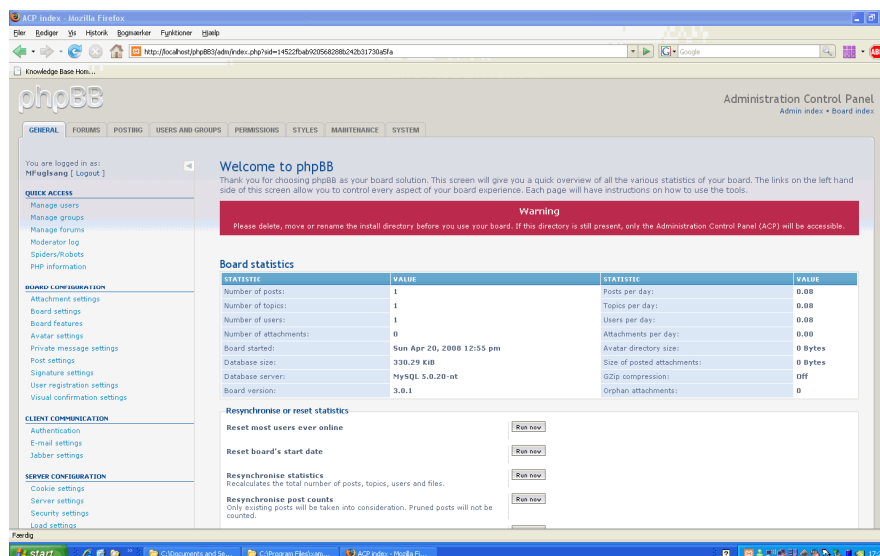


Figure 25 - PhpBB Admin page

Once the installation is finished, the phpBB admin page shown in figure 25 is presented. Here all the content of the forum can be modified to fit the solution where it is implemented.

Now it is time to create the actual content of the forum, meaning that both the different sub-forums, and the general settings have to be defined.

Since there is no clear forum-theory available today, the forum that I created was based on own experiences with online communities, focusing on the fact that the solution would be as simple as possible.

My main overall structure for the forum categories looks like this:

1. Proposal elements
2. Lining issues
3. Station issues
4. Analysis results
5. Data
6. Articles
7. Misc

It is quite simple to set up the boards of the forum in PhpBB: all you need to specify, is a title and a description. In order to actually allow users to add posts to the forum, permissions for each board must be set. Permission means to the rights of the users to post new threads, reply to active threads, and to view contents of existing threads. The most ordinary solution is to allow all registered users to post anything, and to allow unregistered users to view only. However this basic configuration will though not be implemented in my solution. The forum solution should be available online, it would be necessary to keep it free of spam and unauthorized users. So for this case, the configuration will allow only me as a user to use the forum.

7 Results

Working with the creation of the applications for this project, it became quite clear that there was some technical issues impossible to solve within the timeframe. This chapter will be a presentation of the work that was carried out in the production phase of the application. The shortcomings of the solution and explanations of how they could be resolved will follow in the discussion chapter.

7.1 The Index page

As seen on the E-R diagram in the methodology chapter, I was looking to create a service with a login page, that would grant the user access to the main.

This page was coded in ordinary HTML using php scripts to conduct the database functions on the page.

The page ended up looking like this (figure 26):

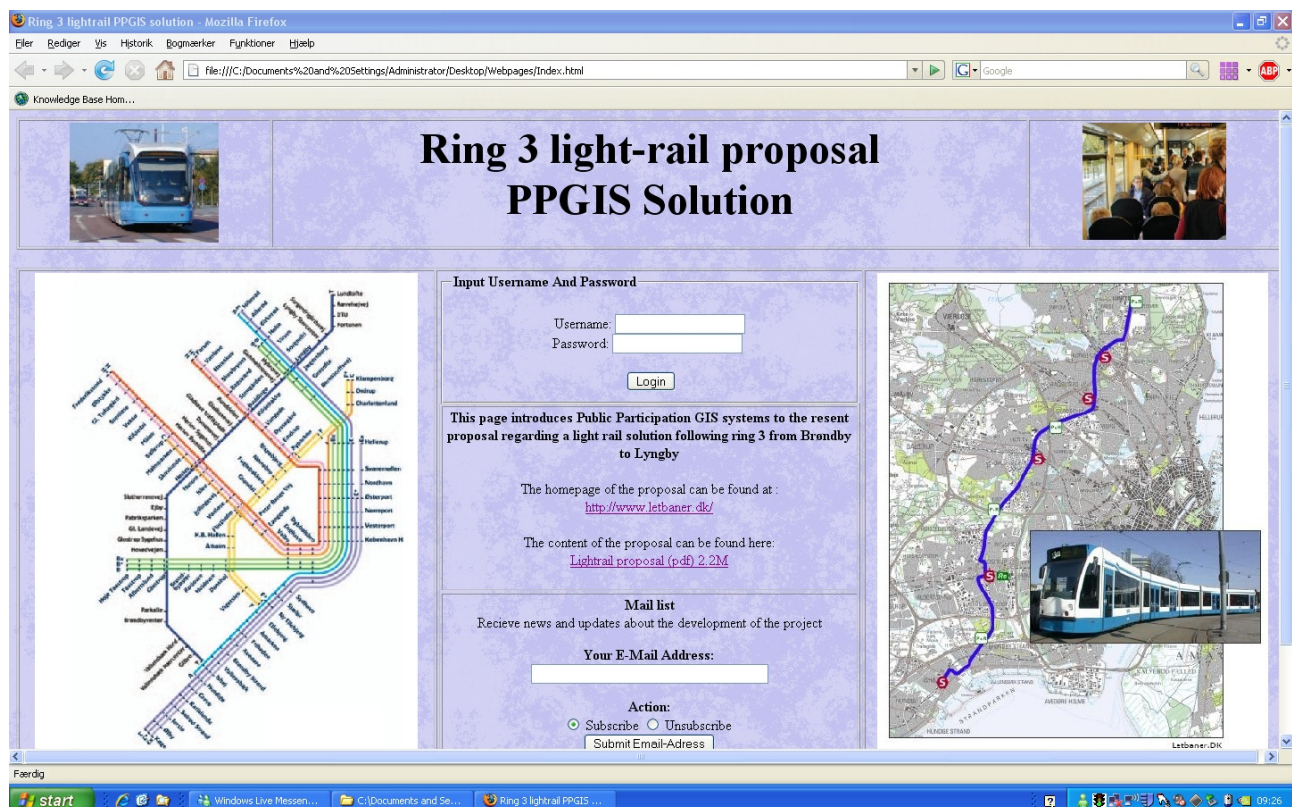


Figure 26 - The index page

The introductory text on the main page is basically two links to the already existing homepage of the light rail proposal, and the published pdf file with the in depth description of the project. The goal was to keep a minimum of information on this page, obtain simplicity and make fit the main context on the page to fit the screen.

