Designing a GIS Database for Planning Organizations:
A Case Study of Urban Planning Directorate,
Dammam Municipality

CRP 601	**:**	**Final Planning Project**
Term	**:**	**021**
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Date	:	11th January 2003

Presentation Outline:

- ✓ **Introduction**

- ✓ **Literature review**

- ✓ **The Proposed Design**

- ✓ **Conclusions and Recommendations**

- ✓ **Demo**

Introduction

Background

- The purpose of a geographic information system (GIS) is to provide a spatial framework to support decisions for the intelligent use of earth's resources and to manage the man-made environment.

- The Geographical Information System has two distinct utilization capabilities –
    1. querying and obtaining information and
    2. integrated analytical modeling

    However, both these capabilities depend upon the core of the GIS - the database that has been organized.

- A geographic data model is an abstract of the real world that can be used in a GIS to produce maps, execute queries and perform analysis.

Introduction

Problem Statement

- Utilization of GIS has been limited because of improper database organization.

The GIS database has also to cater to the different needs of applications. In general, a proper database organization needs to ensure the following [NCGIA, 1990]:

a) a flexibility in the design to adapt to the needs of different users.

b) a controlled and standardized approach to data input and updation.

c) a system of validation checks to maintain the integrity and consistency of the data elements.

d) a level of security for minimizing damage to the data.

e) minimizing redundancy in data storage.

Introduction

Problem Statement

- The current project is related to the design of geodatabase for an Urban Planning Organization

    The challenging part of the database design for a specific organization is that it should

    a) provide a comprehensive framework of the database

    b) allow the database to be viewed in its entirety so that interaction and linkages between elements can be defined and evaluated

    c) permit identification of potential bottlenecks and problem areas so that design alternatives can be considered

    d) identify the essential and correct data and filter out irrelevant data.

Introduction

Objectives of study

1. Conduct a needs assessment study to capture the organizational goals, objectives and needs (of an Urban Planning Organization).

2. Design a geographic database based on the user requirements

3. Test implement the geographic database design to check its consistency and integrity.

Scope of the Study

The scope of the study is limited to the Urban Planning Directorate at Dammam.

Limitations

1. The study is based on the concept of geodatabase, which is relatively new to the GIS community.

2. There is a scarcity of literature on the case studies concerned with implementation of geodatabase model.

Literature review

- ✓ **GIS Applications in spatial Planning**

- ✓ **Geodatabase datamodel**

- ✓ **Advantages of Geodatabase Model**

- ✓ **The Need for Design**

Literature review

GIS Applications in spatial Planning

Planning process deals with different types of information that deals with space, time, resources and organization. Geographic information systems are designed to deal with the spatial part of this set. It is important to develop categorization of different planning tasks regarding their spatial dimension to understand the applicability of GIS to it.

Four different types of planning tasks are identified:

1. Known activity at known location includes *urban management* to administer activities over time.

2. Known activity and unknown location includes *site selection* to find the best location for an activity.
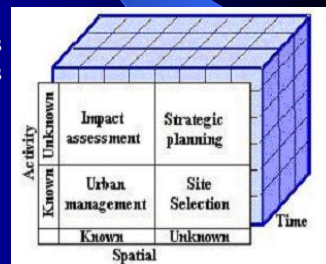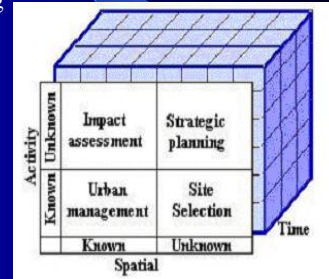
Literature review

GIS Applications in spatial Planning

3. Unknown activity at known location includes *impact assessment* to evaluate the positive and negative impacts of resulting activities.

