UNIT 13 GIS PROJECT DESIGN AND IMPLEMENTATION

Structure

13.1 INTRODUCTION

You have read and learnt about the basic concepts of spatial analysis and GIS outputs in the previous units of this block. Now, in this unit you shall learn about the design of a GIS Project and its successful implementation using the knowledge you have gained from the previous units. You shall also read about the various aspects of GIS design that will help you in preparing a successful GIS. In this regard, you should always remember that *"Careful Design"* at the beginning of a project is the only keyword to achieve a successful GIS. In this unit you will read and know about the science of GIS Design. So come and let's explore the world of GIS Design.

Objectives

After reading this unit you should be able to:

- define and discuss the importance of GIS design;
- identify the various components, approaches and models of GIS design;

- assimilate the concepts and objectives of the system (project) life cycle;
- discuss the limitations of GIS design;
- describe the advantage of the marble model (spiral model) for GIS design as opposed to the waterfall model;
- recognise the influence of GIS information products; and
- familiarise with the idea of verification and validation.

13.2 HISTORY OF GIS DESIGN

GIS design can be defined as a plan or series of processes for developing a successful GIS application. GIS design makes use of state-of-the-art techniques and modelling tools suitable for database development with mainstream software packages.

Let us now briefly look at the history of GIS Design. It was during 1960s, when the GIS was quite a new tool, there was a rapid growth in the production of both raster and vector GIS software. Some of them were created as operational systems almost like today's GIS software; many of them were developed for academic and experimental use in colleges and universities. Unluckily, almost all of these systems failed. Some of them even didn't qualify as an analytical tool while others produced erroneous results.

Do you know why these systems failed? They failed only because of their poor design as software systems.

However, during the last few decades, we have seen more and more successful implementations of the spatial analytical software that is generally referred to as GIS. They are no doubt mostly capable of performing the tasks for which they were designed quite efficiently at a very reasonable price. So, we should remember that GIS design is not only about the software design alone but it also includes efficiency and the price too.

You might be thinking at this point that the major problem in implementing a GIS is always technical whereas this is not the case. Rather the main problem is often the mismatch between the capabilities of the software and the needs of the users, data and analytical needs, as well as personnel needs, including training and user acceptance. Actually, the availability of software capabilities in most of the GIS platforms exceeds the requirements of the user, especially in commercial sectors. Fortunately, these problems can be avoided by adopting a proper GIS design at the beginning. So, let us read in the following section the need to examine the design of GIS implementation. We shall also discuss about how structured design processes, primarily modified from the field of software engineering, can be useful for ensuring GIS success.

13.3 NEED FOR GIS DESIGN

Have you ever thought that why do we need design in GIS? This is a very important question that you should answer before we adopt a GIS. We all know nowadays, that the GIS professionals are working with geographic information to manage various aspects of our world. And as mentioned earlier, careful and good design is what it takes to make their work flow smoothly and successfully. Also you must keep in mind that since developing an operational GIS requires lot of money and time you should avoid the consequences of failure as far as possible. Though design doesn't guarantee the success, for example, the Edsel automobile, one of the most designed automobile in the history of United States was an absolute failure in terms of sales; still careful design will always increase the chances of success. You know that well designed shoes from companies are liked by many but we should also remember that there are still some designs from these companies which are still not liked by people. So the point is clear that proper design is an important part of success. Design in GIS is also an inseparable part of successful implementation of a GIS application.

We know that GIS uses software available in the commercial marketplace that is sometimes very complex. It often requires huge computations in a single session. And because of these computations even minor errors due to the software or poor design at the initial stage of software development eventually leads into unmanageable errors. To understand this better, let us read about the two types of errors:

- **Obscure Computational Errors:** In this case the users cannot detect the error. The error may be found only after thousands of operations have been performed on erroneous results for obtaining the intermediate output/ coverage.
- **Input or Formatting Errors:** This kind of error may cause the software to malfunction and hang up the computing session, resulting in data lost.

From the above scenario it is quite clear that poorly designed software used in the GIS can cause the failure of GIS application. The better care can be taken to minimise or remove as much error as possible in the input phase of an operation. We must always concern ourselves with the basic and more important functions of GIS Design as given below.

i) **Serving the Proper Users**: In GIS design it is important to know the users before we develop the GIS application. But most of the time especially in a multiuser institutional setting, the possibility of excluding potential users during the implementation phase is very high. However, surprisingly, you will find that many district and state organisations, perhaps having offices within easy walking distance begin developing large databases without much consultation or interaction with other interested parties. Such a narrow minded vision of GIS implementation results in duplication of effort, wasting time and money (DeMers and Fisher, 1991).

ii) **Serving the Users Properly:** After the potential users have been identified the second step is to address the needs of the users properly i.e., what are the requirements of the users in terms of software capabilities, data needs and institutional fit? The first two concerns are strong indications of why knowledge of both system functional capabilities and proper database construction are so important to the long-term functioning of a GIS. Before a GIS system is purchased, with its own data model and analytical capabilities, the spatial data handling needs of the user must be determined.