I used two php scripts on this page which I have worked with on other homepage projects. Of course this was an obvious choice since I knew these scripts already and could implement them right away.

I used a login script to conduct the login. This script requires a table in the MySQL database with user information. In the Admin window of the database, the user is created manually by writing the desired usernames and passwords to the fields in the database.

Once the information is typed into the form on my webpage, the php script confirms the information with the fields in the database. If the information is correct the user is logged in, if not, the user will be redirected to a login failure page.

The second function is a simple mail-list function imbedded on the first page. It could have been placed on the main page of the application, but that would cut off the unregistered users from using it.

The script also needs a database table, and every time when information is placed in the field, it is written to the database. The script also handles un-registration from the service, by removing the user from the database.

7.2 The Main page

Once the user completes a successful login to the service, the main page of the service is displayed.

The main page of the service in the current version looks like this (Figure 27):

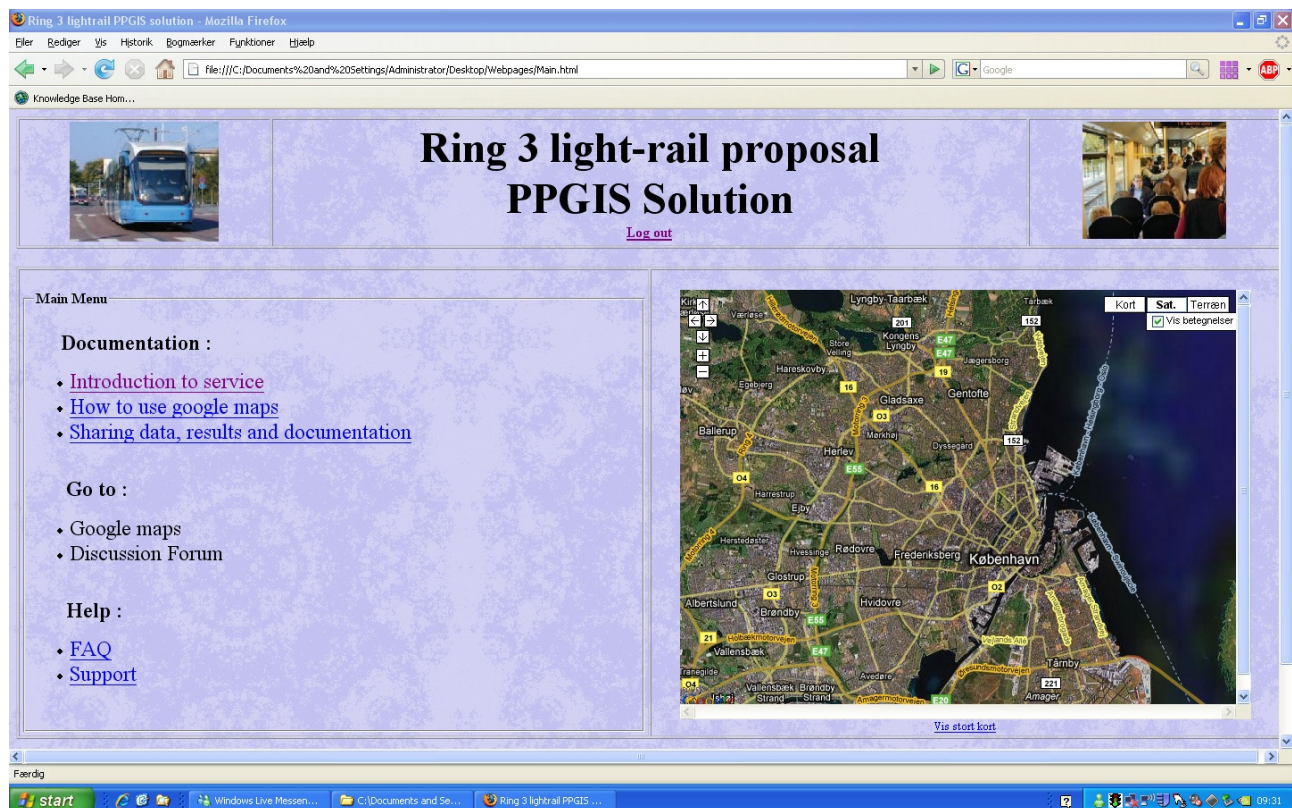


Figure 27 - The main page

The main window is split into two, a navigation window and a Google maps interface.

On the left side of the screen, the navigation interface contains three themes.

The documentation points is in this version a link to pdf files containing all the information required in order to use the service. The 'Go to' points send the user to the discussion forum or into the google maps page, and finally the help point should provide some information regarding problems and support.

On the right hand side of the screen a Google maps centred on the area of interest in this project – if the user wants to elaborate on the zoom of this map, the 'vis stort kort' button underneath takes the user to this map in the Google maps interface. The fact that the button is in Danish is due to the fact that Google logs my IP address and select the appropriate language.

7.3 The discussion Forum

Clicking the discussion forum link will take the user to the forum introduction screen. The user also has to register in the forum interface in order to post topics on the boards.

The interface of the forum looks like this when the user has logged in (Figure 28):

