GEOgraphical Information System & Building Information Modelling

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Definitions

“Building Information Modelling (BIM) refers to an intelligent, model-based process that provides insight for creating and managing building and infrastructure projects faster, more economically, and with lesser environmental impact”.

“Geographical Information System (GIS) a computer system capable of assembling, storing, manipulating and displaying geographically referenced information (data identified according to its location)” – definition by USGS
PROJECT PHASES — CITY / TOWN PLANNING

Project Owner - $$

Master Planners? Landscape? Utilities?

Design

Architect Structural Engineer MEP Designers

Build

Contractor

Control

PM Consultants Cost Consultants Procurement

BIM

O & M

Facility Manager
Typical Usage

- Site Selection / Planning
- Cut Fill Analysis
- Zoning – Buildings / Open Spaces
- Drainage Analysis
- Evacuation Planning
- Transportation – Vehicle Movement
- Security

What if Scenarios

A definite relationship

BIM

- Design Review
- Clash Detection / Coordination
- Quantities / Schedules
- Construction Documentation
- 4 D Simulations
- Energy Analysis
- Lifecycle Data Management
Key Drivers - Technology

- Technology
  - Design
  - Resources
  - Materials
  - Regulations

Optimisation

Execution
- Monitoring
- Decision Making

Benefits
- Cost Savings
- Timely Completion
- Fund Management
- Quality Control
- Facility Management

Objective
Case Study – Township Owner

- Top Developer in Pune
- 250 acres Township
- Villas + High Rise + Commercial
- Off Express Highway - Toll
- Both sides of Highway
- Bound by Hills - North
**Project Requirement**

**Traffic & Transportation**
- Adequacy of proposed Road Widths
- Vehicular Access and Circulation
- Predict Traffic / Trip generation
- Assess Parking Demands

**Earthwork & Site Grading**
- Build 3d Terrain model for review
- Slope Arrow Analysis
- Identify Site opportunities and Constraints
- Assist in determining FFLs (Finished Formation Levels)
- Optimise Cut & Fill based on strategic considerations
## Project Requirement

**Roadways Engineering**
- Horizontal Alignments w.r. to existing & proposed
- Vertical Alignment to optimise cut fill
- Road Junction Design
- Location of retaining Walls

**Pavement Design**
- Representative Design Load case
- No of Equivalent Design loads during design life if pavement
- Design Rigid & Flexible pavement
**Project Requirement**

StormWater Management

- Review Existing Drainage Infrastructure
- Site walkover survey – onsite offsite drainage channels, paths, existing hydraulic structures like culverts / bridges
- Integrate Land-use plan with Drainage strategies
- Prepare Storm water layout illustrating pie sizes, lengths and slopes
- To study high flood situations to include design of detention / retention structures

Internal Plumbing Services - Building

- Planning and Design of Soil, Waste and Vent pipe system; hot and cold water, rainwater disposal and harvesting, pump room, fire protection system, wet risers hydrant system, sprinklers and alarm system
Smart City – Where GIS meets BIM

Challenges

• Growing population
• Traffic congestion
• Space – homes and public space
• Resource management (water and energy use)
• Global warming (Carbon Emissions)
• Tighter city budgets
• Ageing infrastructure
Intelligent Infrastructure provides a common approach to respond to each city’s sustainable attractiveness imperative.
Typical Architecture

**CORE SOLUTION**

- Implementation of ERP Solution
- Enterprise Web GIS
- Building Plan Approval System

**SMART CITY INITIATIVES**

- 3D City Modelling

**BASIC IT INFRA**

- Upgradation of LAN, MPLS and provision of FMS
- e-Office
- Upgrade Hardware and VC Solution

**BASIC IT SOLUTION**

- Web Portal
- E-Tendering Solution
- Scanning, Digitization & DMS

**PREPARATORY ACTIVITIES**

- Typical Architecture

*ADCC Infocad IT Services*
Digital Infrastructure Modeling

Photogrammetry, Survey, Terrestrial Laser Scanning, LIDAR
Remote Sensing
GIS, CAD
BIM
Planning, Architecture, Engineering, Construction, Operations

Design, Visualization
Gaming, Hollywood CG

Land Use Modeling, Sustainability Analysis, Transport Analysis, Energy Simulation
IT, SaaS, Web Collaboration
**Workflow – GIS to BIM**

### Planning
- Quality management plan
- Weather conditions
- Drive path planning

### Preliminary site surveys
- Determine obstructions
- Determine coverage of MLS

### Data Acquisition
- Laser scanner data
- GNSS/IMU

### Geo-referencing
- Combine LiDAR, GNSS & IMU
- Correction & transformation

### Post Processing
- Classification
- DEM/ DTM/ DSM/ nDSM
- Feature extraction
Workflow – GIS to BIM

3D Modeling
- Wireframe modeling
- Texturing
- 3D data integration
- 3D animation

Computation /Analysis
- Zoning of areas
- LoS/Shadow analysis
- Client customized analysis

Validation of data/drawings
- Using Total station
- Comparison & validation report

Application development
- Smart 3D city
- Web application

Deliverables
- Project data
- Reports & statistics
- Training to client
SMART 3D CITY – UNDERGROUND UTILITIES

Above ground level

Street level

Underground level
**Smart 3D City Modelling**

- Transforms 2D GIS Data into Smart 3D City Models
  - 3D City Creation
  - 2D GIS data + rules
  - 3D City Design
  - Interactive and rule-driven design in 3D

