Enterprise GIS in the City of Aalborg

GIS strategy in a multi-disciplinary, multi-departmental organisation

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ABSTRACT

An enterprise organisation gives a broad and dynamic range of needs and demands for GIS services.
This presentation will describe how we try to cope with this challenge at different levels without seeing GIS as the goal, but as a means to support the rest of the organisation in fulfilling their tasks.

Strategy
- *Detecting the needs of the organisation - this makes up the foundation of the strategy*
- *Consolidation – both technical and organisational*
- *Cooperation*
- *Working with integrated information systems rather than isolated ones*

Technical
- *Choosing server hardware/software configuration*
- *Systems & user administration*
- *Controlling software at the client's desktop.*

Organisation
- *(Super) user organisation*
- *Helpdesk*
- *Education*

Where is GIS in Aalborg heading – technologies and methodologies to come?
Finally we take stock of which areas to focus on when implementing GIS in organisations with great diversity in purpose and usage types.

1.0 Introduction

An enterprise organisation gives a broad and dynamic range of needs and demands for GIS services. This presentation will describe how we try to cope with this challenge at different levels without seeing GIS as the goal, but as a means to support the rest of the organisation in fulfilling their tasks.

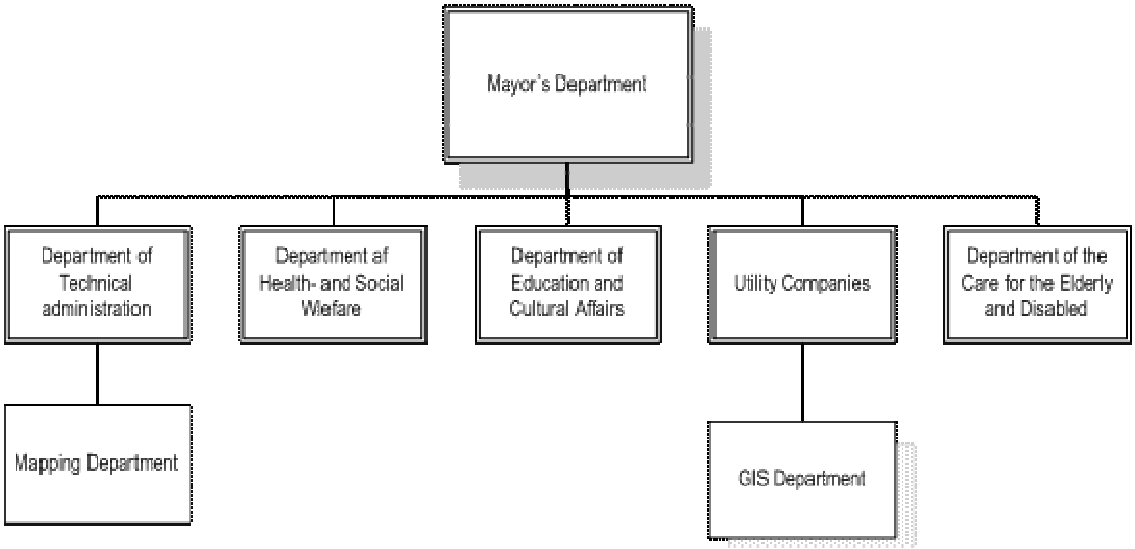
How do we justify calling our GIS environment an EGIS? Our understanding of an EGIS is a GIS environment that can handle many different types of tasks in many different organisations with an extremely varied end user group.

The Public Utility Companies within the City of Aalborg consist of 6 different utility companies, each with their own business culture (see description of the organisation within the City of Aalborg below). The GIS environment is used at all levels within the organisations, from senior management to the "people in the field". The GIS environment is used for a wide range of tasks such as economic analyses, engineering project planning, information to customers, or readiness for watch teams on duty in the event of failures, to name but a few. This complex environment can only be managed by coupling the GIS environment to other utility-specific systems in order to achieve cohesion throughout the entire IT system architecture. According to our definition, the integration of GIS to other systems leads to the difference in the term EGIS in relation to standard GIS environments.