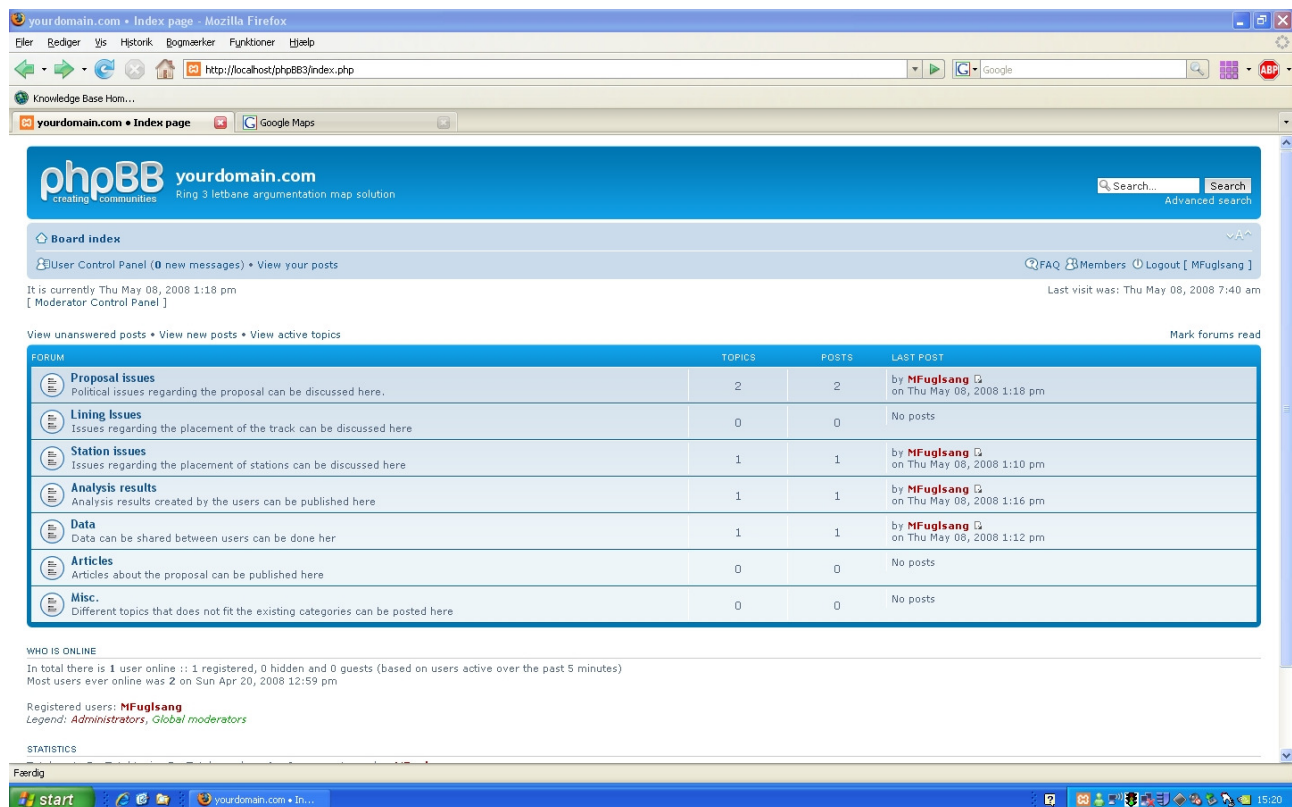


Figure 28 - The discussion forum

The categories all show in the main page, showing the number of topics and replies in each board. At the bottom of the window the activity of the forum can be viewed. The number of guests online at the moment can be seen, along side with the highest number of online participants ever.

Since the forum on this case only has one registered user – me all topics are naturally posted by me. In the following I will explain how the argumentation maps idea will be implemented.

7.3.1 Discussing maps

Due to limitations explained later, the map part of the forum did not quite appear as I had planned, but it is still functional.

A topic is posted containing an issue that the user wants to discuss. In this case is about the Herlev station. The user creates the thread, and imbeds a link to Google maps in the post, that ends up looking like this (Figure 29):

Herlev Station problem

POSTREPLY Search

Herlev Station problem

by MFuglsang on Thu May 08, 2008 1:10 pm

How will the lightrail station at Herlev be integrated with the S-train station that is some distance away from ring 3 ??

<http://maps.google.dk/maps?f=s&ie=UTF8&...23518&z=16>

POSTREPLY

Figure 29 - Example of a map discussion

Pressing the link in the post opens a new Tab or window containing the map which the user wanted to show – in this case like this (Figure 30) :

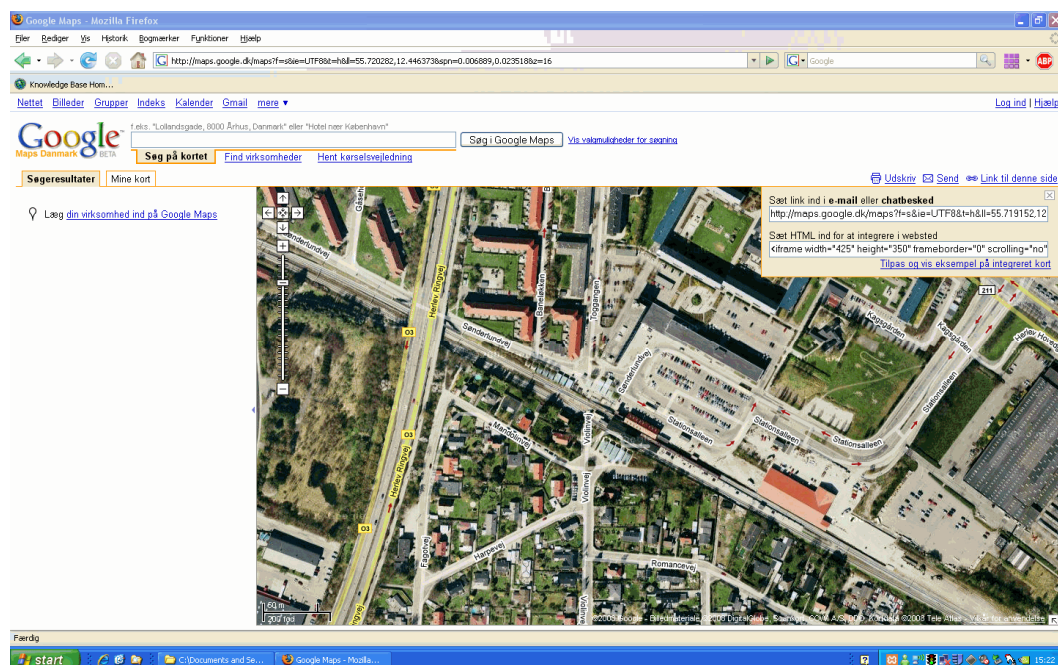


Figure 30 - Example from Google maps

The link to a map is simply made in Google maps upper right corner. In figure 31, the appropriate buttons is shown. At first you zoom in on you map, then you press the ‘Link til denne side’ button,

which means that the link is generated in the window. Then you past the link from Google maps into the thread you are about to establish.

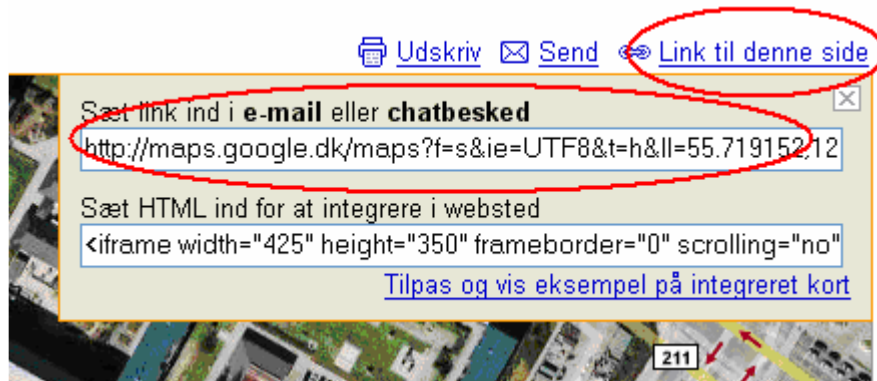


Figure 31 - The 'link to' functionality

7.3.2 Sharing data

If enabled the phpBB forum allows exchange of data. It is possible to attach as many files as required to any post, but optimally the data should be pre- processed and compressed into a zip type file.

