Geoinformation management 3.

Implementation of a GIS

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The aim of the module is to give an overview of the practical methods of a GIS implementation starting with the needs analysis and feasibility study, ending with the description of the GIS application development steps.

Tartalom

3. fejezet - Implementation of a GIS

1. 3.1 Introduction

The module starting with the description of needs analysis and feasibility study, i.e., the decision phase of introducing a GIS. Needs analysis determines the information needs of the organisation. The feasibility study first determines the scope of the project in realistic terms. What can be achieved given the technical, financial and organisational constraints?

After this, the next chapter reflects on the influence that the introduction of GIS can have on an organisation and the people in that organisation. Positive and negative effects are examined.

A very visible step in the realisation of a GIS project is the selection of the actual system. Chapter 3.3 explains the evaluation process and the tasks, which must be solved. It is followed by an analysis of the organisation, which wants to introduce the GIS from a technical point of view and a description of how the technical requirements and benchmarks are set up. The evaluation of the offerings of different GIS vendors is difficult and a multitude of criteria must be considered and weighted. The chapter concludes with a brief description of the steps involved in the development of a GIS application.

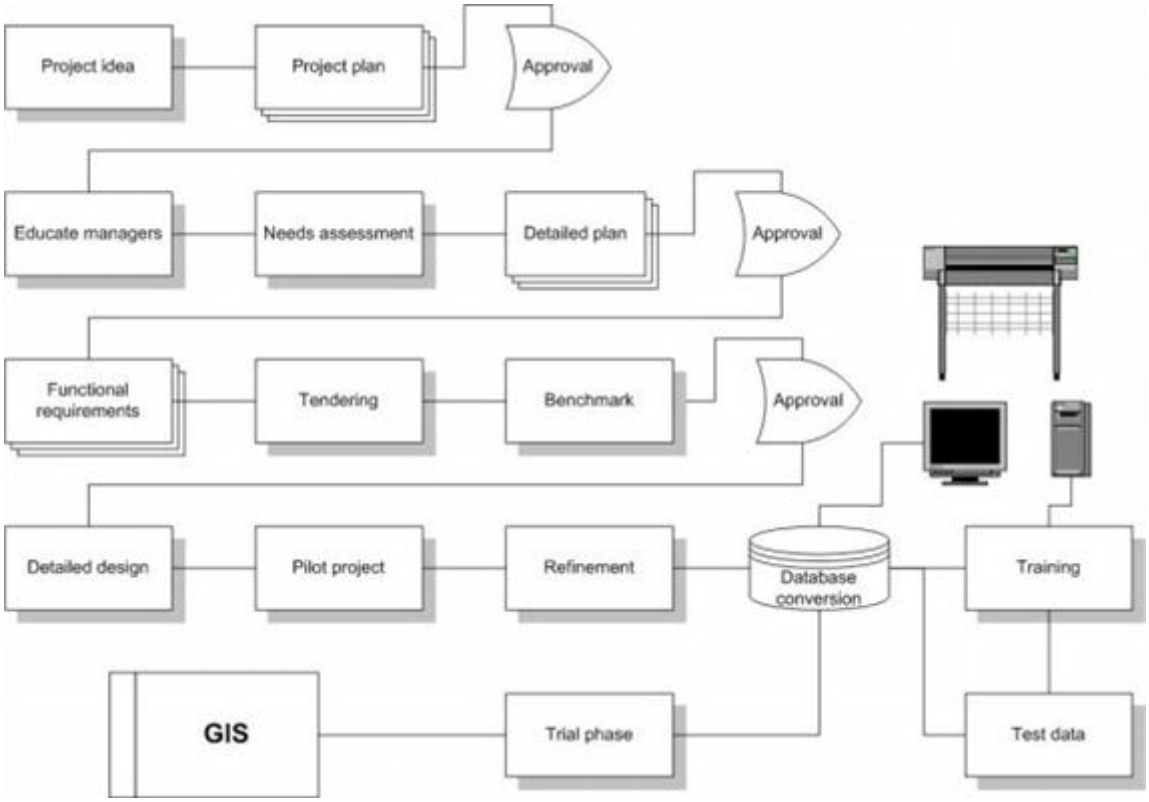

Fig.3.1. The process of a GIS implementation

In this module “Guidelines for best practice in user interface for GIS” are used, which were resulted by the BEST-GIS, EU ESPRIT project (cordinated by GISIG).