This complexity forms the background for what we refer to as EGIS. Compared to, for example, American utility companies, we are very small – in terms of size. However, if considered as an enterprise that in fact covers 6 different types of utility supply, the demands made on our GIS environment are complex. Furthermore, the utility companies are geographically dispersed, but connected with a good LAN. Our postulate is that there is a greater challenge (and more fun) in handling and integrating a complex GIS environment than simply scaling in size the overall GIS installation. What *is* significant with regard to the size of the enterprise in terms of the establishment of an EGIS is the economic aspect. We do not have the same capital as the major American enterprises, but we operate within the same market – and on the same terms. We believe, for instance, that ESRI's price structure for licences for an EGIS is thus better suited to the large American scale, whereas the situation is different for European utility companies.

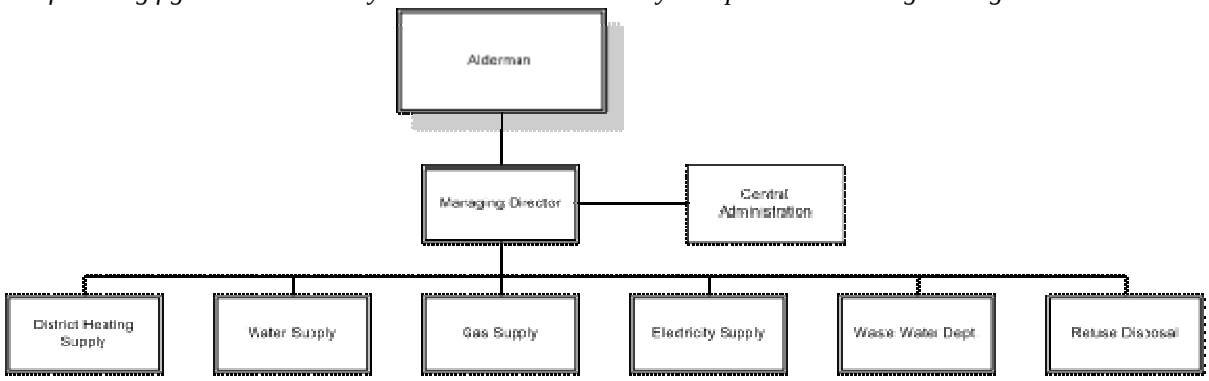
Brief introduction to the City of Aalborg's Public Utility Companies:

The Public Utility Companies are part of the City of Aalborg, which is the municipal authority governing Denmark's fourth largest municipality, which is home to approximately 165,000 inhabitants. The municipal authority has 12,500 employees and a turnover of approximately DKK 10 billion (1.35 billion Euro). The City of Aalborg is organised as shown below.



There are two departments in the municipal organisation that work with GIS. The mapping department is responsible for technical maps, cadastral maps, orthophotos, etc. The department we are dealing with belongs to the Public Utility Companies. Collaboration takes place across the departments in order to achieve a synergy effect.

The following figure shows the way in which the Public Utility Companies in Aalborg are organised.



In this paper we will concentrate exclusively on the Public Utility Companies and the use of GIS herein.

In the following we will try to elaborate on our definition of what EGIS is in relation to the Public Utility Companies and which overall considerations we have made on a strategic, technical and organisational level in connection with the establishment of our EGIS.

2.0 Strategy

Detecting the needs of the organisation - this makes up the foundation of the strategy.

Why use EGIS at all – can it solve the needs/problems of the Public Utility Companies?

This has required a comprehensive analysis and description of the problems that exist in the types of utility companies for which we work. In any case, utility companies are generally enterprises in which it is necessary to have full control over information. Information is used in all business procedures in the utility companies – operations, maintenance, turnover, etc. For example, it is absolutely essential that information is easily accessible and accurate in the event of failure of the utility supply systems. It is not acceptable that customers should be without gas, water, electricity, district heating or are unable to have their refuse collected due to inaccurate or insufficient data. This data often has to be used in situations that require rapid action. The majority of this information has a geographical component.

The executive management in the Public Utility Companies in Aalborg recognised at a very early stage that the use of the information, seen with a geographical perspective, was essential for successful operation of the utility companies. As a result, during the 1980s and up to the present day a great deal of resources have been devoted to the acquisition and quality assurance of geodata in many forms. At the same time, the management decided strategically that the GIS environment should be given a leading and coordinating role in the various utility companies – it can be defined as the link in the quantity/flow of data between other systems. It is therefore a management demand that when carrying out changes to the system architecture of the Public Utility Companies, the potential for integration into GIS must always be taken into account.
An important point in the establishment of EGIS in the Public Utility Companies has been the acknowledgement that GIS is a means to solve problems/needs and not an actual goal in itself. The requirements for establishment have been to exploit resources in the optimum manner – both economic and human. This optimisation of business procedures with regard to the use of EGIS has been carried out on the basis of a desire for greater competitiveness, i.e. that costs should be low – not necessarily in absolute terms – but in relation to the utility value.