Once a file is attached to a post, all users can download this file and make use of the contents. There is no limitations to which file type can be attached – the only limitation to the attachment functions is an upper-size limit to the attached file.

An example of an attached file looks like this (Figure 32):

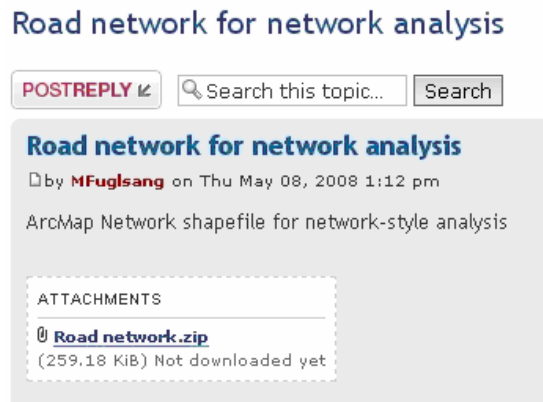


Figure 32 - Exchange of files

It shows the name of the files, the size of the attachment and statistics on how many times it was downloaded.

7.3.3 Showing analysis results

If the user has made some calculations, or has got some sort of image which he wants to share with the forum, it can be posted as an image attachment and will then be visible in the post in the forum. All users can post materials in all threads when necessary.

A posted result looks like this (Figure 33):

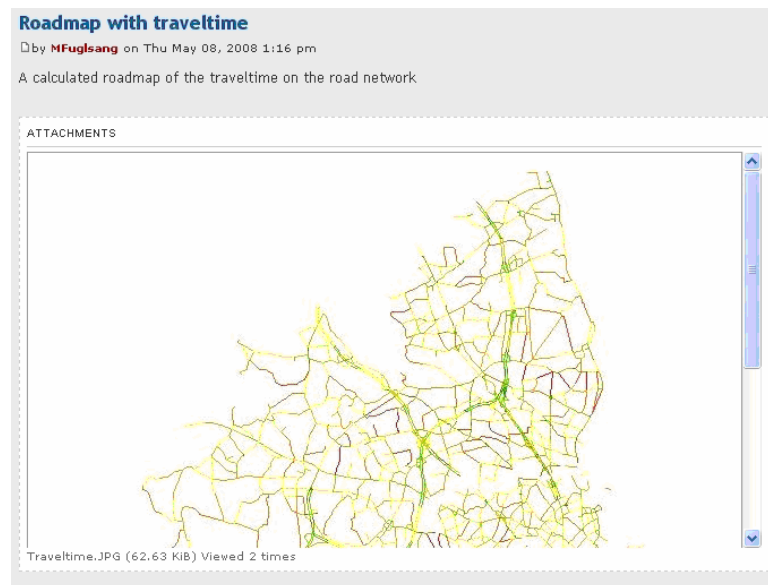


Figure 33 - Publishing graphics

7.3.4 Taking polls

The forum software makes it very simple to create small quick polls about a topic selected by the user. This can be done in any of the boards; the only limiting factor is that the poll can only have 10 different answers.

A PhpBB poll will look like this(Figure 34):

The screenshot shows a forum poll titled "In terrain or submerged" by user MFuglsang. The poll question is "Should the Rail run in line with traffic, or should it be suspended where possible ??". The poll settings indicate it runs until Fri May 08, 2009 1:18 pm and allows 1 option. There are two radio button options: "In Line with traffic" and "Suspended". A "Submit vote" button is located below the options, and a "View results" link is at the bottom. The post footer includes the title "In terrain or submerged", the user "MFuglsang", the date "Thu May 08, 2008 1:18 pm", and the text "Post your wote".

Figure 34 - The poll function

The design of the poll is put in the hands of the user, who can specify many options regarding his or her poll. This can be the ability to edit answers once submitted, the length of the poll period, and how the statistical output is to be presented.

Once the poll is activated it will work as a normal thread in the forum, and comments and replies can be posted in normal fashion.

8 Discussion

This chapter will be an evaluation of many of the aspects involved in creating the argumentation map service. The topics covered here will be an evaluation of the existing product and how it could or should be improved to become a working solution. After that the exchange of data and results in this context will be discussed and examples of relevant analysis task which could be conducted in the case study will be presented. Finally the entire public participation GIS idea will be discussed and the strengths and weaknesses of this concept will be evaluated

8.1 The created solution

The solution I ended up with had met my overall ideas as to how the functionality could be incorporated using the software that selected by me. But due to the time limitations of the project several issues could not be resolved completely, and another problem was the fact that this was a one man project. I was quite pleased that the components almost ended up working together as I had planned, since this supports my notion that the construction could be done this way

Because no all of it turned out as I had originally intended, the next paragraphs will be describing some of the shortcomings that I know could be improved.

8.1.1 Login

I created a main login on the front page of the service ensuring that only registered users can login to the service but in the current solution it isn't possible to sign up for it. The php script that I use for this purpose was created to work with a known user group, which means that I by hand can create all login information and assign permissions manually.

This would of course not work in a solution, where a user sign up interface able to store information in the database would be created. This is not a functionality which I have used before, and I have not got the full insights into how security issues are handled in this context, which means, that it should be addressed in the finished solution.

Also the incorporation of the front page login with the PhpBB forum login mechanism created some difficulties. As a result the user must actually log in twice on the service. I tried to change the forum login script to my own database script, but I was not able to get this to work properly, so for the time being the user has log in twice.

The forum has got an automated login feature which stores the users IP address in the database, and once the user enters the page, he is automatically logged in by PhpBB. This means that the problem with double login is only exists once – in future visits the user is automatically logged in.

8.1.2 Expand pages

The design of my pages is also an area where I deliberately choose to make due to the fact that it would not extend the functionality of the site, only make it look better. The menu items are just simple hyperlinks leading to web content or documents.

Most of the links lead to PDF format files for the time being, since I just needed to distribute information at this point. The simplest way was to create the text in a document and then create a PDF file from it. This means that I did not have to be concerned about layout of the sub pages, but could focus on other subjects. However, since the text exists in the PDF documents it could quite

easily be transformed into sub pages, since it would be a matter of setting up the text on the webpage.