4. Unknown activity and unknown location includes *strategic planning* to evaluate options to sustain a community.

Literature review

Case Studies of real time GIS Applications in Planning:

Analyze Building Trends :
         The Department of Housing and Urban Development for Adelaide in Australia

Develop Land Use Plans :
         The Instituto Geografico "Agustin Codazzi" (IGAC) of Colombia

Assess the Effects of Land Use Changes :
         The City of Albuquerque's Planning Department

Site Selection :
         U.S. Environmental Protection Agency

Local Governments:

- City of Anaheim, California
- The Municipality of Anchorage
- City of Philadelphia, Pennsylvania
- City of Portland, Oregon
- State of Utah
- The City of Chicago, Illinois

Literature review

GIS data model: A geographic data model is an abstraction of the real world that employs a set of data objects that support map display, query, editing, and analysis.

The Geodatabase data model:

ArcInfo 8 introduced a new object-oriented data model called the geodatabase data model.

Advantages:

a. This data model make the features smarter by endowing them with natural behaviors, and to allow any sort of relationship to be defined among features.

b. This model brings a physical data model more closely to the logical data model. The data objects in geodatabase are mostly the same objects defined in the logical data model, such as owners, parcels, roads etc.

c. The geodatabase data model allows to implement custom behaviors without writing any code.

Literature review

GIS data models

The Geodatabase data model:

Advantages:

d. A geodatabase is a physical storage of geographic information inside a Relational database management system (RDBMS). Hence all the capabilities of a RDBMS can be utilized to store and centrally manage Geographic data.

e. Data entry and editing is more accurate. Fewer mistakes are made because most of them can be prevented by intelligent validation behavior.

f. Better maps can be made. One has more control over how features are drawn and one can add intelligent drawing behavior.

g. Features on map display are dynamic. One can also associate custom queries or analytic tools with features.

h. Shapes of futures are better defined

Literature review

GIS data models

The Geodatabase data model:

Advantages:

   i. Sets of features are continuous. By their design, geodatabases can accommodate very large sets of features without tiles or spatial partitions.

   j. Many users can edit geographic data simultaneously. The geodatabase data model permits workflows where many people can edit features in a local area, and then reconcile any conflicts that emerge.

Literature review

Need for Design

1. How can GIS technology be implemented to streamline existing functions, or change the way a particular goal is achieved in a planning organization?

2. What data will benefit the organization most?

3. What data can be stored?

4. Who is, or should be responsible for maintaining the database?

The Proposed Design

Designing the geodatabase

Reality

Database schema (UML diagram)

Geodatabase

Object-Oriented Analysis and Design
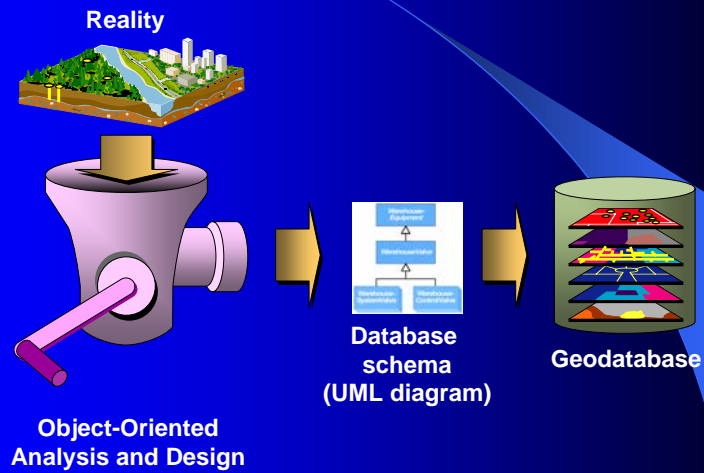
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The Proposed Design

The object Oriented Approach

Project Start-up

Define use cases

Inception

Elaboration

Construction

Design

Analyze

Build and test

Deploy

Transition

Version 1, Version 2, …
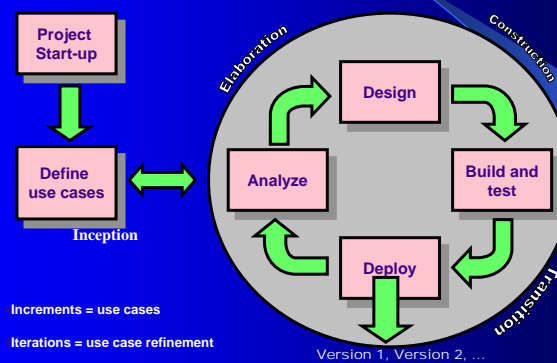
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Increments = use cases