A combination of experience gained from earlier closed, proprietary and restrictive systems and the desire to obtain operational benefits with a controlled use of resources has been the basis for our requirements with regard to the current system. The main elements of these requirements are: openness, standard system, modelling options, integratability and a high degree of accessibility. We believe that these characteristics fulfil the needs and problems that exist at the Public Utility Companies.

How have we then implemented the GIS system such that it contributes to the solution of tasks?

<u>Consolidation, cooperation, integration</u>

2.1 Consolidation – both technical and organisational

The main aim has clearly been a meaningful establishment of the systems, i.e. utilisation of the systems that provide a common benefit instead of choosing the systems that in isolation give the fastest/easiest benefit for the individual utility company. It may therefore be the case that the individual utility companies would have been able to benefit from the possibilities offered by the utility-specific system, but our experience is that the synergy effect in the long term leads to a completely different and better exploitation. In short, the main thesis is that we do not solve the individual utility company's problems with so-called "quick fixes", but think the problems through more thoroughly, transfer them to the different companies and carry out implementation with the participation of all the utility companies. This places great demands on the organisation, however. It has been a management strategy to announce clear goals and visions at an early stage so that the employees have been totally aware of the goals to be achieved, a course of action that promotes motivation and cooperation. In the end, however, this strategy opens up far greater possibilities and, equally important, will not impose any restrictions on future solutions.

2.2 Cooperation

A second general strategy has been that this task should be tackled through cooperation across the utility companies. The GIS Department was therefore also set up with the goal of working for all the utility companies. This gives a completely different economic dimension, but also makes demands with regard to openness on the platform. All decisions at both strategic and system level are taken jointly. The synergy that has arisen as a result of this has led to all the utility companies working towards the same goal. In addition we also have en extensive cooperation with external resources, among which the local danish ESRI distributor InformiGIS is one of our major partners.

2.3 Working with integrated information systems rather than isolated ones

An important strategic decision has been that the data should be intelligent – i.e. that actual data models are used, e.g. network models. These models enable the data to be utilised in new ways such that analyses for maintenance can be made, contingency plans can be made, and optimisation can be implemented. The models have also resulted in the creation of a set of rules for minimising errors, as well as proper documentation of the data, etc.

One of the most important characteristics for the models has been the possibility of integration across the specific systems in the individual utility companies. The use of models is not a pre-requisite for integration, but provides other and better conditions for integration, in particular concerning documentation of data and maintenance of relations, which have become easier and clearer.

Today the Public Utility Companies are working on integration towards specific systems such as the economy/billing system and SCADA (Supervisory Control And Data Acquisition), towards network design calculation systems and maintenance systems. This takes place based on the idea that these specialist systems are the best tools to handle the related tasks, but that the data/results have to be able to be used and visualised by other persons/systems.

The GIS environment is therefore defined at management level as a strategic system on a par with the billing system because it is seen as the core element in the integration of utility-specific systems.