The aim of the module is to give an overview of the practical methods of a GIS implementation starting with the needs analysis and feasibility study, ending with the description of the GIS application development steps.

From the module you become familiar with the:

- GIS implementation process
- feasibility study of a GIS Project (Cost-Benefit Analysis, technical feasibility and institutional feasibility);
- GIS influence on organisations and on people;

- methodologies for design and selection (the GIS evaluation phases and procedures, GIS application development, basic steps in the completion of an application);
- project monitoring.

After learning of this chapter, you will be able to:

- summarize the GIS implementation process as a whole,
- explain the main features of the Cost-Benefit Analysis,
- illustrate the GIS influence on organisations,
- demonstrate GIS influence on people,
- give orientation on the methodologies for design of a GIS,
- identify the basic steps in the completion of an application,
- discuss the importance of project monitoring.

2. 3.2 Feasibility of a GIS Project

2.1. 3.2.1 Cost-Benefit Analysis

Cost-Benefit analysis (CBA) is a method to reduce uncertainty during decision making and planning by replacing opinions, believes, and emotion by a framework for identification and determination of the benefits and cost, respectively of each alternative GIS.

The objective of CBA is the assessment of the advantages of a specific GIS application over competitive solutions and traditional work procedures.

The results of CBA provide a basis for comparing GIS options. Public sector decisions are thought to be more complex because both policy and financial impacts must be considered. Private enterprises need to be concerned only with the accountant's 'bottom line'. In fact, though, both private and public sector decisions are better when they consider all aspects of a given alternative, whether those aspects have a line in the balance sheet or not.

The assessment of the economic viability of a project requires a comparison of the cost with the benefits. The total cost of a project must be less than the total benefits it produces, otherwise the project should not be realised.

The cost of the solution can be estimated by combining cost of hard- and software, data collection, user training etc. To estimate the benefits, there are two approaches available, based on the Information Product Metaphor. The ‘avoided cost’ approach compares the cost of producing the information product by GIS, with the traditional method used. Assuming that the traditional method is beneficial (i.e. not running at a loss), the costs of the traditional method can be taken as a minimum estimate of the benefits it contributes to the organisation.

Estimating a fair price for the information product is the appropriate method if the same information product is not currently being used. The idea is to consider how much a user would pay for the information product. A user is willing to pay at most the amount he benefits from the information; therefore we consider the task, the risk involved in the decision, how much the risk is reduced by the information received etc. Reduction of risk is comparable to buying insurance - its value to the user and thus its market price can be assessed.

Cost calculation

The cost estimation is a vital link in the success or failure of the GIS project/purchase. However, the price of a GIS (hardware and software) is not the most important cost factor. Issues such as usability, learning and training cost, support, (future) vision of the vendor as well as data compatibility all affect the decision for a particular GIS.

Roughly one can divide the costs of a GIS into the following components:

- Hardware
- Software (base software, base GIS and additional GIS modules)
- Maintenance
- Services (resources to fulfil the GIS project objectives, e.g. customisation)
- Training
- Data (if obtained from elsewhere)

Benefits

There are no fixed categories of benefits. This makes counting benefits much more difficult than counting costs.

In a large, government-wide project benefits were grouped into four categories: direct, agency, government, and external. A valid equivalent for the private sector would be direct, departmental, company-wide, and external.