Iterations = use case refinement

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…The Proposed Design

Phases of the geodatabase design

✓ The Inception Phase
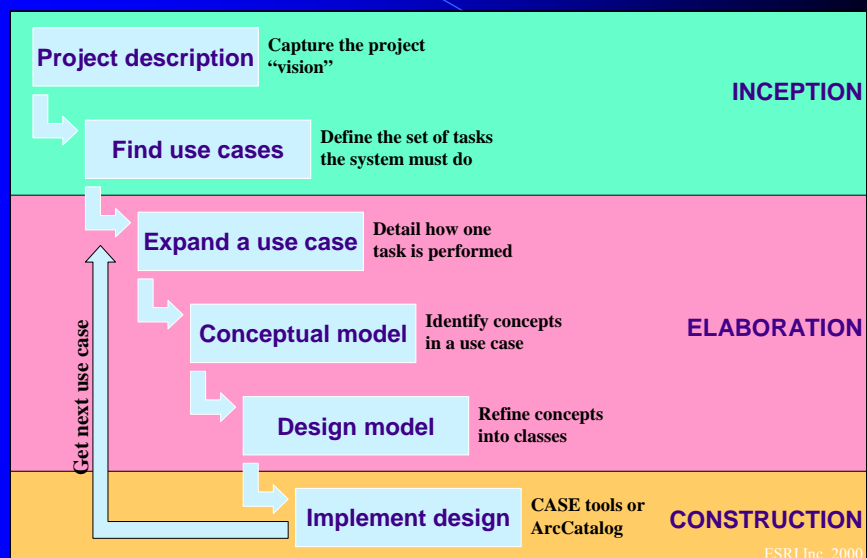
✓ The Elaboration Phase

✓ The construction phase

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…The Proposed Design

The core data modeling process

| Project description | Capture the project "vision" | INCEPTION |

| Find use cases | Define the set of tasks the system must do |

| Expand a use case | Detail how one task is performed |

| Conceptual model | Identify concepts in a use case | ELABORATION |

| Design model | Refine concepts into classes |

Get next use case

| Implement design | CASE tools or ArcCatalog | CONSTRUCTION |

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…The Proposed Design

The Inception phase

This phase constitutes two major tasks:

1. Capture the organizational goals, objectives
2. Find the use cases. Use cases define a set of tasks the system should perform

1. Capture the organizational goals, objectives

- Target Organization - Dammam Urban Planning Directorate

- Interviews were held to understand the organization structure, personnel, their functions and the workflow.

- Written documents and Internet sites were browsed as part of understanding the organization.

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The Inception phase

Dammam Urban Planning Directorate (DUPD)

Dammam Urban planning Directorate (DUPD) is part of Dammam Municipality which is a public organization under the jurisdiction of MOMRA (Ministry of Municipal and Rural Affairs).

DUPD was established to prepare local area plans, manage the land information, and provide services to the landowners' regarding effective management of their lands

Dammam Urban planning Directorate is the sole supplier of land information to different government and non-governmental agencies like:

SEC (Saudi Electric Company)
The Ministry of Water
Saudi Telecom
Ministry of Education
ARAMCO
Other departments in Municipality
…
…

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The Inception phase

Functions of DUPD

Preparation of the Regional Master plan and local area plans:

Land sub-division planning

Landuse change

Zoning

Regulating and controlling the height of buildings

Controlling the building set backs

Resolve disputes between the Municipalities

Resolve disputes between the owners of the land parcels

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The Inception phase

Functions of Municipality

- Control and regulate municipal works

- Developmental control

- Issuing Building License or permits

- Projects maintenance and implementation

- Maintain Street Infrastructure etc

- Conduct landuse and socio-economic survey.