Spend
5 mins

Check Your Progress I

1. Why GIS design is important in successful implementation of GIS?

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13.4 COMPONENTS OF GIS DESIGN

Let us know about the basic structure of a GIS design process. GIS design consists of two major components *viz. GIS system design* and *GIS software design* (Fig.13.1).

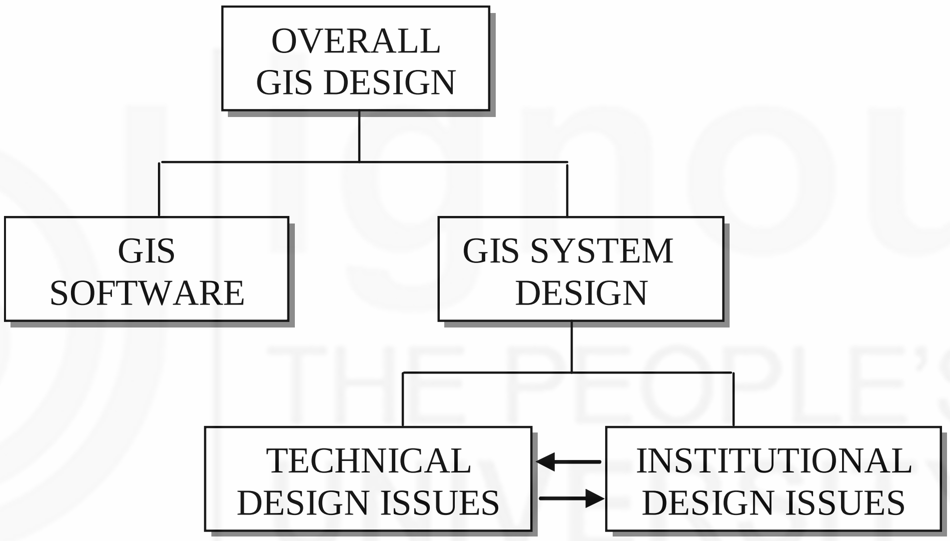

Fig. 13.1: GIS design process (source: Marble, 1994)

i) **GIS Software Design** deals with the software development and related issues. It requires a very good technical knowledge of data structures, data models and computer programming. Though persons in this field get comparatively higher salaries but one has to have an equivalent of a computer science or computer engineering degree in addition to knowledge of GIS basics.

ii) **GIS System Design** deals with the interactions of individual people, groups of people and computers as they function within organisations. GIS is not just about computing. It is also about how people are affected when GIS design is incorporated into an organisation. It also deals with the changes brought in the working of the people and overall functioning of the organisation.

The computerisation of many banks in different part of the world has changed the way we do transactions. Similarly, the GIS changed the functioning of many organisations. When a new technology is introduced in an organisation the structure of that organisation is generally modified due to (i) requirement of different or additional training of people doing the work, (ii) along with the funds for software and hardware and (iii) changes in the flow of information within the organisation. Since, nowadays huge databases are available that can be accessed by individuals, the integrity and quality of the data need to be maintained with proper security by developing security and quality control measures within the organisation.

As seen in Fig.13.1 GIS system design can further be divided into two highly interactive subdivisions viz.,

i) Technical or internal design issues deals mostly with the system functionality and the database

ii) Institutional or external design issues deals with the relationship between the GIS operation and the organisational setting.

Let us try to answer some of the questions that go with the technical issues are:

Will the system work the way we need it to?

Can we answer the questions needed to be answered?

Have we got the correct data in the right format?

Do we have people with the right training to run the system?

Can our system adapt to changing demands?

Likewise, some of the major questions that accompany the institutional issues are:

Do we have the funding necessary to permit continued operations?

Can we obtain data at reasonable cost?

Do we need to employ applications programmers to customise the software? Will we have adequate software support from our GIS vendor?

Will we be legally responsible for errors made through our analyses?

And are we meeting the larger goals of the organisation beyond the immediate end of performing GIS analyses?

Now it is clear to you after reading the above paragraphs that the technical design issues and the institutional issues are highly interactive and inseparable. That is even if a GIS operation is successful in every way from the technical design standpoint it will fail if there is no support from the organisation or external sponsor.

13.5 APPROACHES AND MODELS OF GIS DESIGN

Planning before we begin the GIS design and good management is necessary to make our GIS successful. And we also know that most of the GIS failed due to lack of a good plan at the initial stage. Let us discuss some of the approaches and models of GIS design:

13.5.1 The Software Engineering Approach

Software Engineering is a subfield of computer science that is dedicated to designing, implementing and modifying software so that it is of high quality, affordable, maintainable and fast to build. It is a “systematic approach to the analysis, design, assessment, implementation, test, maintenance and reengineering of software, that is the application of engineering to software” (Phillip, 2007). It has been developed mainly to address the problems of software that failed to achieve its intended goals. Since GIS is mostly driven by software, most of its problems during the initial implementation phase are very much similar to those encountered in the development of software. For example, you are developing a word processing system that allows you to write, edit, save, check spelling and grammar, use a thesaurus, import graphics, format page layouts, typeset, and print documents easily and efficiently.