8.1.3 Incorporate Google maps

My incorporation of Google maps to the forum was not quite as intended.

My initial idea was something like figure 35

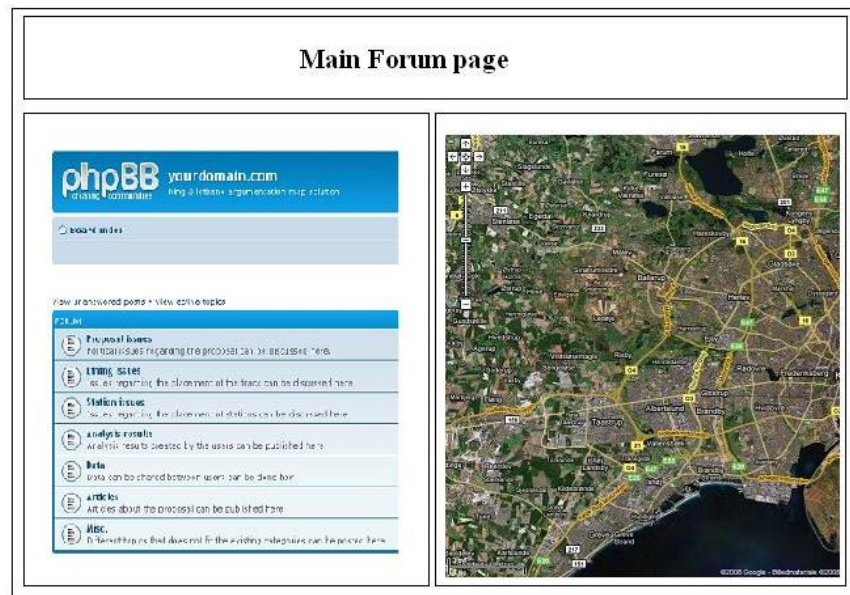


Figure 35 – The original idea

I would have liked to see a split window mode incorporated into the system, so that the maps would be showing right next to the forum posts, instead of working in separate windows. This would have been an improvement of the functionality and would have made the use of the system much more transparent.

This could have been achieved in two ways:

1. *Turning the forum into a java object*
2. *Modifying the layout of the forum*

1. *Turning the forum into a java object.*

I am not sure of the user friendliness of this solution, but I know for a fact that it is possible to create a java object from the forum. It requires that the forum is live online, so that the object can be created by linking constantly. Another problem is then how it would be incorporated with Google maps, but my knowledge of java coding is not good enough to answer this question

2. *Modifying the layout of the forum*

It would surely be possible to make room for a Google maps window in the forum layout. It is a quite simple task to make small modifications to the layout view of the forum. The only problem is that in this case it would not be a small task, since I would have to edit many of the style files

associated with the forum. This means that I am not even remotely sure that I would be able to get it up and running within the timeframe.

Furthermore I had originally intended to use the Google maps API to incorporate the maps directly into the webpage. This would have meant that each map would have had a point stored in the database centered on the area of interest. This would surely have been a better solution, and it would have been easy to set up the API for this method. The difficulty would however, be to incorporate of the imbedded maps and the API scripts in the forum. This would have needed creating an add-on to the PhpBB forum solution, which would enable a map window and a database query interface. The database query would have been easy to set up but the problem would be to integrate it within the forum.

It was a surprising experience to see how huge a task it would be to modify the forum. Technologically seen it is not so demanding, since it is basically just a matter of coding php, but the sheer magnitude of files that must be fit in makes it a monumental task. Having attempted to modify the forum, I had to realize that it was not possible within my timeframe, and therefore the link to Google solution had to work as plan B.

The actual advantage of this solution is that it works without storing points to the database, which probably simplifies the mapmaking process for untrained users, but of course it lacks some functionality for trained users.

8.1.4 Security

Since the project is only running locally on my own computer using Xampp, several issues regarding the security would need to be addressed before the solution could be functional online. The forum itself has got the required security build in, but the php script execution and similar issues would need to be resolved with the web host. But it is something that every web developer must pay attention to – security is one of the primary issues online today.

Furthermore the suggested solution with the forum part should contain some sort of moderation. This means that someone should be monitoring the debate closely, securing that the tone is sober. Within online communication this is a basic rule - if you do not restrict the debate it will eventually run loose. Therefore it is always necessary to have a combination of a human moderator, and preprogrammed bots to control access and language.

In other words: Generally there is room for improvement in the current solution. Some of the things have only cosmetic effect while others are of great importance for the functionality and security of the website. In this sort of process where the development is made under a tight schedule, new ideas come up every now and then, but the timeframe does not permit them to be implemented. The improvement ideas stated above only represent the current state of the process- surely with more to come

8.2 Publishing analysis results

One of the main goals of the project was to create an environment where users could exchange data and knowledge about the proposal being discussed. This paragraph will be a short evaluation of the possible GIS analysis types that would benefit the debate of this case study.

Since it is an infrastructure expansion suggestion, at least two things could be analyzed. Analysis of migration of people, and the effect of the neighborhoods in the area of the proposal. This is though not a direct theme in this assignment.

8.2.1 Network analysis

Many GIS packages provide a limited set of functions designed to answer basic questions of this kind. Some packages provide more extensive tools using optional add-ins, such as ESRI's ArcGIS Network Analyst (now included in ArcGIS as standard), ESRI's ArcLogistics option, Manifold's Business Tools option, and Intergraph's Incident Mapping and Analysis software. Commonly most of these packages contain abbreviations of the same type of analysis. There is provides facilities for: network analysis (shortest paths, travelling salesman problems and network partitioning); transit analysis (designing and modelling the use of public transit networks and associated fare structures); transportation planning and travel demand modelling (trip modelling, modal split modelling and traffic assignment); vehicle routing and logistics (dispatching/collection problems, arc routing problems and flow-related problems); and territory management and site location modelling.

To create network analysis tasks in ArcMap, the data at hand must be converted into a data model called network data model. This is done by running a wizard in arctoolbox creating a network data layer from an ordinary shape file road network. The wizard calculates the connectivity of the network, and adds nodes to the intersections in the network. With this it is possible to determine the distance from any point in the network. Furthermore several other informations can be included in the network, such as drive time for the road pieces, on way traffic etc.

Once the network model is created, instances can be added. This can be shops, firehouses or in this case stations. Figure 36 and 37 shows the results of two different analysis tasks.

