

GIS AND ITS APPLICATION IN CONSTRUCTION INDUSTRY

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Abstract: Geographic Information Systems (GIS) have been used in many fields of Science; one of these fields is civil engineering. Geographic Information System (GIS) is a Computer based tool used to solve engineering problems related to spatial data. GIS, its complete potential to construction industry has not been realized. GIS technologies have the potential to solve space related problems of construction involving, integration of information, urban planning, and project site selection, soil studies, Hydrology and environmental studies. Proper use for these tools necessitates training the GIS techniques.

Keywords: Geographical Information System, Construction industry, custom application, Project Management

I. INTRODUCTION

A geographic information system (GIS) is a computer-based tool for the input, storage, management, retrieval and output of information. The information in a GIS relates to the characteristics of geographic locations or areas. In other words, a GIS answers questions about where things are or about what is located at a given location. The term “GIS” has different meanings in different contexts. It can relate to the overall system of hardware and software that is used to work with spatial information. It might refer to a particular software package that is designed to handle information about geographic features. It may relate to an application, for example a comprehensive geographic database of a country or region.

Geographic information (i.e., land information, spatial information) is information that can be associated with a place name, a street address, section/township, a zip code, or coordinates of latitude and longitude. A multitude of government functions require geographic information; at least 70 percent of all information used by local governments is geographically referenced. [1] For example, property records and assessment, planning and zoning, permit tracking, natural resource management, infrastructure and transportation management, economic development planning, and health and public safety. All of these applications consider the location o/f certain features on the landscape in relation to other features. For instance, in assessment, the location of soil types relative to property parcels is considered, whereas in planning and zoning, the location of animal confinement facilities relative to residential areas might be relevant. A geographic information system (GIS) allows the user to examine and visualize these relationships.

II. VIEWS OF THE GIS

A. DATABASE VIEW

The Database View: A GIS is a unique kind of database of the world-a geographic database (geo database). It is an "Information System for Geography." Fundamentally, a GIS is based on a structured database that describes the world in geographic terms

B. MAP VIEW

A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Maps of the underlying geographic information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information.

C. THE MODEL VIEW

A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.

III. GIS AND CIVIL ENGINEERING

An advanced information system like GIS plays a vital role and serves as a complete platform in every phase of infrastructure life cycle. Advancement and availability of technology has set new marks for the professionals in the infrastructure development areas. Now more and more professionals are seeking help of these technologically smart and improved information systems like GIS for infrastructure development. Each and every phase of infrastructure life-cycle is greatly affected and enhanced by the enrollment of GIS.

- **Planning:** In planning its major contribution is to give us with an organized set of data which can help professionals to combat complex scenarios relating to the selection of site, environmental impact, study of ecosystem, managing risk regarding the use of natural resources, sustainability issues, managing traffic congestion, routing of roads and pipelines etc.
- **Data Collection:** Precise and accurate data is the core driving factor of any successful project. GIS is equipped with almost all those tools and functions that enables user to have access to the required data within a reasonable time.
- **Analysis:** Analysis is one of the major and most influential phases of infrastructure life cycle. Analysis guides us about the validity or correctness of design or we can say that analysis is a method which supports our design. Some of the analyses that can be performed by GIS are:
 - Water distribution analysis
 - Traffic management analysis
 - Soil analysis
 - Site feasibility analysis
 - Environment impact analysis
 - Volume or Area analysis of catchment
 - River or canals pattern analysis
 - Temperature and humidity analysis

Construction: It is the stage when all layout plans and paper work design come into existence in the real world. The GIS helps the professionals to understand the site conditions that affect

the schedule baseline and cost baseline. To keep the construction within budget and schedule GIS guides us about how to utilize our resources on site efficiency by:

- Timely usage of construction equipment.
- Working Hours
- Effects of seasonal fluctuations.
- Optimizing routes for dumpers and concrete trucks
- Earth filling and cutting
- Calculation of volumes and areas of constructed phase thereby helping in Estimation and Valuation.

Operations: Operations are controlled by modeling of site data and compared by the baselines prepared in planning phase. Modeling of site may be in the form of raster images or CAD drawings. These can help us to keep track of timely operations of activities.

GIS can help to make a record of work that has been completed and can give us visualization in the form of thematic maps which will guide us about rate of operations, completed operations and pending operations.

In short we can say that GIS will prove to be the foundation of next generation civil engineering.

IV. APPLICATION OF GIS IN CONSTRUCTION INDUSTRY

Remote sensing and GIS techniques become potential and indispensable tools for solving many problems of civil engineering. Remote sensing observations provides data on earth's resources in a spatial format, GIS correlates different kinds of spatial data and their attribute data, so as to use them in various fields of civil engineering. The examples below show the used of GIS in many branches of civil engineering.

- Transportation
- Watershed Analysis
- Environment Impact Assessment
- Remote Sensing
- Urban Development
- Target Site Selection
- Landfill Site Selection
- Mineral mapping
- Pollution Monitoring
- Natural Hazard Assessment
- Resource Management

V. GIS IN CONSTRUCTION MANAGEMENT

GIS applications have proliferated in the construction industry in recent years. This fact is illustrated by the growing number of articles finding their way into civil engineering and construction journals and conference proceedings, in addition to the handful of special publications devoted to GIS (Oloufa et al. 1994)

GIS can be used for:

Progress monitoring system in construction

Networking solutions

3-D data analysis
Site location and Client Distance
Comparison of data
Construction scheduling and progress control with 3-D visualization
Government Regulations

VI. CONCLUSION

The advantages of GIS in this paper are

- It provides the accuracy and saves time in the production of map for the project. And it enables to have special maps with different scales at low cost. And these maps act as document for the project, which produced to it and is, used in the design stage, per-tender and estimated cost. This is what the construction manager needs in his job.
- The features of GIS enable the engineer to operate the model by incorporating any non-uniform data. And GIS is used in performing the analysis of large amount of data and Decision making. The database which built (created) in the GIS is very useful for the project especially In the planning stage because the large amount of information save and easy Manipulate with specially accrue for it.
- The use of the digital map which is produced in GIS for the project saves the time and update the information at any time if there is any change in it.
- The data which is digitally treated and saved as a digital reference for the project can be used as reference for another project.
- There is always a trend to verify the time and the effort in any civil engineering project. From this fact suggested advice to the civil engineering department to widen the Information about the remote sensing techniques and GIS.
- It is important to start teaching the GIS techniques in department of civil engineering because these techniques are very useful for the information which any civil engineering project needs such as, urban planning, project site selection, soil studies, Hydrology and environmental studies.

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