- Higher productivity (of the end-user's final product). For instance compared to using old methods productivity increases with a factor 4 to 6.
- Resource reduction. By using a GIS, the number of people working in the department can be reduced.
- Although care should be taken with the statement. Many people have thought the GIS and automated mapping would costs jobs. The opposite proves to be true. Mostly the same number of people were employed, only the production went up.
- Quicker response. In some applications, such as traffic management using a GIS, the time factor is important.
- Easier (cheaper) maintenance. Often the real payoff for a GIS lies in the maintenance of data. The initial data capturing is the big hurdle to overcome (technically and price-wise)

GIS is not a miracle machine that solves all the customer's problems. It should be considered as a tool that forms part of a project of which the service cost is bigger than the system itself. A few objectives could be:

- Cost savings. Install a GIS in order to save cost that would be spent without a GIS.
- Better response times. Install a GIS because the traditional workflow is too slow.
- Higher quality. Install a GIS because the traditional work procedures produce inaccurate results

The key question always to keep in mind is "what is the user's goal". It has been demonstrated in many failed IT projects that a seemingly wonderful system does not solve the desired problem because it was poorly focused and aimed at the outset.

The economic aspects of GIS are further discussed in Module 7.

2.2. 3.2.2 Technical feasibility

Technical feasibility is a complex issue and the measure of feasibility depends on many factors. Having criteria by which to select the most appropriate technology for each application or set of applications is of greatest significance. These criteria are the result of a detailed understanding of the business functions to be supported and to what level of sophistication. Basic support functions such as data query and display are far less complicated to implement than complex decision-making.

Without adequate decision criteria directed by the strategic vision, the likelihood of becoming "technology driven" is high. That is, solutions are looking for problems to solve. In this environment technical feasibility ceases to be an issue. The right technology is always available, because "right" is defined by what is available. A broader more systematic view of technical feasibility is required to avoid becoming technology driven.

In evaluating technical feasibility, part of the evaluation relates to the use by the end user and to the amount of training and technical support necessary to use the application. One way of dealing with technical complexity is

to hide it from the end user by implementing sophisticated easy-to-use machine interfaces. The human-machine boundary is a conceptual meeting point of the operator and the computer. The more the complexity of the computer's work that can be hidden from the user, the easier the computer is to use. More "user friendliness" generally means more software development, but also lower training and start-up costs for the end user.

It has been demonstrated through various projects that significant reductions in training requirements and learning curves can be achieved by customising software for specific job functions and through effective user interfaces. However, that often translates into higher development costs per application unless the software development can be shared.

Technical feasibility is further complicated by the likelihood that GIS technology will be acquired over long periods of time. Acquiring technology over a period of time involves both benefits and risks. By purchasing only what is required for each application, the organisation can benefit from the rapid advances in information technology. The risk is not being able to properly or readily combine the technology. The risk can be managed by defining a technology strategy and architecture, by adhering to as many industry standards as practical, and by closely monitoring technology trends.

2.3. 3.2.3 Institutional feasibility

Institutional feasibility deals with the willingness and ability of an organisation to accommodate change and to work across traditional lines of authority. When a planned GIS implementation will serve many organisational units and require several years to be completed, institutional feasibility is important. Technical feasibility needs to be aligned with the ability and willingness of the organisation to sustain a large project over the life of the planning horizon. Budgets and management support will need to be sustained at required levels, staff education and training may need to span several years, and technology acquisition may be spread over several fiscal years.

Institutional feasibility, more than technical feasibility, is tightly bound to the scope of the project. Some additional factors to be considered in evaluating institutional feasibility and establishing the project scope are discussed below.

- Is the GIS to be multiple or single purpose?

A system designed to support a single organisational function is simpler to specify, design, and implement, than one that must support a variety of functions. However, if the single purpose implementation depends on data from other parts of the organisation, or if other parts of the organisation also have an interest in GIS, then a single purpose project attempt may fail. Implementing a GIS in one organisational unit and not in other related units may also create imbalances in the overall functioning of the organisation.

It is often advisable to make a plan for a phased introduction, thus achieving the simplicity of a single purpose system with the institutional support for a multi-purpose (long-term) goal.

- Will the GIS be implemented to automate line-management or support functions?

Many organisations have begun by implementing computer aided drafting systems to automate map production. That technology will likely not be adequate to support line-management functions that require complex information retrieval and modelling.

- Who is the computer system being developed for and what type of computer system is required?

If the system is being implemented to support management planning and decision making, the system will be significantly more complicated than if it is being implemented to perform routine information handling tasks.