Similar to the above example in case of GIS implementation, it is very important to understand the user’s needs before we begin the process. In GIS systems design, the relevant user needs involve the kinds of spatial analytical technique to be applied, training and the capacity of the analytical techniques to meet the overall organisational goals.

13.5.2 Systems Life Cycle Approach

The systems life cycle (also known as project life cycle) is one of the first concepts developed in the field of system design. Like in any other system, GIS also has a life cycle starting all the way from project initiation going through project planning, project execution and finally the project closure (Fig.13.2). In short every GIS project has a beginning, middle and an end.

The project life cycle dictates the operations and organisational structure that will bring the project to a successful completion. If you are working on a single project, the project life cycle will focus on that one under-taking with the same principles though the operational details will differ. Whether your project is to be performed by yourself, within a small group or within a larger organisational structure, there must be methodology to give a framework for finishing the job. Let us read about the three main objectives of the project life cycle to be considered before starting the project:

- define the activities of the project and their order of performance
- assure consistency among many projects in the same organisation
- provide points for management decision making regarding starting and stopping of individual phases of the larger project

Here you must remember that the project life cycle provides only the guidelines for successful management of a project, i.e. a framework for the project. The fundamental decisions and other important aspects of the organisation like support of the workers, political issues, assurance of good moral, etc. are done by the Project Manager. The life cycle provides guidelines to facilitate the making of right decisions at the correct time (Yourdon, 1989).

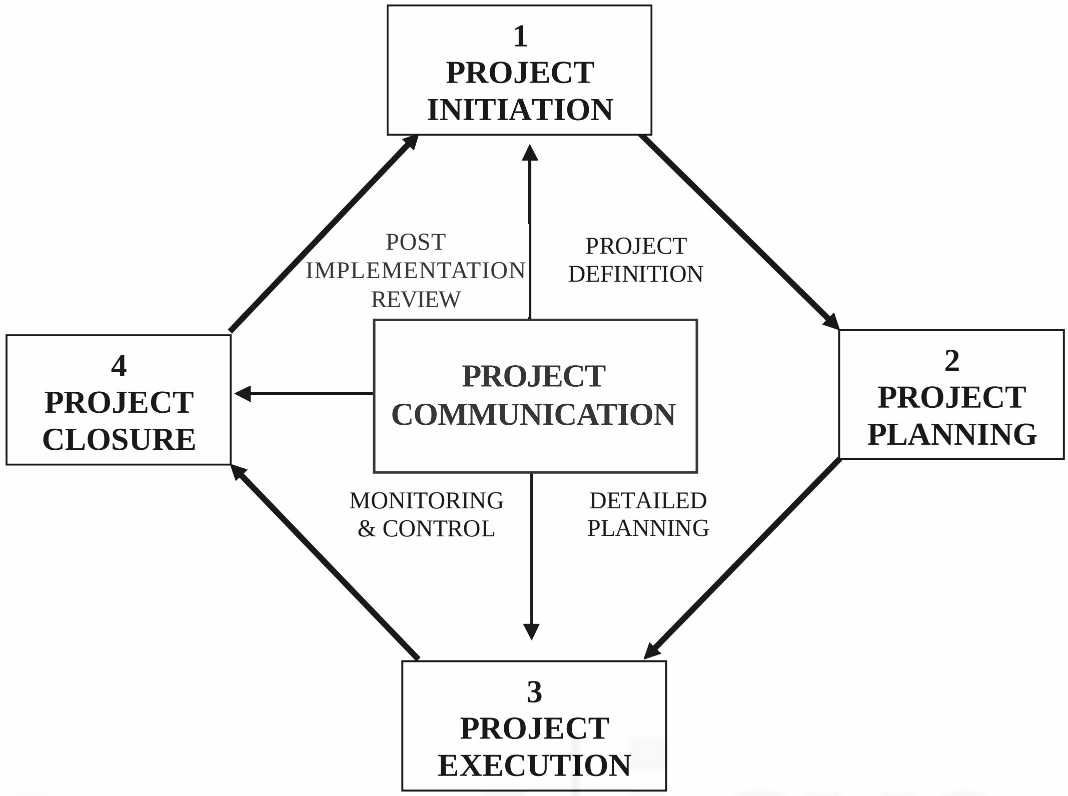

Fig. 13.2: Typical project life cycle (source: http://cnx.org/content/m31913/latest/Fig1new.jpg)

The main advantage of the systems life cycle approach is that it provides a very structured framework for the management of a GIS project. Let us read about the number of problems with the systems life cycle approach:

- Designers using the systems life cycle approach often fail to address the context of the business for which the system is being developed.
- The timescale and linear nature of the systems life cycle process do not allow for change in the scope and character of the problem.
- The systems life cycle approach does not put the user at the centre of the system design.
- The systems life cycle approach is often considered to favour hierarchical and centralised systems of information provision. It offers a very techno-centric view of system development.

13.5.3 Waterfall Model of System Life Cycle

This method although flexible in terms of the number of steps is highly structured and progresses in linear fashion. The steps cover the definition of user requirements, the specification of functional needs, systems analysis, detailed design, the testing of individual modules, the testing of subsystems, and finally system testing. In the computer industry this approach is often called the Waterfall Model (Fig.13.3) of system design (Boehm, 1981).