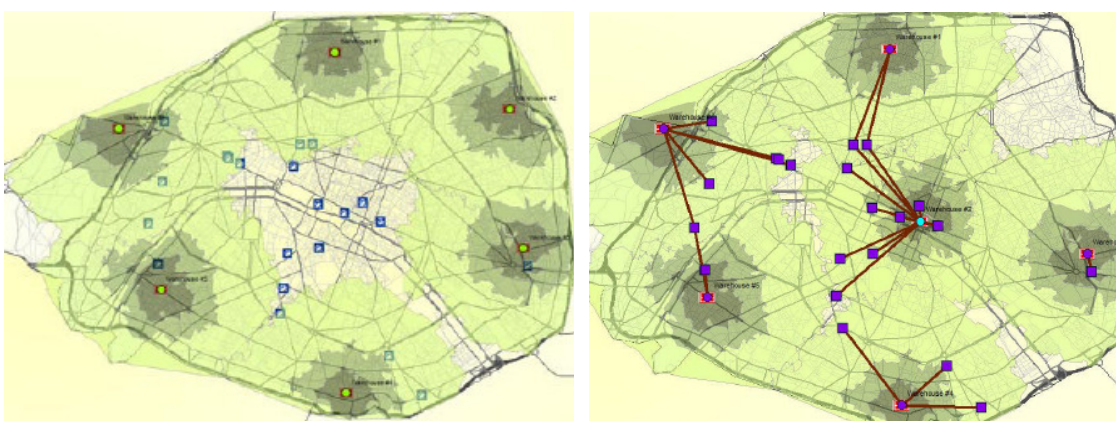


Figure 36 & 37 : Network analysis functions

In figure 36 we see the results of the calculated service area. A distance buffer is calculated with respect to the network distance, so that the travel time to each instance is calculated.

This analysis could be directly implemented in the case study, where the travel time to each light rail stop could be calculated. With the distance buffer calculated, the amount of people living within the area could be determined, to evaluate the potential number of passengers.

Figure 37 assigns other instances to the centres determined. This means that instances within a certain network distance will use the center. This could be translated into the case study by adding other means of transportation, evaluation the potential exchange of passengers between for instance busses near the rail solution.

8.2.2 Cellular automata (CA)

The impact of the change in infrastructure in relation to urban growth could be model in a cellular automata model. The scope of this analysis would be to asses the impact of the increased availability in the areas of impact. Putting the new rail information into a carefully tuned cellular automata model could provide information about impacts on growth and desirability in the area.

The CA model would need to be based on many different criteria regarding growth potential, effect of infrastructure, key demographic, and to some extent the rationale of the people involved.

If all these factors are carefully linked together in a complex model, the year by year impact of the new rail solution could be simulated, giving results regarding many different aspects in the target area – such as growth, change in real-estate price levels, change in population etc.

8.2.3 Publishing and distributing the results

The suggested analysis can then be made available to other users in several ways. The simplest is to export the result to a graphical format and post it in the forum as an image. This a is simple but never the less a solid way of exchanging information.

In the more advanced exchange ways, the data can be made available by uploading the files to the forum. Here the users have a made a 250 mb limit per post to be able to handle such data.

Since the data load is not directly loaded into the forum, this will not affect the load times of the solution. But it is important to keep in mind that such loads of data would require a huge and certainly expensive hosting solution. This means that in practice the maximum size should be adjusted, but in this case it is of no further importance.

Finally the most advanced way of publishing work is to release the model behind the analysis results to the public as scripts. This would give the advanced user the capability of modifying and altering the analysis results for instance by alter the factors in a CA model.

Without depending on a certain level of expertise it should be able for almost any user to publish material in this solution, making it accessible to all – which was one of the main goal of the assignment.

8.3 The public participation decision process

In the theory chapter the ladder of participation was presented as a way of evaluating public participation solutions. In the adaptation made by Smyth the solution suggested here would be rated as an online decision support system. On the same level of the ladder Weidemann & Femers describes this level as “Public participation in assessing risks and recommending solutions”. In my opinion the proposed solution would be able to become all of this if correctly implemented by the authorities. One of the key aspects of the original ladder by Arnstein was, that any level of the

ladder can be compromised if the input is not handled correctly by the authorities. The public can participate but if the input is not used in the process it is no actual participation but only manipulation - making the public think that they are being heard.

Several different group decision methods were also presented in the theory chapter. The most important solution here is surely the brainstorming process. Here the word is free for all and anybody can formulate an idea or a comment. But aspects off SWOT, Delphi and stakeholder involvement has also been used and can be further enhanced.

Any comment made to the proposal could be thought of as a SWOT assessment, since it will pinpoint an area where the project needs to be improved. Furthermore the groupware tools available here, supports the Delphi method in terms of communication and group interactions, making it possible to use the suggested product in a clear cut Delphi process.

8.4 Future of PPGIS

There is no doubt that the technological advances over the next couple of years are going to encourage the use of GIS and public participation GIS even further. The computer power of the general user is growing so powerful, that many new uses of technology will be available for the home user. Furthermore the internet bandwidth distributed to the public is rapidly growing, making it is very unusual for a Dane to have below 1 mbit capacity today.

The technological level is definitely adequate but there are still issues able to hamper the evolution of true PPGIS if not resolved. These issues will be the main focus in the remaining part of this discussion.

8.4.1 Digital divide

The term digital divide is of great importance here, and will be one of the instrumental challenges for PPGIS in the next years. The definition of the term is something like this:

“The term digital divide refers to the gap between those people with effective access to digital and information technology and those without access to it. It includes the imbalances in physical access to technology as well as the imbalances in resources and skills needed to effectively participate as a digital citizen. In other words, it’s the unequal access by some members of the society to information and communications technology, and the unequal acquisition of related skills.”

(Wikipedia 1)

The goal of an ideal PPGIS solution should be to get total involvement from the public, disregarding differences in age, gender, status, location, and economical status.

Overcoming this divide however is an instrumental task which requiring many different efforts to solve

Discussing digital divide in an age context it is mostly the elderly generations is the problem today. The youth of Denmark is today growing up with the internet and its technologies, and the use of the internet is as ordinary as reading a newspaper 50 years ago

But for the generation being 60+ today, the approach to new technology is quite different, which means that full participation will be at least half a generation ahead – but time will certainly solve this problem.

When the next generation reaches 60, they will have been using internet and it technology in their work and private life, making them much more capable users. This is the key to giving everybody the possibility of participating – the use of internet has to be a natural part of life. Lack of access to technology can be evened out quickly, but not having the skills is much harder to handle.