In general, projects should start with a modest, well-defined scope and expand over time as the organisation learns about GI-use and GIS technology.

3. 3.3 Organisations, People and GIS

The application of GIS in different aspects of life changes the ways of collecting, storing and using spatial data. This reflects not only on organisations creating or using geodata, but on people as well (ordinary consumers or serving staff). Positive and negative sides of these influences are reflected upon in the following sections.

In general, GIS projects are similar to other projects where technology changes the way an organisation works efficiently. Such change creates excitement in some of the staff and anxiety in others. Projects succeed if people can be motivated to address the changes and challenges and are insulated from the potential negative effects.

3.1. 3.3.1 GIS influence on organisations

Several positive effects of the introduction of GIS in organisations can be distinguished, leading to improved spatial decision-making. First of all there will be a larger commitment to using spatial data. Furthermore, new methods for analyses and management can be used and unification of data with different features is possible.

On an organisational level, facilitating the communication among separate administrative groups in different organisations and departments is a positive influence. Also the opportunity for a more rational use of specialists' knowledge, creating a potential to reduce the number of staff, and minimising administrative mistakes by automating workflow can be mentioned.

The goal of GIS projects in an organisation should be mostly to improve the organisation's efficiency and contribute to its goals of quality production for its ultimate uses. It is dangerous to describe GIS projects in terms of the reduction in staff, etc. Experience shows that demand for GI increases in an organisation more rapidly than technology reduces staffing levels; the same number of staff produces more and better Geographical Information, and finds more fulfilling jobs.

But of course there are also negative effects possible. Structural changes in the organisation and changes in legislative and normative base could under certain circumstances be perceived as negative. Also the introduction of GIS often leads to increased requirements for data collection and representation, needing additional staff skills and therefore training.

3.2. 3.3.2 GIS influence on people

GIS effects people not only by its technical features, but also by changing social relationships and norms. Some negative attitudes towards GIS by staff are created in organisations adopting this technology. These are connected with the needs of additional staff training and the increase in the required skill of the staff. However the introduction of GIS also leads to some positive trends, such as staff qualification improvements, reduction of the time spent on activities connected with data collection and representation and easier communication with other specialists working in the same or other organisations.

GIS makes it possible for customers (of public sector organisations for instance) to get better, faster and more detailed information on their inquiries. It should be noted however, that this is not an automatic result from introducing GIS in public sector offices. Additionally, it often requires a change in staff attitude and workflow processes. On the other hand, GIS implementation in the public sector requires the customer to learn about the changes in the way information is made available to him or her.

The opportunity for widespread publishing of spatial data is maybe the most significant effect of GIS usage. This increases the danger of privacy-sensitive data becoming public. This danger should be taken into account seriously.

4. 3.4 Methodologies for Design and Selection

After explaining how to determine the organisational requirements for a GIS in the first part of this chapter, this section explains the methodology for a systematic approach how to evaluate and select a concrete GIS, leading to a rational choice of system. Also, it describes the basic steps in the development of a GIS application.

4.1. 3.4.1 The GIS Evaluation Phases

There are some simple rules to pay attention to when evaluating a GIS:

- If the available money is only sufficient for buying hard- and software, you should rethink your project scope again. Money will be needed for training, data, maintenance and technical advice as well!
- Investing into larger GIS solutions will take 3 to 5 years before it yields major benefit. Phase the project and make sure there are initial benefits to be shown within the first year.

- During the implementation period of GIS qualified and motivated staff are required. In certain cases the old and new system need to be run in parallel.

The major phases for the selection and evaluation of a GIS are:

1. Planning
2. Decision
3. Installation
4. Operating phase

Planning phase

The planning phase starts with setting up an expert team, consisting of four to six members who bring in their expertise concerning the organisation and the given tasks. In most cases they are not GIS experts, but will gain expertise during the evaluation process. However, adding one or two outside experts with GIS experience may avoid many costly errors. If not already available, the expert team should conduct a needs and feasibility study.