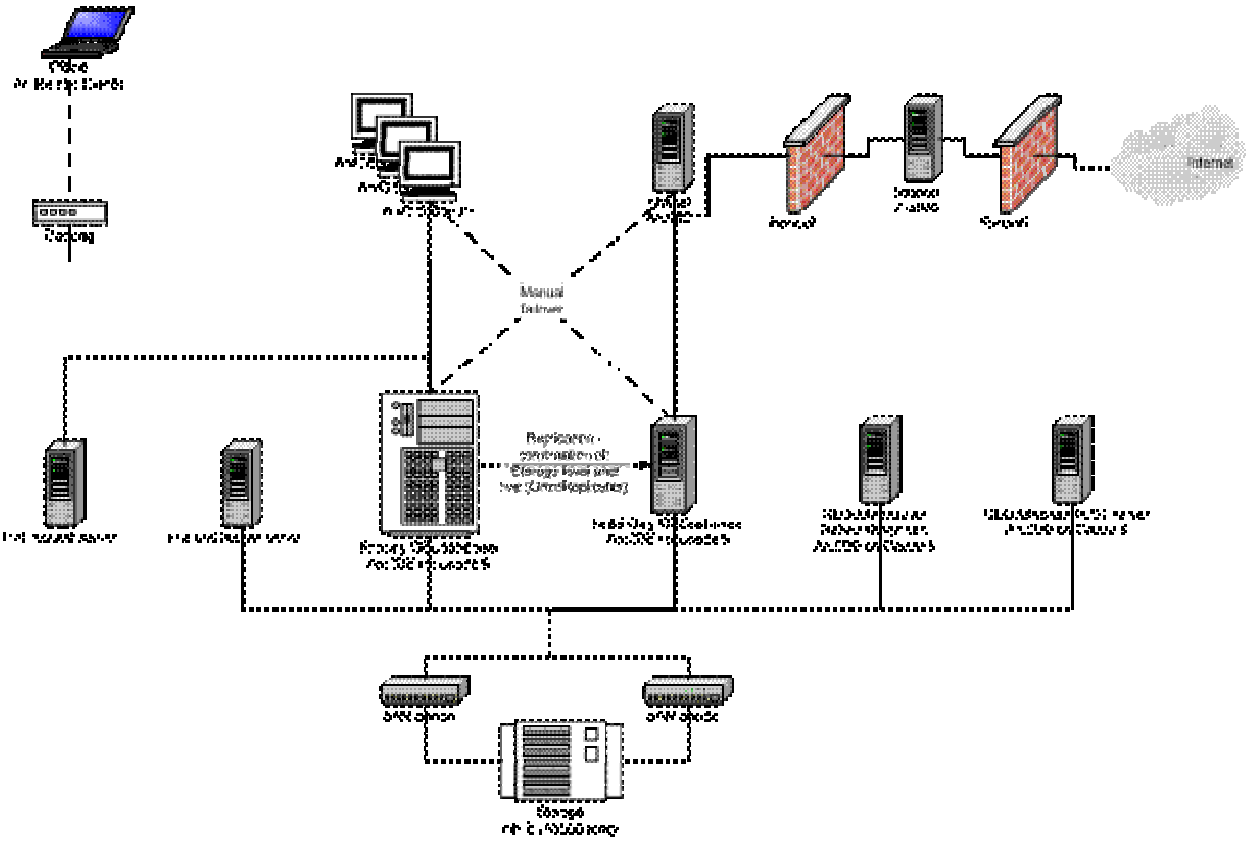
3.0 Technical

3.1 Choosing server hardware/software configuration

Our general IT use is organised such that the municipal authority has a common IT centre that is responsible for our infrastructure – from network to standard PC installation. Standards for hardware, operating system, configuration, network, etc., are laid down within this structure. The environment is based on standard servers and personal computers, MS Windows as the operating system, a 100 Mbit network with Gbit on the server side. We only purchase hardware that falls within the general standard lines. In this way the number of specialist products is limited, which helps to make operations efficient.

The same applies to software, where the aim once again is as many standard products as possible. If it is found as standard, it is used.

Since the areas of application continue to increase in scope, more and more focus is being applied to system reliability and uptime. Work is therefore progressing towards a system configuration that takes this into consideration:



By consolidating operations around a central storage unit for the GIS database environment, not only is the uptime improved, but also the potential for effective replication.

In this configuration a copy database for enquiries must be maintained that will be available in the event of system maintenance on the operational system. In this way, we can be sure that data is always accessible without precluding maintenance of the main system. In addition, the storage solution provides an easy way of creating a copy data set (snapshot) without requiring major work or storage space, e.g. for use for test systems.