The waterfall model is a sequential development approach, in which development is seen as flowing steadily downwards (like a waterfall) through the phases of requirements analysis, design, implementation, testing (validation), integration, and maintenance. The basic principles of waterfall model are:

- Project is divided into sequential phases, with some overlap and splash-back acceptable between phases.
- Emphasis is on planning, time schedules, target dates, budgets and implementation of an entire system at one time.
- Tight control is maintained over the life of the project via extensive written documentation, formal reviews, and approval/signoff by the user and information technology management occurring at the end of most phases before beginning the next phase.

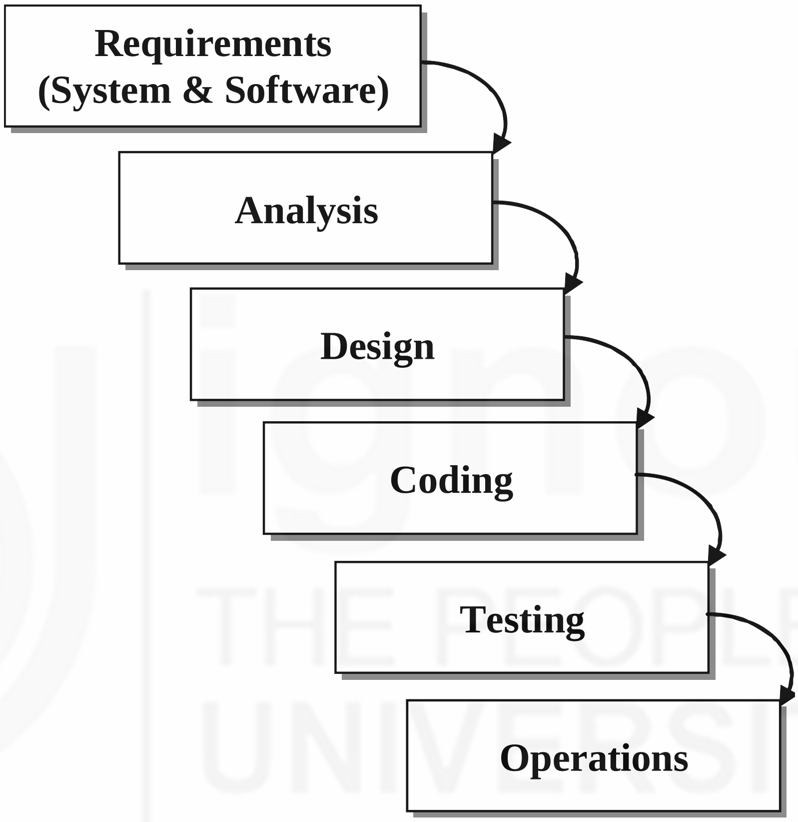

Fig. 13.3: Waterfall model of system life cycle (source: DeMers, 1997)

The waterfall model was developed to provide a structure for the systematic movement from requirements analysis through testing and final operation of an information system. The waterfall model generally cascades from conceptual design through program detail design, code creation and code testing to program implementation.

Despite its popularity, there are a number of problems with the waterfall model as a tool for developing a GIS. First, since the model requires each step to be completed properly before the next proceeds, any delay in a single step will slow the entire system (Yourdon, 1989). Within a GIS context, even if we know most but not all of the user requirements, we may not proceed to the input phase until the rest of the requirements have been received. In this approach most of the time new requirements are often discovered late in the requirements phase. This implies that by the time when all requirements are known input data could be out of date. Yet another problem with the waterfall model is its linear structure. Because of this linear progression almost every implementation is going to encounter problems at various steps.

13.5.4 The Prototyping Approach

The prototyping approach was developed as a response to the criticisms of the systems life cycle approach (waterfall model), particularly in response to the lack of consideration of users. The user first defines the basic requirements of the system by using the rich picture and root definition techniques. The system designer takes these basic ideas to construct a prototype system to meet the needs identified by the user. These prototype systems are often described as demonstrators in GIS projects. The users who identified the original requirements for the system then experiment with the demonstration system to see if it is what they expected. Other potential users of the final system may be brought in at this stage to see if the system is of wider value. The system designer uses their recommendations to improve the system.

The basic principles involved in the approach of system designer are:

- It provides a complete development methodology and approach to handling selected parts of a larger, more traditional development methodology (i.e. incremental, spiral or Rapid Application Development (RAD)).
- It attempts to reduce inherent project risk by breaking a project into smaller segments and providing more ease-of-change during the development process.
- The user is involved throughout the development process, which increases the likelihood of user acceptance of the final implementation.
- Small-scale mock-ups of the system are developed following an iterative modification process until the prototype evolves to meet the users' requirements.
- While most prototypes are developed with the expectation that they will be discarded, it is possible in some cases to evolve from prototype to working system.
- A basic understanding of the fundamental business problem is necessary to avoid solving the wrong problem.