The outcome of this study forms the basis of a pre-evaluation of systems. The number of GIS products on the market is large; the pre-evaluation should reduce this number to an acceptable range. A rough pre-selection of feasible GIS products may be made based on published material. These materials can be obtained from vendors, trade magazines, independent market research organisations, university institutes or consultants. Criteria that should be considered during the pre-evaluation are hardware, operating system, choice of database, performance, vendor and functionality, as described in the GIS design document.

The final part of the planning phase is the benchmark design. A benchmark is an unbiased mechanism to measure the suitability and efficiency of a supplier's proposed solution within the context of the buyer’s application and environment. During the evaluation process the benchmark is the most important step to judge the feasibility and performance of products.

The purposes of a benchmark are:

- objective technical comparison of alternative solutions
- check compliance to functional and performance specifications
- determine resource utilisation
- motivate and commit personnel
- evaluate user response to GIS technology
- gain experience with leading edge GIS technology

In designing the benchmark, the expert team chooses criteria by which to evaluate the systems that survived the pre-evaluation phase, and selects a method of testing these criteria.

Decision phase

The decision phase consists of two steps:

- A decision to go forward with the project based on the feasibility study and overall economic assessment.
- The decision for a specific GIS from a particular vendor.

For the go-ahead with the project only overall cost information is required and assurance that at least one vendor can provide the technology.

The decision for a specific vendor must follow the accepted rules for procurement, typically with a call for tender and a rational, impartial selection of the best offer. The cost of this selection process is quite high and it is highly recommended to get assistance from vendor independent GIS experts as consultants.

Benchmarks to establish whether a system is capable of fulfilling the requirements are typically used to help assess the systems. Benchmarks are useful, but they stress properties of a system, which can be measured easily, – especially the speed of returning some function. These are often less relevant in day-to-day operations than the quality of the user interface or the ease of learning the system, which are much more difficult to assess.

Installation

After deciding for a GIS, the implementation may start. With the installation the GIS evaluation process stops partially, but nevertheless, the customer has to continue looking at the GIS market. Experience shows that within a year or two, further equipment is needed; additional tasks may be fulfilled and so on. The installation phase includes the training of the operators, possibly further software development, installation of the hardware and software.

The system configuration is installed; a pilot project may be started under the leadership of the vendor. The production process may start after the staff has been trained. Training and education may take up to half a year. It may be necessary to customise the GIS to the user demands. Customising the GIS to the users may take a year or more. A pilot project may run several months before production starts.

Operation phase, expansion and updating

Within one or two years it might be necessary to expand or update hardware and software. Additional hardware may be needed; more equipment, more or better workstations. The supplier usually offers software updates and revision once or twice a year. Additional software modules may be bought to serve additional applications. Continuous education and training of the staff is necessary. Experienced staff will leave the company, additional or new personnel will need to be trained. The updating and revisions of data depends on the demand of the user. Data are the most valuable part of GIS, so keep them up-to-date. Upgrading data may become necessary with new software revisions. With a growing customer base further data exchange modules may be needed.

Renewal of the GIS cycle

A few years later a new GIS evaluation cycle may start. The renewal of the GIS can be required whenever major changes in the production process, the organisation and its workflow occur. It is also necessary when the technical equipment becomes out-of- date. The GIS evaluation process will follow the same steps, but with more knowledge.

4.2. 3.4.2 Alternative Evaluation Procedures

There may be several reasons why the described evaluation phases may be shortened or other sequences may be necessary. Some major reasons are:

- limited budget,
- restricted resources and skills,
- corporate computer suppliers pressure,
- limited window of opportunity.

In the following different alternatives are illustrated and discussed.

Pilot projects to reduce risk

This approach expands the previously described steps with one or more pilot projects. The risk is minimised, but takes more time. During the pilot project the organisation learns a lot about GIS. This approach is recommended for organisations that have little experience with GIS. It is closely related to a phased approach, as the pilot can be seen as a first (small) step in a larger project, which is adapted further based on the experiences gained during the pilot phase.