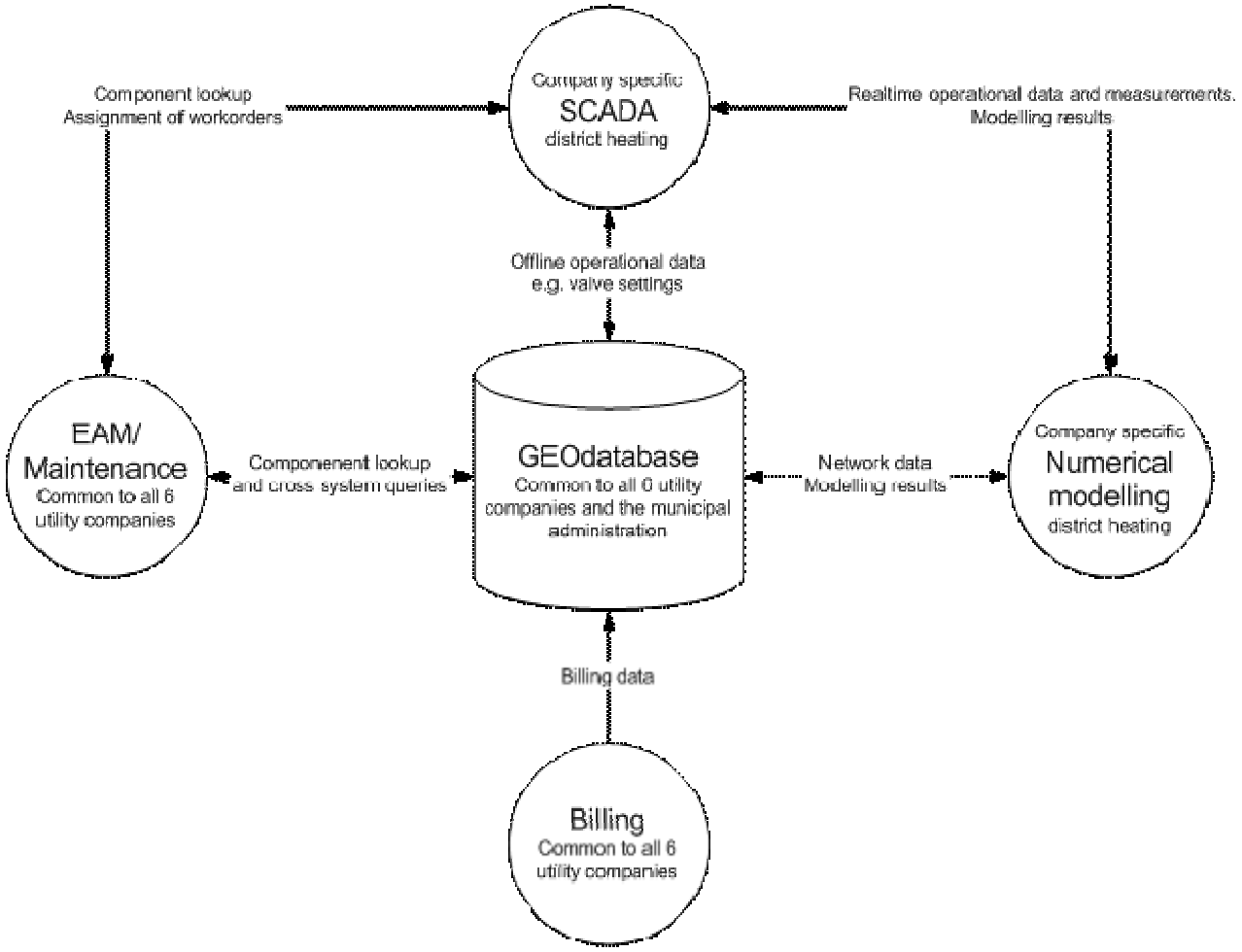
A well-performing storage system is also necessary to ensure that GIS data can be gathered in one central database, otherwise there is a risk that departments that have special requirements demand their own individual solutions, whereby the potential for integration and synergy effects is reduced.

On the system/software side we work with a configuration of the following GIS products: ArcSDE on Oracle, ArcGIS (Info, Editor, View) clients, ArcFM in the utility companies, ArcIMS (implementation, operation and development rooted in the mapping department). ArcReader is the preliminary implementation for field personnel while we are waiting for sufficient bandwidth for "heavy" online field solutions. We also use various extensions – both standard and specially developed.
We are currently implementing NetworkEngineer from MESA solutions for the registration of copper and fibre cables for control and communication.

When we receive specially developed applications, we try to persuade our suppliers to supply standardised products that technically, functionally and in terms of the system are suitable for our environment. At the same time, we encourage our suppliers to find other interested customers in order to achieve a synergy effect in the development and pricing of these applications.