The prototyping approach has the following advantages over the systems life cycle (waterfall model) method:

- Users have a more direct and regular involvement in the design of the system.
- It is easier to adapt the system in the face of changing circumstances which were not identified at the outset of the project.
- The system can be abandoned altogether after the first prototype if it fails to meet the needs of users. This reduces the cost of developing full systems.
- If money and time are available a number of prototypes can be built until the user is satisfied.

Though the prototyping approach has a lot of advantages over system life cycle approach yet, it is not completely fault proof. It has the following drawbacks.

- Prototyping can be difficult to manage. There may be large numbers of users with large numbers of ideas and opinions.

- The resource implications may change following the development of the first prototype.
- Knowing when to stop development can also be a problem. However, some GIS designers argue that this is a positive aspect of the approach since few, if any, GIS systems are ever finished.

13.5.5 The Spiral Model: Rapid Prototyping

Several attempts have been made by various workers in the field to develop and refine GIS design models. Among these varied models, Duane Marble (1994) after certain modification of software engineering approach, pioneered by earlier workers, conceptualised and developed a more flexible, multilevel design process called the *Spiral Model*.

Let us discuss the Spiral Model. In this model of GIS design the three tasks of acquiring, organising and analysing information are treated separately and impose three levels of detail. The spiral model and its component parts are shown below (Fig.13.4).

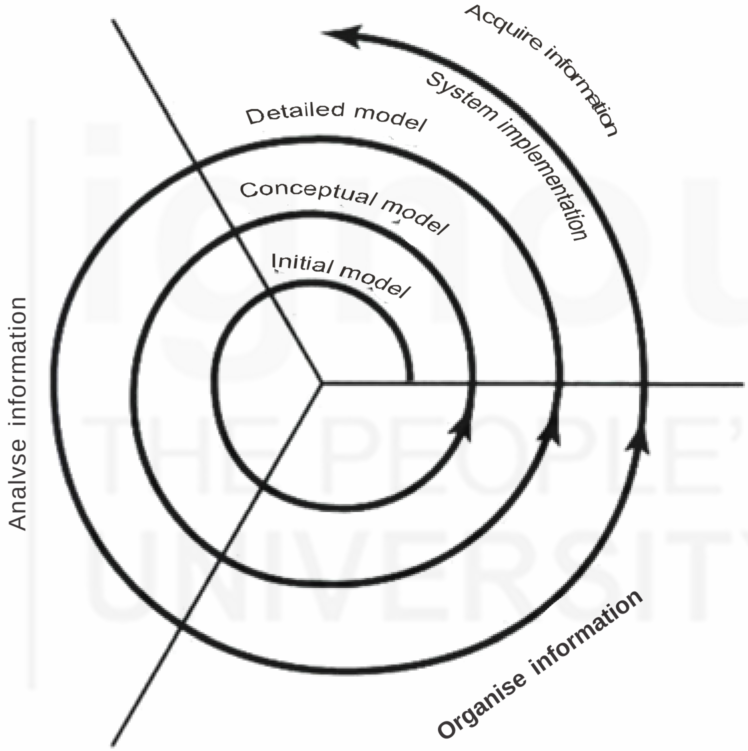

Fig.13.4: Spiral GIS design model. The labels indicate the levels of design (source: Marble, 1994)

The basic general principles involves with the rapid prototyping of spiral model are:

- Focus is on risk assessment and on minimising project risk by breaking a project into smaller segments and providing more ease-of-change during the development process.
- Each cycle involves a progression through the same sequence of steps, for each part of the product and for each of its levels of elaboration, from an overall concept-of-operation document down to the coding of each individual program.
- Each trip around the spiral traverses three basic quadrants: (1) acquire information (2) organise information and (3) analyse information.
- Begin each cycle with an identification of stakeholders and their win conditions and end each cycle with review and commitment.

13.6 GIS INFORMATION PRODUCTS

You have read about the potential of GIS and now let us discuss about the GIS information products. Generally, the GIS information products are the result of analysis within the software. These products are very much dependent on the nature of organisation, its goals and its experience with the system. Even in scientific organisations there are most often general ideas of what the GIS is capable of doing and what the technology might offer the individual institution.

Organisations have a particular goal in mind while considering the implementation of GIS. They most likely know roughly about the general data that might be part of the system. In fact, many organisations recognise the value of the data in an automated form even before they could see the potential utility for analysis. To extract particular spatial information products from the users, we must recognise the close linkage between what goes into the system (data input) and what comes out (output).

13.6.1 Managing and Organising the Local Views

It is always a good practice to keep track of the relationships between each user and each GIS product because mostly we'll be working with many potential users of differing individual needs. The use of a decision system matrix has been suggested that lists the users along the side of and the products along the top; Fig.13.5 shows a highly simplified version. Decision System Matrix is a useful tool.

This device allows us to keep track of the Spatial Information Products (outputs) for each user. Later, while integrating each of the local (individual user) views into a larger global view, data from this matrix provides much of what we need.