Gender is another issue of some importance as a digital divide issue today. If a household is to participate voting for some proposal, in many cases it still might be the man that does the actual job of voting. This might be a divide closing rapidly, but it is still important, since it can be thought of as a problem of interest. I am afraid that a single male individual is more prone to participate in public participation than a similar female individual. This might be a controversial stereotype but I think that there still is some truth to it. Furthermore it might be a vital point in the participation process, because the interest of the two genders might not be the same regarding an issue. If the male population for this reason should be overrepresented in the process, the result might also be skewed, not showing the true opinion of the public.

To some extend financial status can also be seen as a divide in this context. People with good jobs and incomes might be more interested in spending time and getting involved in political work, making them aware of the political issues concerning their area. A similar project in from Northern Jutland (Hansen 2008 Nr. 2) showed an overrepresentation of middle aged male participants, most of them being members of political parties. This divide might be the major problem in this case since it is based on family life conditions: the social heritage. For example the young people with children might not have the same amount of time to participate, as the elderly middle aged public with no children living at home. To even out this gap the simplicity and availability of PPGIS solutions has to be as high as possible, making it less time consuming to participate.

8.4.2 Simplicity

To overcome all of these obstacles, the solutions created for PPGIS needs to be as simple and straight forward as possible. To get as many people as possible, you need to keep it as simple as possible. You will get no useful results having a truly good solution only accessible to those who have a trained computer science background. In my opinion a good PPGIS solution has got different layers of complexity, meaning that the users can work at their own level of confidence. At the basic level the fundamental decision making should take place involving the broadest spectrum of the participants, while giving those who can handle it access to more advanced tools and analysis.

8.4.3 Open source software

To incorporate the public into the participation process it is also important, that software is developed which the home user can use without having to pay a heavy priced license. In my opinion the home users ideally should be provided with the same kind of tools as professional. If the creative freedom of the ordinary user is restrained by the lack of software, vital parts of the creative problem solving process is undermined. Hopefully the development of open source software will soon reach the field of GIS, providing the home users with an open office like GIS suite for basic operations and analysis.

In PPGIS solutions being developed today you either have to have access to licensed software or use the tools provided to you by the creators of the service. If there is a chance that just one user thinks: “I might want to try to prove this, but I haven’t got the tools for it”, the process has lost vital

input. This again would mean that the creation of analysis result is reserved for the trained user, skewing the decision process.

8.4.4 Standardization

If the PPGIS solutions are to be hosted at a government or municipality level, it would be a great benefit for the process if the data was structured with metadata and descriptions according to the European standards for geographic data. This would make it much easier for the users to retrieve information about the data that they need and make them compatible with other government data. With the INSPIRE directive being implemented, much of the basic data at government level will already be produced – ready to be used in good public participation GIS solutions.

9 Conclusion

As a conclusion, I will try to answer my four research questions from the problem statement.

1. What are the technological problems of implementing such a solution?

As I see it the primary technical problem would be to get good hosting solutions making it possible to handle the amounts of traffic provided by a well implemented service. This could be done but would be very expensive, meaning that the costs for the hosting would represent a massive post on the budget.

Secondly it is always an issue to get the components working together in a secure environment. The solution needs to be secure in order to be kept free of internet bots and hackers. This means that the password system should be carefully constructed, and the web server (apache in this case) should be configured to maximize security.

Finally the flow of the forum would need to be moderated, meaning that someone with administrative rights should be monitoring the debate, keeping it sober and constructive.

Having taken care of these three aspects, it should be possible to have a good working solution.

2. What defines a good PPGIS solution?

The two key elements defining a good PPGIS solution would certainly be simplicity and user friendliness.

If the solution is hard and difficult to understand, then you will only have input from the people that actually spending time on learning the functionality of the service. This means that a substantial part of the possible contributors would not be able to state their opinion and they would not get their voices heard.

It is acceptable to incorporate advanced features, but they should be incorporated in a way not make them vital to the service.

To overcome the digital divide it is of great importance that everybody can get their voice heard in the system. This might in practice not be possible to achieve, but it is surely something that those responsible of the systems should aim for.

In my opinion no particular software can be recommended in relation to this subject. The software development situation today means, that almost any functionality can be incorporated using open source software. This means, that the functionality of the systems has to be adapted to the individual case. Some situations might call for one software configuration, and other might require completely different functionalities.

3. How can analysis results be implemented in the solutions to support the decision process?

In my solution it is possible to exchange data and scripts to facilitate the exchange of analysis and results. Furthermore it is possible to exchange the analysis results as graphics, and in forms of maps. However, my solution is not though able to handle the execution of tools, to make 'on the fly' analysis in the forum. It should probably be possible to establish such functionalities, but this needs an too big programming effort. Therefore I have proposed a way of exchanging materials in a simple form, probably accessible for all users. It is simple and clear to do, and you are carefully guided by the forum software when you upload you materials.

4. How is it possible to design the solution using free software and maps?

In this project i have exemplified how it is possible to use free software to set up a solution. I am certain that if I had used another approach to the creation of this product, I would have been able to find open source software being able to do just that. The focus on developing good software under the GNU license is so intense, that every month, new software with new possibilities is available. In other words: The sky is the limit, it is just a matter of the creativity of the programmer to create the best free solution possible. The supporting community of the different applications makes it easy and fast to get the support required.

Furthermore the use of Google maps as background data is a strong alternative as long as it remains free. It is legal to use the Google maps in any service uncharged

Most municipalities would probably provide their own background material, but for the ordinary users wanting to set up a service using maps, Google maps are the obvious choice.

I have used Php and apache in my design; it could for instance have been java using JavaBB as well – the Java equivalent to phpBB. This is a fine example of the availability of open source software, which makes it a powerful toolbox for all users on all platforms and programming languages.

9.1 Summary

The overall problem statement question was:

How can a public participation GIS system be established to facilitate debate regarding the proposal?

I have analyzed the problems regarding the establishment of a public participation GIS solution to facilitate debate about the proposal. I have recommended a simple user-friendly solution with focus on security. The solution is free to set up due to the use of open source software and free background maps.

The group that initially has raised the idea of building a light rail along ‘Ring 3’ is an interest group of volunteers, working on a case meaningful and important to them. They might not have a huge budget to set up a PPGIS solution, but with my setup they would be able to establish a small functional system to could conduct the debate.

If the proposal becomes political – and it looks as if it is going to be soon, the municipalities have to create an actual public participation process on a higher level – But as a PPGIS solution for an interest group, I think my solution would be adequate.

10 Prospects

Had the development period of the project been longer, I might have had time to create extended functionality, or add more features.

One of the primary things that I have thought of in the later parts of the writing process would be to turn the entire foundation of the system around. Instead of using separate components for web hosting, and forum, I would probably have chosen another approach today.