Desktop approach

The desktop approach tries to select a GIS without a benchmark. All evaluation phases are more or less based on paper studies. A GIS team is created and starts the strategic study, typically expanded by outside GIS experts

and consultants. Pre-evaluation of systems is done from market surveys or literature. A request for information is sent out to a small number of vendors remaining from the pre-evaluation process. The user requirements analysis (operational requirements) is done based on the existing know-how on GIS. A tender follows. The GIS is selected and installed. A pilot project and benchmark are done to demonstrate the functionality. This usually takes longer because in this approach it is the company's first experience with GIS in the company. If the pilot project runs successfully, production can start afterwards.

The risk is that the selected vendor cannot fulfil the benchmark and the process has to start again. This risk is low today, as functionality differences between GIS's are small.

Project driven approach

The shortest evaluation process runs under pressure from outside the organisation. For instance, if a contract would be lost, for not being fulfilled with GIS technology. This procedure may work fine when knowledge on GIS technology and the GIS market exists in the company. A small number of vendors are pre-selected. The operational requirements may only be related to the project. Still, one should do the user requirements analysis very carefully to know and analyse the demand. From the tender one selects a GIS, starts installation and immediately goes into production. The risk is that the selected GIS is only useful for a specific project.

4.3. 3.4.3 Development of a GIS application

Once an organisation has chosen and installed GIS software, it can start development of additional applications. As we have seen, in some cases a (small) application or pilot project can even be part of the evaluation process.

Application development does mean not rewriting the GIS software, but instead customising applications to meet specific needs. The applications may be as simple as a set of preferences that are stored for each user group or individual and are run as a macro at start-up. Or they may be a very complex query that selects a group of layers, identifies features of interest based on attribute ranges, creates variable width buffers, performs a series of overlays and produces a hard copy map. In either case, an application is required to convert the user's ideas into a usable, stable product.

There are three approaches typically used by organisations to develop GIS applications. Organisations can develop these applications in-house from scratch, interface with an existing 'over-the-counter' GIS application or use a GIS framework as the foundation for their customised GIS application. The strengths and weaknesses of each approach will be considered here. The details of application development depend on the selected technology, but the general recommendation is to follow the steps proposed.

Building a GIS application in-house

The primary advantage to building a GIS application in-house can be summed up in one word - control. Because one is using their own staff, there is more control over what functionality is delivered, and when it is delivered. However, this control comes at a price. Building a GIS has its own unique set of challenges not found in other types of applications. One needs user-interface experts, graphics experts, database experts, and performance tuning experts. Does the staff have the expertise? Do you have time or budget to train them? The lack of availability of these experts can significantly stretch the delivery time of your project; even prevent the project from ever being completed.

Interfacing with an 'over-the-counter' GIS application

Using an 'over-the-counter' GIS application as the nucleus of your own application allows you to deliver a completed system much more quickly than by developing it from scratch using in-house developers. It's likely that the application will contain a much more comprehensive set of GIS functionality than one would ever get trying to develop it in-house. Likely it will be able to deliver the application more quickly than by building it all yourself. There are also problems with this approach, though. While the GIS system vendor may know about GIS, they do not know your business, and so may not implement the GIS functions in the most efficient manner for your needs. Even when the vendor product has the necessary functions, one is forced into doing things their way. And if the requirements change, or there is a need to add new functionality at a later date, the vendor package may suddenly not meet the requirements.

Using a GIS framework as the basis for an application

What is needed is a solution that leverages someone else's GIS expertise while allowing customisation of the application to the specific business needs. That solution is to use a framework. A framework has most of the hard work already done. It provides the foundation for an application that contains all the GIS functionality. It allows for building the business-specific parts of the application on top of that foundation. And it allows customisation of the GIS behaviour to meet the specific needs of the application. It takes full advantage of the power of object-oriented programming to maximise reuse and minimise the effect of changes. One gets the benefit of using someone else's GIS and graphics experts while using one's own business experts.

The development of an application can also be contracted out. Typically the vendors of GIS work with software companies that build custom applications. The companies have the experience with the software and may even know the application area from previous contracts.