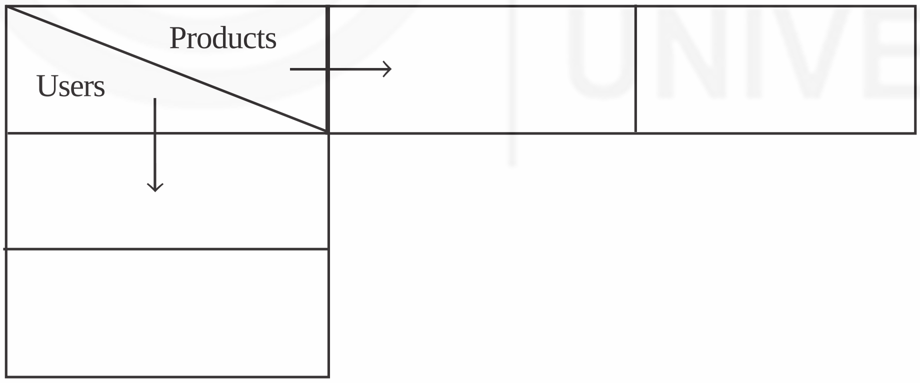

Fig. 13.5: Decision system matrix. Simplified decision system matrix used to organise individual user views of the GIS (source: DeMers, 1997)

An alternative to the decision matrix is an organisational diagram such as that shown in Fig. 13.6. This type of diagram, like the matrix format, is useful for integrating the local views into a more general global view. Both can also be used to decide which products are the most important, based on which are most often called for by individual users.

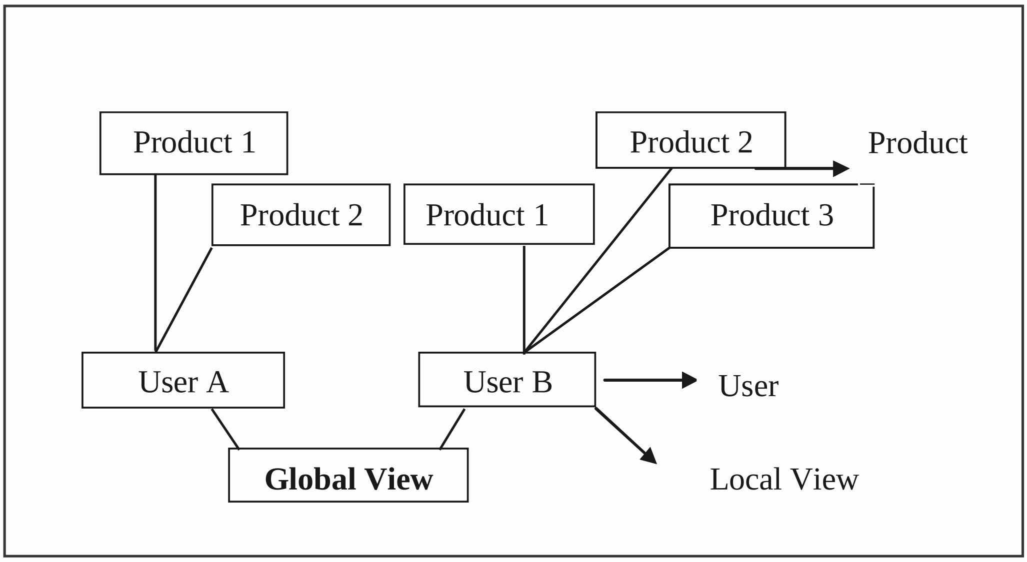

Fig. 13.6: Organisational chart used to display individual user views of the GIS (source: Marble, 1994)

13.6.2 Design Creep

Design creep, can be defined in terms of its results: at one extreme is a system with more functionality than is necessary and at the other is a system having an incorrect functionality. Fig. 13.7a shows a model for a rather structured approach to GIS design, proceeding from the feasibility study at the left through the design phase and finally into the implementation phase. The two curves indicate the relationship between the technical design process (light curve) and organisational learning. As you can see**,** organisational learning begins late in the process, when the system is almost completely designed and is nearly ready for implementation. Thus users are forced to learn and operate a system that may not meet their needs.

In Fig.13.7b the more flexible spiral model (Marble, 1994) is shown where the organisational learning drives system development. As users become familiar with what a GIS is capable of, they can describe their system needs at a point well in advance of implementation stage. You can also see that the more sophisticated the organisational learning, the more sophisticated the system becomes, but the learning curve is always above the design curve. In short, the users are driving the design of the GIS, rather than being driven to learn by an in-place system. The latter approach avoids design creep and allows the system to grow in complexity as the organisation's needs increase.