It would probably benefit the entire solution in terms of user friendliness if the basis platform was a Content Management System (CMS). Here a dedicated download section for analysis, data and articles could be made, providing better overview for the users. The system could also have an integrated forum solution, working within the source code of the CMS. I am not sure whether I would have been able to make a better integration with Google maps if I had chosen this path, but it is certain that it as a minimum would have worked in the same way as my solution.

11 Litterature List

- Arnstein, S. R (1969): "A ladder of citizen participation" JAIP, vol. 35 No. 4 July 1969
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- Hjelmager, J. (2008). "SDI Lecture Notes" Course materials 8. semester Geoinformation technology & Management, Aalborg univeristy
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- Rio Declaration (1992) : "The Rio declaration on environment and development" www.unep.org/Law/PDF/Rio_Declaration.pdf
- Simon, H. A (1978): "Rational decision-making in business organizations" Carnegi-Mellon Univeristy, Pittsburgh, Pennsylvania, USA
- Wikipedia 1: http://en.wikipedia.org/wiki/Digital_divide 10.05.08

Århus convention (1998): “Convention on access to information, public participation in decision making and access to justice in environmental matters”
www.unece.org/env/pp/documents/cep43e.pdf

11.1 Internet documentation for Open source software

GNU: <http://www.gnu.org/licenses/gpl.html>

Apachefriends: www.apachefriends.org

PhpBB: www.phpbb.com

Mysql: www.mysql.com

Php: www.php.org

XAMPP : www.apachefriends.org/XAMPP

12 Appendix A - HTML source code:

12.1 Index Page:

```
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
<head>
  <meta content="text/html; charset=ISO-8859-1" http-equiv="Content-Type">
  <title>Ring 3 lightrail PPGIS solution</title>
</head>
<body style="background-image: url(Graphics/Background.jpg);">
<table style="text-align: left; width: 1420px; height: 148px;"
border="1" cellpadding="2" cellspacing="2">
  <tbody>
    <tr>
      <td style="vertical-align: top; width: 20%; text-align: center;"><br>
      </td>
      <td style="vertical-align: top; text-align: center;"><big
style="font-weight: bold;"><big><big><big>Ring 3 light-rail proposal<br>
PPGIS Solution</big></big></big></big><br>
      </td>
      <td style="vertical-align: top; width: 20%; text-align: center;"><br>
      </td>
    </tr>
  </tbody>
</table>
<br>
<table style="text-align: left; width: 1420px; height: 523px;"
border="1" cellpadding="2" cellspacing="2">
  <tbody>
    <tr>
      <td style="vertical-align: top; width: 33%; text-align: center;"><br>
      </td>
      <td style="vertical-align: top;">
        <div style="text-align: center;">
          <fieldset><br>
<?php
  <legend style="font-weight: bold;">Input Username And Password</legend>
  <label for="t1">Username: </label><input id="t1" name="Username"
type="text"><br>
  <label for="t2">Password: </label><input id="t2" name=" password"
type="password"> <br>
  <br>
  <label for="subm">&nbsp;</label><input id="subm" name="login"
session_start();
?>
<? $strTitle="Passwordcontrol";?>

<? include("header.inc"); ?>

<div class="Content">

<?
$db=mysql_connect("root", "", ""); mysql_select_db("Login");
$result = mysql_query("SELECT NULL FROM users WHERE Username =
'".$_POST['Username']."' AND password = '".$_POST['password']."'") or die
(mysql_error());
if ($antal_raekker=mysql_num_rows($result)>0){
$_SESSION['main.html']=1;
$_SESSION['Username'] = $Username;
$_SESSION['password'] = $password;
}
else
{
  echo "<h1>Login Failed</h1>
```

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```

<p>Login required <a href=\"default.php\">Log in</a></p>;
value=\"Login\" type=\"submit\"> </fieldset>
</div>
<table style=\"text-align: left; width: 472px; height: 343px;\"
border=\"1\" cellpadding=\"2\" cellspacing=\"2\">
<tbody>
<tr>
<td style=\"vertical-align: top; height: 25%;\">
<div style=\"text-align: center;\"><span
style=\"font-weight: bold;\">This page introduces
Public Participation GIS systems to the resent proposal regarding a
light rail solution following ring 3 from Br&oslash;ndby to Lyngby</span><br>
The homepage of the proposal can be found at :<br>
<a href=\"http://www.letbaner.dk/\">http://www.letbaner.dk/</a><br>
The content of the proposal can be found here:<br>
<a href=\"Pdf/ideoplaeg_ring3.pdf\">Lightrail proposal (pdf)
2.2M</a><br>
</div>
<br>
</td>
</tr>
<tr align=\"center\">
</tr>
<tr align=\"center\">
<?php
if (!$_POST) {
<td style=\"vertical-align: top;\"><span
style=\"font-weight: bold;\">Mail list</span><br>
Recieve news and updates about the development of the project
<p><strong>Your E-Mail Address:</strong><br>
<input name=\"&quot;email&quot;\" size=\"40\" maxlength=\"150\"
type=\"&quot;text&quot;\"> </p>
<p><strong>Action:</strong><br>
<input name=\"action\" value=\"Subscribe\" checked=\"checked\"
type=\"radio\"> Subscribe <input name=\"action\" value=\"Unsubscribe\"
type=\"radio\"> Unsubscribe <br>
<input name=\"submit\" value=\"Submit Email-Adress\"
type=\"submit\">
} else if ($_POST) {
if (($_POST[\"subject\"] == \"\") || ($_POST[\"message\"] == \"\")) {
header(\"Location: sendmymail.php\");
exit;
}

//connect to database
$mysqli = mysqli_connect(\"localhost\", \"\", \"\", \"Maillist\");

if (mysqli_connect_errno()) {
//if connection fails, stop script execution
printf(\"Connect failed: %s\\n\", mysqli_connect_error());
exit();
} else {
//otherwise, get emails from subscribers list
$sql = \"SELECT email FROM subscribers\";
$result = mysqli_query($mysqli, $sql) or die(mysqli_error($mysqli));

//create a From: mailheader
$mailheaders = \"From: Your Mailing List <you@yourdomain.com>\";

//loop through results and send mail
while ($row = mysqli_fetch_array($result)) {
set_time_limit(0);
$email = $row[\"email\"];
mail(\"$email\", stripslashes($_POST[\"subject\"]),
stripslashes($_POST[\"message\"]), $mailheaders);
echo \"newsletter sent to: \".$email.\"<br/>\";
}
mysqli_free_result($result);
mysqli_close($mysqli);
}
}
?>

```

[illegible]

12.2 Main page :

[illegible]

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[illegible]