In general, today's business philosophy of concentrating on the 'core competence' of one's business and contract out most of the aspects that are peripheral fosters this approach. The risk is in future additions or changes to an application, where one either goes back to the initial contractor, hoping that they have maintained the skills, or is faced with a decision to redevelop the whole application (which may be less costly than to make the change!).

4.4. 3.4.4 Basic Steps in the Completion of an Application

Irrespective of the chosen approach, application development should go through a minimum series of basic steps. These steps are:

- Basic preparation of data sources,
- Data and process modelling,
- Test project.

Basic Preparation of Data sources

For the same region in space various data material may already exist. The first step is to analyse which type of data exists in your organisation or outside that is related to the application you are dealing with. The different sources include maps, images, tables, file-cabinets, publications, reports, and sensor data. Field surveys may help to prepare an inventory on what exists at a specific place. How are these data available, either in digital or analogue form? Do they exist or do they have to be created?

A data evaluation sheet may be prepared extracting all the relevant information about the data. This may be viewed as an analogue meta-information system. Whenever it is possible this analogue system should be transferred into digital form during the installation process of a GIS. This has major advantages concerning the information flow, the workload on communication systems and the selection process for data.

The most important aspects to keep in mind during data preparation are:

- Consider getting data from someone else. Avoid own data capturing whenever possible, but keep in mind the quality you expect from these data.
- Prepare evaluation sheets for your data and assess carefully the data quality aspect. This may require field checking for a subset of the data.
- You need to have the sources in your hand or on your computer before you start working in your project, otherwise you lose time.
- If you require the data from another source, arrange for future updates and regular maintenance of the data.

Data and Process Modelling

- Data base design Data modelling is meant to structure the existing data in a way that multiple usage is possible. The data model is an abstraction of the real world, which incorporates only those properties thought to be relevant to the application at hand, usually a human conceptualisation of reality. In order to determine how a collection of data is ultimately presented in digital form it has to be divided into different groups or levels. This abstract data model has to be realised independent from a specific system This allows for

recognising bottlenecks in the implementation on top of a specific GIS. These bottlenecks have to be overcome, either by additional or redundant information or by customisation of the existing GIS.

- Information model Information modelling is intended to analyse the workflow in the organisation and tries to establish an appropriate way of supporting the workflow with a GIS. The processes that lead from data capture through storage and processing to the results must be laid out. This leads to an identification of all parts of the organisation that are involved in the project.

- Update of data Data will change from time to time. The rhythm of change, – how often and how important the changes are, very much depends on the type of application. It will be necessary to analyse the update frequency of the data and propose an update procedure. Data may also be incomplete and become complete only after a longer period of time or by adding additional data from other departments. The model should be flexible enough to handle these problems. Preliminary solutions might be necessary. In some cases it may be necessary to collect completely new data instead of updating them, and this may be less expensive than to foresee regular maintenance. In general most of the cost of maintaining the application will be in the maintenance cost of the data. This needs careful planning from the start. The important rule is simple: store only data that are actually used by your application. Data that are not used tend to deteriorate quickly and if used later, will not have the quality required and a completely new collection will likely be needed.

- Maintenance of data is costly because:

It is hard to schedule and triggered by outside events; Maintenance tends to discover errors in the existing data that will need to be fixed; It often requires inspection in the field.It is therefore difficult to automate and requires highly skilled personnel. It is sometimes less expensive to recapture the complete dataset in a planned and well-organised process, where economies of scale reduce the price per element considerably.

Small test projects
Before starting the production process, small test projects should be carried out. Each GIS project differs from the other. Thus, a prognosis of the workload and the data amount is not easy. Small test projects in a new and specific field of application put these estimations on a more solid background. Similar projects may be used to predict these numbers. Preparing small test projects allows analysis of the time and data amount needed for processing. During the capture and processing of data, times are measured together with the number of objects and the total amount of disk storage. Data amount and costs estimations for larger projects can be extrapolated. This makes the feasibility decision to go ahead with the project much more reliable.

5. 3.5 Project monitoring

Monitoring is an integral part of every project, from start to finish. Monitoring should be executed by all individuals and institutions which have an interest in the project. To efficiently implement a project, the people planning and implementing it should plan for all the interrelated stages from the beginning.