Organisational learning

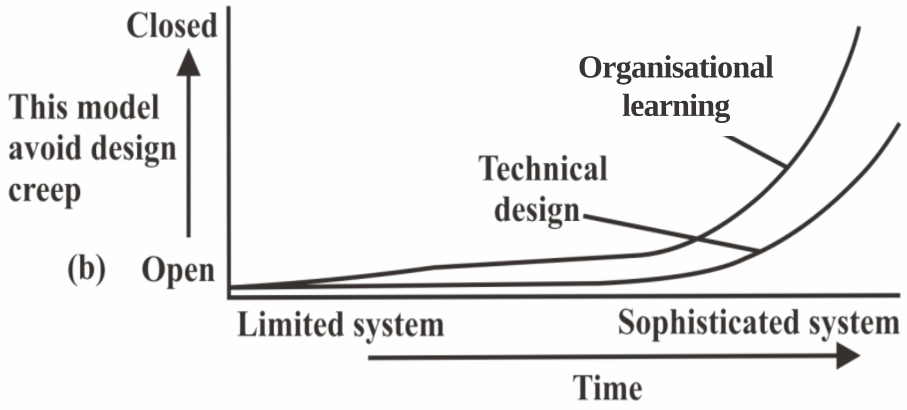

Fig. 13.7: Avoiding Design creep. Two approaches to system design:
(a) a structured, linear approach that leads to design creep and
(b) the Marble spiral mode, which avoids design creep
(source:DeMers, 1997)

13.7 VERIFICATION AND VALIDATION

In any software related project *Verification and Validation* is the process of checking that a software system meets specifications and that it fulfills its intended purpose. It is normally part of the software testing process of a project. This is the same in case of GIS also. In GIS, *validation* ensures that the product actually meets the user's needs and that the specifications were correct in the first place, while *verification* is ensures that the product has been built according to the requirements and design specifications.

Validation ensures that 'you built the right thing' while *verification* ensures that 'you built it right'.

Let us look at the primary questions that are required to be asked here:

Will the GIS perform the tasks the organisation needs in a timely and correct manner? The answer should be YES if the design process has been performed properly. This is possible only when all the details and specific needs of the organisation are available to the GIS provider otherwise the system is likely to fail to meet the needs. This will in turn help the GIS vendor to determine whether the system under consideration can meet those needs because doing the right thing at the first time is better than fixing it later with huge expenditure.

Check Your Progress II

Spend 5 mins

1. Mention the two components of GIS Design.

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2. How is Waterfall model different from Spiral model?

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3. What is verification and validation?

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13.8 ACTIVITY

1. Write down the steps involved in developing a GIS project using the waterfall model.

13.9 SUMMARY

You have read in this unit about GIS project design and implementation. Let us sum up about what we have learnt in this unit:

- Careful and proper design at the beginning makes the GIS design work flow smoothly and successfully.
- The basic and more important func-tions other than the software issues of GIS Design are Serving the Proper Users and Serving the Users Properly.
- The overall GIS design has been divided into GIS software design and GIS system design. The GIS system design is again divided into the technical design and the institutional design.
- When a new technology is introduced in an organisation the structure of that organisation is generally modified due to (i) requirement of different or additional training of peo-ple doing the work, (ii) along with the funds for software and hardware and (iii) changes in the flow of information within the organisation.
- Due to increase in the volume of databases that are available for individual accessibility, the maintenance of integrity and data quality becomes eminent through security and quality control measures within the organisation.
- The technical design issues and the institutional issues are highly interactive and inseparable.
- The various approaches and models of GIS design are: The Software Engineering Approach, Systems Life Cycle Approach (Waterfall model of system life cycle), The Prototyping Approach and The Spiral Model: Rapid Prototyping. In the section advantages and disadvantages of each approach and the models were discussed.
- The Spiral model has certain advantages over waterfall model. The products of a GIS are related to the organisational needs or requirements.
- There is a close relationship between the technical design and the organisational needs. It is very important to gather all the requirements of the organisation prior to its GIS Design.
- Verification of GIS verification is ensuring that the product has been built according to the requirements and design specifications while validation ensures that the product actually meets the user's needs, and that the specifications were correct in the first place.

13.10 UNIT END QUESTIONS

Spend 30 mins

1. What are the components of GIS? Explain in GIS System design.
2. Give a brief account of the various approaches and models of GIS Design.
3. What is GIS Information Product?

13.11 REFERENCES

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- Phillip, L. (2007), What Every Engineer Should Know about Software Engineering. Boca Raton: CRC. ISBN 9780849372285. Retrieved 2011-01-21.
- Marble, D.F. (1994), An Introduction to the Structured Design of Geographic Information Sys-tems. John Wiley & Sons, London.
- Yourdon, E. (1989), Modern Structured Analysis. Englewood Cliffs, NJ: Prentice-Hall.
- http://cnx.org/content/m31913/latest/Fig1new.jpg (retrieved 2011-01-21).

13.12 FURTHER/SUGGESTED READING

- DeMers, M. N. (2009), GIS for dummies. Wiley Publishing, Inc., 384p.
- Fazal, Shahab (2008), GIS Basic New Age International (P) Ltd., Publishers, New Delhi, 339p.