System-wise we also try to consolidate with respect to the integration of GIS with utility-specific systems. We operate with a number of systems that are common to all types of utility supply. These are economy and stock, consumer billing, remote reading and GIS. We are also working on the establishment of a common maintenance system based on a test case in one of the utility companies. In addition, each type of utility supply has systems that are more or less technically specific, primarily since they are designed for the technical configuration of the type of supply in question. Such systems primarily concern SCADA systems and systems for numerical modelling. We are working to ensure that the integration of these systems with the common standard systems is implemented according to uniform methods so that accumulated experience and development efforts can be reused and shared between the utility companies.

An example of the integration setup is illustrated here in the case of district heating:



The example shows the need to know the current valve settings in the network when performing design optimisation calculations for the district heating network in numerical network calculation systems. This information is handled in the SCADA system, from where the valve settings are adjusted via remote control. At the same time it is always necessary to perform calculations on the basis of the latest information concerning the district heating network with respect to repairs, etc. This information is stored in the GIS system, which means that if the network calculations are to be utilised in the optimum manner, there must be integration between the network calculation, SCADA and GIS systems.

Technically speaking, integration takes place by ensuring that the modelling – especially with respect to identifications – is uniform across the systems, and that SCADA and model calculation systems retrieve data from the GIS database directly.

3.2 Systems & user administration

Within the administration of systems and users, our focus is concentrated on the areas that create value for the utility companies. We therefore work with a small internal operating crew, so both monitoring and corrective action with regard to the server are outsourced to the local distributor of ESRI software. Similarly, we are not responsible for internal development, but use resources to coordinate projects and create cooperation (and synergy) between the utility companies.

User administration on a multi-utility, multi-version database is relatively complex when it is necessary to ensure that only relevant users edit the individual data sets and versions. It would be of benefit if the possibilities for supporting complex management of user privileges were further enhanced in future versions of ArcGIS.

Owing to the diversity of the group of users, system integration and intensive use, accessibility of the data is essential.
Modifications in data models and version upgrades are therefore made more difficult. Measures that increase uptime - storage, duplicate system for enquiries, etc. - are therefore required.

3.3 Controlling software at the client's desktop

Owing to requirements concerning increased accessibility, version upgrades of ArcGIS basis versions and applications cannot be carried out without thorough preparation. In addition, the resources available for such upgrades are not unlimited. We have therefore chosen to organise such considerations into a system.

Installations of the GIS basis client environment, including both standard and customised extensions, are performed as adapted package installations by the employee responsible for the local system in the IT organisation.
Service packs, patches and modified extensions, etc., are installed by means of MS SMS. A system to check that the GIS clients have the correct versions installed has been developed.
This would not be possible if we did not have a well-functioning IT organisation that was involved in the work – once again an example of cooperation across professional boundaries. At the same time, the fact that we use a standardised software environment makes it economically viable. It is particularly important to consider these aspects in an organisation with many users in numerous different geographical locations: At present there are 220 desktop users and an unknown number of IMS and offline users.
In this regard, a particularly positive development has been that ESRI and Miner&Miner have begun to support MS SMS and standardise their installation concept on MSinstaller. We would be happy to see this development continue in future versions.

4.0 Organisation

4.1 (Super) user organisation

An EGIS requires control of the organisation in several respects. There must be a safety net to gather errors, wishes, provide information, etc. We have chosen to organise ourselves in the Public Utility Companies in such a way that the GIS Department is the central knowledge unit from which all overall strategies, error solutions, etc., are handled. From this department there is contact to super users and system administrators in the individual utility companies.

We define our support system as the "wave principle" towards the end user. The first wave is the local super user or system administrator at the utility company in question with knowledge backup from the other companies depending on the problem or the need. Expertise within the individual fields in the GIS area and the use of special data types (e.g. topologies or networks) are distributed between the utility companies. At the same time the user is encouraged to utilise self-help through our own GIS Helpdesk system, which is described in more detail later. The second wave is the GIS Department in cooperation with ITC (general IT experts). The third wave is made up of the Danish

suppliers of programs/software solutions with whom we have taken out support contracts or the use of different forums on the Internet. The fourth wave is made up of the software developers, e.g. ESRI or Miner&Miner, if the problem/need has to be scaled “all the way to the top”.