- The social surveys aims at collecting information on the number of household units per block, vacant lands, number of people residing in each unit etc.

- The economic survey aims at collecting information pertaining to the type of establishment like residential, commercial, industrial, recreational or institutional etc.

- Different studies on traffic flow pattern, number of accidents, parking problems, public facilities etc and help Municipalities, DUPD and other public sectors in providing necessary information as and when required
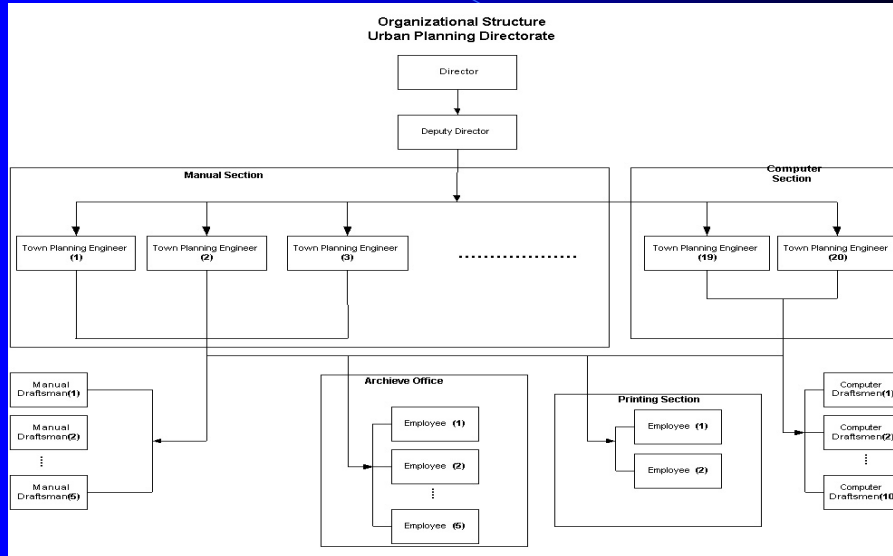
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The Inception phase

Organizational Structure
Urban Planning Directorate

Director

Deputy Director

Manual Section

Computer Section

Town Planning Engineer (1) Town Planning Engineer (2) Town Planning Engineer (3) .... Town Planning Engineer (19) Town Planning Engineer (20)

Manual Draftsman(1)
Manual Draftsman(2)
⋮
Manual Draftsman(5)

Archieve Office
Employee (1)
Employee (2)
⋮
Employee (5)

Printing Section
Employee (1)
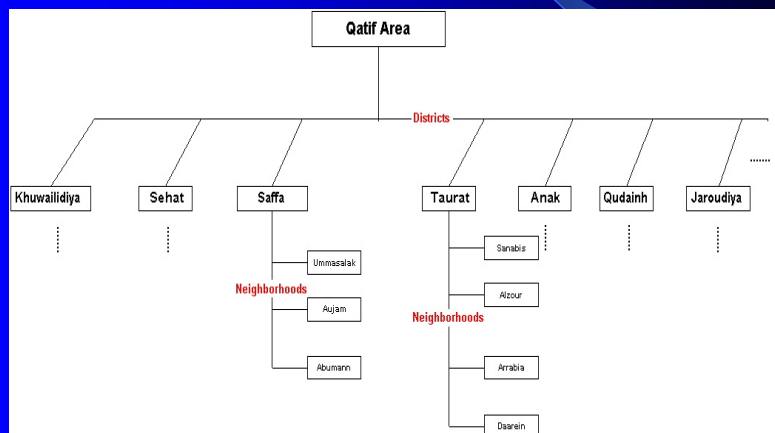Employee (2)

Computer Draftsmen(1)
Computer Draftsmen(2)
⋮
Computer Draftsmen(10)

…The Proposed Design

The Inception phase

The Eastern Province region is sub-divided into different areas like Dammam, Khobar, Qatif, Ras Tannura, Al Jubail, Al Nairiya, Saffawa, Al Khafji, Baqiaq, Al Raffia, Mehja, Assarrar, Khariya Uliya etc. Each area is again subdivided into different sub-areas or districts. Again each sub-area or district is subdivided into different neighborhoods.