13.13 ANSWERS

Check Your Progress I

1. Refer section 13.3.

Check Your Progress II

1. GIS design consists of two major components – GIS system design and GIS software design
2. Refer to section 13.5.3, 13.5.4 and 13.5.5
3. Refer to section 13.7

Unit End Questions

1. Refer to section 13.4
2. Refer to section 13.5
3. Refer to section 13.6

GLOSSARY

- **Address Geocoding:** It is the process of assigning alphanumeric locational identifiers to spatially related information.
- **Alphanumeric:** It consists of both letters and numbers and including other symbols such as punctuation marks.
- **Analog/Digital Conversion:** It is the process of converting data from analog to machine usable digital format via processes such as digitising or scanning.
- **Arc:** It is a portion of the perimeter of a two-dimensional closed figure lying between two nodes at which two or more arcs intersect. An arc usually represents a continuous common boundary between two adjoining mapping units.
- **Area:** It is a level of spatial measurement referring to a two-dimensional defined space. A polygon on the earth as projected onto a horizontal plane is an example of an area.
- **Attribute:** This is a set or collection of data that describe the characteristics of real world entities or conditions. Attribute data are usually alphanumeric. Small amounts of attribute data are frequently used to describe the graphic representation of an entity on a map as a label, e.g., a polygon label. Large amounts of attribute data are usually maintained as separate attribute data sets, related to a map by names or codes.
- **Cartographic Model:** It is a flow diagram depicting a process of combining and analysing multiple layers of mapped information to create a new synthesised map.
- **Digital Data:** It is the information stored and processed with numerical digits, often in base 2.
- **Digital Elevation Model (DEM):** This is a file with terrain elevations recorded for the intersection of a fine-grained grid and organized by quadrangle as the digital equivalent of the elevation data on a topographic base map.
- **Digital Terrain Model (DTM):** This is a land surface represented in digital form by an elevation grid or lists of three-dimensional coordinates.
- **Digitisation:** It is the process of converting an analog display into a digital display.
- **Digitiser:** It is a device for scanning an image and converting it into numerical format.
- **Drawing Exchange Format (DXF):** This is used by several mapping programs that are based on AutoCad.
- **Drum Plotter:** It is a device with a rotating cylindrical drawing surface and paper reels for plotting graphic images on a long roll of
- **Drum Scanner:** It is a device for converting maps to digital form automatically.
- **ESRI:** This is a software development and services company providing Geographic Information System (GIS) software and geodatabase management applications with headquarters in Redlands, California.

- **Global Positioning System:** This is a network of radio-emitting satellites deployed by the U.S. Department of Defense.
- **IDRISI:** This is a public domain, raster-based GIS system from Clark University. It is also the name of a cartographer and geographer of major significance during the medieval period.
- **Line in Polygon:** It is the process to superimpose a set of lines on a set of polygons, and determine which polygons (if any) contain each line.
- **Line:** It is a level of spatial measurement referring to a one-dimensional defined object having a length and direction and connecting at least two points. Examples are roads, railroads, telecommunication lines, streams, etc.
- **Map Generalisation:** It is the process of reducing the detail of spatial features in a map layer. This process is relatively easy for humans and relatively difficult for computers.
- **Map Projection:** It is a device for representing all or part of a rounded surface on a flat sheet.
- **Overlay Analysis:** This is the process of combining spatial information from two or more maps to derive a map consisting of new spatial boundaries.
- **Overlay:** This is a transparent layer placed on an underlying layer or image. The overlay is where symbols, annotations, or image traces can be created or displayed without changing the underlying image.
- **Planimeter:** This is an instrument for measuring mechanically the area of plane figures.
- **Planimetric** map is a map designed to portray the horizontal positions of features; vertical information is specifically ignored.
- **Plotter:** This is a device for drawing maps and figures
- **Point in Polygon:** This is the ability to superimpose a set of points on a set of polygons and determine which polygons (if any) contain each point.
- **Polygon:** It is a two-dimensional figure with three or more sides intersecting at a like number of points.
- **Query:** This is the process to find specific information in a database.
- **Raster-to-Vector:** This is the process of converting an image made of cells into one described by lines and polygons.
- **Spatial:** This refers to phenomena distributed in two or three dimensional space and therefore having physical dimensions.
- **Text File:** It is a file containing only letters, digits, and symbols.
- **Topology:** It is a description of the relationship between node, line, and polygon elements in a vector object.

ABBREVIATIONS

.dgn	:	Micro station design files
.dwg	:	Autodesk exchange format
.dxf	:	Autodesk drawing
.kml/kmz	:	Key hole markup language
CAD	:	Computer Aided Drafting/Design/Drawing
COTS	:	Commercially available Off-The-Shelf
CRT	:	Cathode Ray Tube
DEM	:	Digital Elevation Models
DLG	:	Digital Line Graphs
DSS	:	Decision Support Systems
DTM	:	Digital Terrain Model
DXF	:	Data Exchange Format
ESRI	:	Environmental Systems Research Institute
IS	:	Information Systems
RAD	:	Rapid Application Development
SDSS	:	Spatial Decision Support System
SQL	:	Structured Query Language
USGS	:	United States Geological Survey
UTM	:	Universal Traverse Mercator
ViSC	:	Visualisation in Scientific Computing

This paper discusses organization and processing approach to Internet geographic information, and provides a new method to cross-platform and distributed geographic information and its software implementation. The example is used to show the practicality and superiority of this method. Key words. GIS distributed Internet. This paper is supported by the project â€œG2000077904â€. This is a preview of subscription content, log in to check access. Preview.