In this context, the organisation may appear to be confusing for the end user. We therefore make it a point of honour to maintain this system on an informal level such that the majority of end users find the system flexible. Internally within the GIS Department we operate with a rotation principle at the utility companies such that the end user, super user and system administrator are upgraded in terms of knowledge. It has proved to be very important that help is provided as locally as possible.

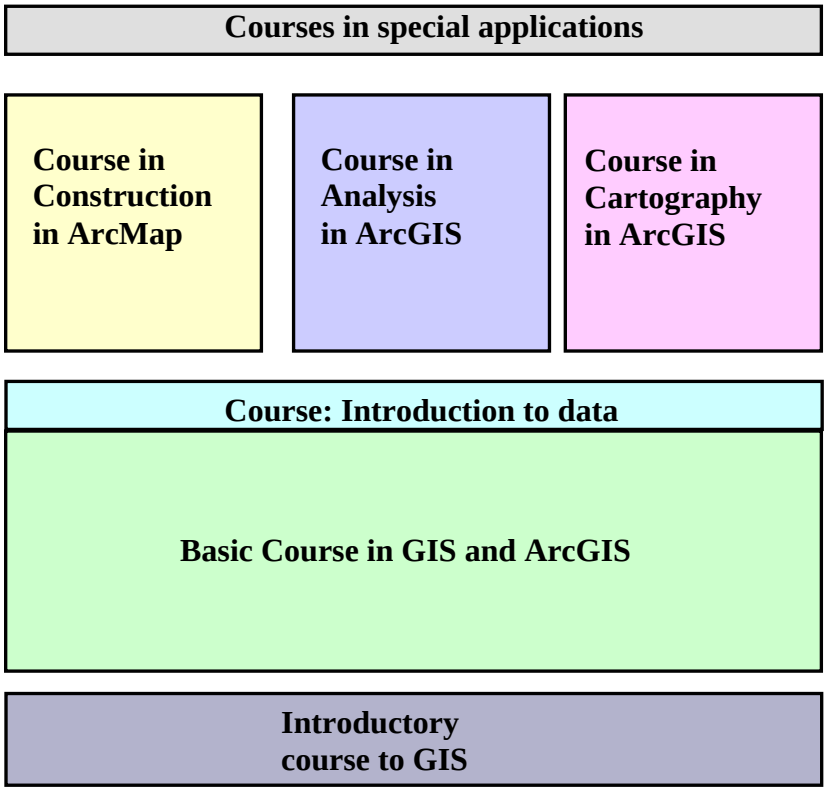
4.2 Helpdesk

At present we are in the implementation phase of a specific GIS Helpdesk, which is (once again) a standard system configured for our purposes. The helpdesk will deal with several areas, such as error reporting, reporting of wishes/projects, exchange of information, tips & tricks, to name but a few. This system again helps the end user to perceive the system as flexible since the distribution of resources (internally, externally and between the different waves in a support context) takes place through this system. The end user can therefore follow the process since the system is fundamentally open. At the same time, this system shall reveal/optimise our internal resources in the area.

4.3 Education

Our management has acknowledged that it is not possible to run EGIS unless users at all levels of the organisation have received training. This training must cover not only the basic knowledge concerning use of the software, but also an understanding of using the tools and the data. In partnership with Informi GIS (the Danish ESRI distributor), we have produced a training concept that takes into account the diversity of our users – ranging from artisans in the field through project-planning engineers and all the way up to senior management.

The concept covers a varied course of study as shown in the sketch below.



The training course began in 2003, where approximately 650 course days were held for approximately 210 participants in different variations. The most important aspect of this concept is not just that we have a large number of well qualified end users, but that the GIS tools and data have migrated into all corners of the organisation! In this way, GIS as a concept has been demystified and has thereby acquired the status of being an accepted and comprehendible tool! It has not resulted in fewer errors or questions to support, but they are at a different level than previously.

During the last few years we have gained an understanding of the fact that the organisational approach to implementation, operation and development of an EGIS plays a major role. Reasonable strategies, monster hardware and quality software are not worth anything if the organisation - with the associated human factors - is not up to speed.