Qatif Area

Districts

Khuwailidiya   Sehat   Saffa   Taurat   Anak   Qudainh   Jaroudiya ....

⋮   ⋮

Ummasalak

Neighborhoods

Aujam

Abumann

Sanabis

Alzour

Neighborhoods

Arrabia

Daarein

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The Inception phase

Use cases, Actors and Roles:

<u>Use case</u>:

A use case is a description of the interaction between a user (an "actor") and the system to accomplish a task. eg: planner prepares landuse map.

<u>Actor</u>:
An actor is someone or something that interacts with the system

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…The Proposed Design

The Inception phase

Use Case List as per the tasks performed

I.   <u>Creating and editing tasks:</u>

1. Create Parcel Map before approval from MOMRA
2. Create Parcel Map after approval from MOMRA
3. Update Parcel Map

II.   <u>Identify and locating tasks:</u>

1. Locate Parcel
2. Notify Owners

III.   <u>Verification and updating tasks:</u>

1. Verify Parcel
2. Verify Laws and Regulations
3. Verify Socio-economic data
4. Update Landuse data

IV.   <u>Database tasks:</u>

1. Data Integrity
2. Database Security

V.   <u>Analysis, reports and prints:</u>

1. Analysis and Reports
2. Print Map

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The Inception phase

DUPD <u>Actors, Roles, Use cases</u>

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The Elaboration Phase

This phase constitutes three major tasks:

1. Expand the use cases to incorporate more <u>detail</u> into them

2. Generate <u>conceptual</u> <u>models</u> based on the use cases

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The Elaboration Phase

Develop a design model (which is captured in a UML diagram) that shows the
classes, their attributes and the relationship between them.

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The Construction Phase

Procedure

✓　**Create Schema with ArcCatalog**
✓　**Importing Existing Data**

Environment and Tools that are used

✓　**Windows NT**
✓　**ArcCatalog**
✓　**Visio 2000**
✓　**SDE 8.1(Spatial Database Engine)**
✓　**Sql Server 2000**

Demo

Conclusions

1. GIS Database has been successfully designed to cater to the needs of the Urban Planning Directorate at Dammam.

2. A pilot project implementation has been successfully completed for a small area.

3. The database is checked for integrity and consistency.

The proposed design model has a number of advantages

- This design model facilitates the routine tasks performed by the planning personnel like identifying a subject parcel, its owners, block to which a particular parcel belongs, number of blocks in a plan, Maumulat concerned with a particular Plan etc.

- This model facilitates the Urban Planning Director to easily identify the number of Maumulat (complaint request or cases) that have been solved and the number of those that remained unsolved. The Urban Planning Director can also identify the planners concerned with the unsolved Maumulat and can instruct them to solve those cases in time.

- GIS based decision support systems (Spatial Decision Support Systems) can be built based on this design model to facilitate Planning Director to take timely decisions.

Conclusions

- The Urban Planning Director can easily identify the Laws and Regulations that were used by the Planner to solve the Maumulat.

- There remains a little scope for the data entry personnel to make any mistakes.

- Since the design model is applied on to a RDBMS (Relational Database Management System), all the advantages of the RDBMS can be successfully utilized. Using an RDBMS will ensure database security, users authorization (permitting only the authorized users to use the system), data backups (time specific) etc. This also allows multiple users to edit the same parcel at the same time through conflict management system.

- This data model ensures data consistency since all the tables are tied by relationships.

Recommendations

- The scope of the study can be further extended to design an enterprise wide geodatabase model that can cater to the needs of all the organizations under Dammam Municipality.

- Applications can be designed to automate most frequently performed tasks at the organization.

- An Internet/Intranet GIS Application can be built on this design model, which can facilitate the citizens to view the status of Maumulat from any place and at any time.

Thank You for Listening