Collect Progress Information

On a regular basis, the project manager will collect together progress information that has been reported by the project team. This will allow the compilation of progress reports, such as :

- Activities completed within the past two weeks

- Activities forecast for the next two weeks, with a focus on activities on the critical path

- Funds expended vs. fund expenditure forecast

- Prioritized issues report

Metrics can also be developed to measure project progress in other ways, such as earned value, or activity float statistics. If the project manager reviews the progress data and concludes that the project is complete, a phase-exit review will be completed to confirm that all the objectives have been met before moving into the final closure phase. Deliverables: Set of progress reports, set of exception reports, metrics report, (phase-exit review checklist).

Analyze Current Status

By analyzing the progress information received, the project manager will be able to augment the above reports with information about which areas of the project are of concern, and where problems are likely to occur in the future. This allows managers to focus on the important/critical areas of the project. Deliverables: Project evaluation report(s).

Adjust the Plan, and Manage Project Change

Based on the analysis, and with the support of the project team, the project manager will make plan adjustments to help reduce risks, accommodate scope changes, or to compensate for activities that have not occurred on schedule. Once this has happened, the plan will re-published, and the cycle repeated until the project is complete. Deliverables: Change request forms, updated plan.

Over the course of any GIS project, the work scope may change. Change is a normal and expected part of the construction process. Changes can be the result of necessary design modifications, differing site conditions, material availability, contractor-requested changes, value engineering and impacts from third parties, to name a few. Beyond executing the change in the field, the change normally needs to be documented to show what was actually constructed. This is referred to as Change Management. Hence, the owner usually requires a final record to show all changes or, more specifically, any change that modifies the tangible portions of the finished work. The record is made on the contract documents – usually, but not necessarily limited to, the design drawings. The end product of this effort is what the industry terms as-built drawings, or more simply, "as built." The requirement for providing them is a norm in construction contracts.

When changes are introduced to the project, the viability of the project has to be re-assessed. It is important not to lose sight of the initial goals and targets of the projects. When the changes accumulate, the forecasted result may not justify the original proposed investment in the project.

Close Project

When the objectives of the project have been achieved, the project manager will close down the project. This will involve some financial closure tasks, as well as archiving of the project materials.

Closing includes the formal acceptance of the project and the ending thereof. Administrative activities include the archiving of the files and documenting lessons learned. This phase consists of:

- Project close: Finalize all activities across all of the process groups to formally close the project or a project phase. A lessons-learned document will be developed to benefit future projects, and if possible a project team celebration will be held.
- Contract closure: Complete and settle each contract (including the resolution of any open items) and close each contract applicable to the project or project phase.

6. 3.6 Summary

The aim of the module was to give an overview of the practical methods of a GIS implementation starting with the needs analysis and feasibility study, ending with the description of the GIS application development steps.

From the module you became familiar with the GIS implementation process as a whole; understand the feasibility study of a GIS Project (Cost-Benefit Analysis, technical feasibility and institutional feasibility), identify the GIS influence on organisations and on people; realize methodologies for design and selection (the GIS evaluation phases and procedures, GIS application development, basic steps in the completion of an application); know the main issues of project monitoring.

After learning of this chapter, you are able to:

- summarize the GIS implementation process as a whole,
- explain the main features of the Cost-Benefit Analysis,
- illustrate the GIS influence on organisations,
- demonstrate GIS influence on people,

- give orientation on the methodologies for design of a GIS,
- identify the basic steps in the completion of an application,
- discuss the importance of project monitoring.

Review questions

1. What are the main elements of a GIS implementation process?
2. How costs and benefits are counted within a GIS Cost-Benefit Analysis?
3. What are the factors of the technical and institutional feasibility?
4. Illustrate the relationship between GIS, organisations, and people!
5. Describe the main evaluation phases!
6. What are the reasons for alternative evaluation procedures?
7. Give orientation on the methodologies for development of a GIS application!
8. Identify and explain the basic steps in the completion of an application!
9. What is the importance of project monitoring? Explain the methodology!

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