5.0 Concluding remarks

5.1 Where is GIS in Aalborg heading – technologies and methodologies to come?

The Public Utility Companies are at present on the verge of upgrading to ArcGIS version 9. Experience has shown that, unlike in isolated systems, upgrades require major considerations and planning. An EGIS with many users, integration to other systems, etc., requires a totally different level of planning. The advantages and disadvantages of upgrading must be clearly defined. ArcGIS 9 has a number of functions that make it attractive to upgrade – including the new geo-processing environment of which we are expecting a great deal. Utility companies often have a large volume of data that is frequently processed or improved. However, it is clear that upgrades will in future be controlled by tangible benefits for the utility companies – benefits that must outweigh the costs associated with upgrading.

In the near future, integration to other utility-specific systems will also have high priority, both with respect to more systems and the development of existing integrations. The following projects can be mentioned:

- Greater integration to network calculation of district heating
- Greater integration to SCADA, district heating
- Integration to maintenance system, initially district heating - the rest of the utility companies will follow in due course.
- Greater integration to the billing system for all utility companies.
- Integration to network calculation and SCADA for electricity.
- Integration to network calculation and SCADA for water.
- Integration in relation to property registers.
- Documentation of communication and optical fibre cables (Network Engineer).

These projects will make the work with EGIS more complicated, although the potential for utilising the data and systems will increase significantly.

Following the upgrading of the GIS environment to version 9, we will examine the possibilities for utilising other ESRI products: Engine and Server. We have already had a great deal of application development carried out for our various tasks in the ArcGIS environment. In the future these new products will be taken into consideration when looking at development tasks. Both the possibility of

making specially designed applications for particular user groups and the possibilities for making web applications with greater functionality, e.g. for the field personnel (when we have sufficient bandwidth), are particularly relevant.

2005 will also be the year in which ArcFM from Miner&Miner will be fully integrated into our environment. At present the products are used in more specialised tasks where it has been decided that we will exploit the many facilities that are available in ArcFM. ArcFM will become part of the standard setup.

ArcSchematics has already been acquired, and it is our plan that the product is run in within the environment. There are a large number of possible applications that are essential in connection with a supply network.

The greater exploitation and greater accessibility of data demand greater distribution among the user group. Mobile GIS will have a high priority in the future. We already have online and offline solutions when using ArcIMS and ArcReader. These products are to be developed so that our teams in the field (maintenance, repair, duty, etc.) can take greater advantage of our general and utility-specific systems.

5.2 Conclusion

In addition to the aforementioned new projects, the future will also be characterised by a continued consolidation of the entire GIS environment. For example, the automation of general data routines will be in focus so that human resources can be released to handle projects and the production of new data. Resources will be released through an increased focus on quality assurance of both data and applications/extensions. This will first and foremost be in areas in which there are errors in data or in which applications adversely affect the operating environment – especially with regard to integration. This greater degree of security for uptime on the systems and higher quality levels are necessary since the GIS environment is central in all utility companies and thereby involves a lot of people. We are therefore aiming for standardisation/uniformity as a general characteristic throughout the GIS environment such that this area will be easier to handle for the GIS personnel.

In terms of data, it is vital that we maintain and develop all our data models. In our opinion, the data models form the backbone of EGIS. It is thanks to these models that we are able to develop and integrate to the extent that we do today and fulfil our future aims.

However, all these noble words concerning powerful hardware that provides good performance, powerful software and brilliant data models mean nothing if focus is not applied to some of the most important areas. The implementation of such an EGIS requires visionary management that is willing to risk striking out in alternative directions and which sees the GIS environment as a pivotal point in the operation of the utility companies. This solid rooting in the management is an absolute prerequisite for the whole environment. In addition, our cooperation across the various utility companies makes this synergy effect possible.

To conclude, we would like to emphasise recognition of the fact that GIS is just a means and not a goal in itself! With this in mind, EGIS is able to reach out to all personnel groups rather than being a specialist system.

Have we then achieved the objectives that the Public Utility Companies have specified for an EGIS?

Yes! We are convinced that we are on the right track. We have chosen to approach the problems that exist on the basis of the goals that the management has specified with regard to utility value, coordination and synergy. From this it can be concluded that the technical part of the implementation of an EGIS is not the area that shall receive highest priority, but that focus should be applied to the organisational and human side; it is from there that success is born!
At the same time, it is crucial to recognise that such a task will NEVER be completely finished!