*Geometry + Attributes + Rules*
Share 3D Scenes - Web
**Store 3D City Model**

- 3D Cities Information Model
  - Maps, apps, analytics
- Different Levels of Detail
  - Exterior
  - Interior

- Building level
- Floor level
- Street level
Soil Analysis

Visual impact

3D routing

Analyse 3D City Model

• Model based approach
• Iterative analysis
• Time aware
• Quantitative results
**Visualise 3D City Model**

- Desktop / Web / Mobile
- Massive 3D city models
- View cities in larger context
- Semantic / realistic views
- Incorporate sensor data

Thematic city

Photo-realistic city

Sensor data
4D Visualisation

- Screenshot from a 4-D video for Highway project. The video includes parcel data, highway and building images, roadway infrastructure, and moving vehicular traffic.
- Yellow lines represent parcel boundaries; green lines represent existing ROW boundaries; red and blue lines represent future ROW boundaries after acquisition.
Visibility Impact Analysis
Visibility Impact Analysis
Urban Heat Canyon
Sub Surface Mapping

- **Subsurface Mapping** is underground surface representation, of geologic data, features or utilities beneath the Earth's surface.
- Pinpointing the exact location of utilities is vital when planning and undertaking both design and construction work.
- Enable us to map the underground environment for buried utilities of any construction, and anomalies such as voids, tunnels, cellars, foundations or other obstructions so that underground aspects of smart 3D city can be mapped.
**Subsurface Utility Mapping**

- **Ground Penetrating RADAR (GPR)** is a powerful tool for mapping the location and depth of metallic, non-metallic, plastic, concrete and asbestos-concrete utilities.
- **GPR Mapping** rapidly covers an area to reveal the distribution and character of multiple buried utilities.

![Diagram of subsurface utility mapping](image-url)

- **Data Editing**
- **Data Processing:** dewow, gains, temporal filters & spatial filters
- **Advance Data Processing:** 2D filters, de-convolution, trace attribute analysis
- **2D Visualization:** Profiles & slices
- **3D Visualization:** Isosurfaces
**Subsurface Utility Mapping**

- **EM Locators** is a ground penetrating device which employs electromagnetic radiation to identify underground utilities e.g. sewer pipeline, telecom line, gas pipeline etc.

- EM is sensitive to pore-fluid resistivity and the resistivity of the rock matrix.

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**EM survey**

**Raw Data Processing**

**Data QC**

**Visualization:**
- Profiles & slices
- 1D, 2D or 3D inversions
Subsurface Data Acquisition

- GPR is a pulse/wave technology. A transmitter generates an electromagnetic wave.
- Energy reflected back by an underground target is captured by a Receiving Antenna that travels along the surface.
- The Transmitter and Receiver operate as a single unit or they can be phased.
- Data captured by the Receiver is recorded for later processing & interpretation.
GPR scanning

GPR depth scan

Subsurface CAD drawing

Subsurface 3D model

Subsurface 2D map

Subsurface 3D Modelling
City buildings “in gray” are modeled with underground utilities.

RGB-colored point cloud helps locate existing utilities.

Street view shows geo-located above- and below-ground utilities.

Image incorporates main street data point cloud and as-built plan sets.
# Case Study: GIS + BIM

Geospatial vis-à-vis Road Infrastructure Life Cycle

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<th>Design and Construction</th>
<th>Operations</th>
<th>Maintenance and Management</th>
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<td>Building Information Modeling</td>
<td>GIS</td>
<td>Road Asset Management System</td>
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<tr>
<td>Aerial Photography</td>
<td>Modern Surveying and Machine Control and Automation</td>
<td>Geospatially enabled Integrated Collaborative Workflow</td>
<td>Traffic Management System</td>
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<td>Lidar</td>
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<td>GIS</td>
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<td>Highway Information and Management System</td>
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<tr>
<td>Automated Alignment Planning System</td>
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<td></td>
<td>Road repair, maintenance, road widening, safety, toll etc.</td>
</tr>
</tbody>
</table>
**Technology - Software**

**Software - RS**

The image processing software to access:
1. Satellite and aerial data
2. LiDAR based data

**Software - GIS**

The GIS system should be interoperable with:
1. Industry standard design and engineering format
2. Industry standard data formats
3. Industry standard geospatial enabled survey tools.

**Software - BIM**

Adoption of software system that can interface, integrate or interoperate with geospatial enabled system.

Build an up to date Highway Information System
Stormwater Modelling

- Develop new or incorporate existing hydrology, hydraulic and water quality models ("Bring the models together")
- Provide GIS-based interfaces for models
- Provide for maintenance of models and geospatial data
- Develop standards for modeling and geospatial data
- Stormwater Modeling System to assist in:
  - flood mitigation planning
  - capital project prioritization
Framework Input Data

Streams

Watersheds

Waterbody

Hydro Points
Data Model - Layers

- Streams
- Hydrographic points
- Drainage areas
- Hydrography
- Channels
- Surface terrain
- Rainfall response
- Digital orthophotography
GEOGRAPHICAL INFORMATION SYSTEM
- Cadastral Mapping
- Utility GIS – Gas, Water, Electrical, Telecom
- Municipal GIS
- 3D GIS-LiDAR, Photogrammetry
- Navigation • Imagery Solutions-Digital Globe (facilitator for Digital Globe)

ENERGY SYSTEMS & SERVICES
- Managed Data Services
- AMI/ SCADA Solution
- Infra Projects

SMART SOLUTION & SERVICES
- E-Governance – BPAS| TDR | ERP
- 3D City Modeling
- Smart - Grid | Wi-Fi | Surveillance Parking | Street Lighting

SOFTWARE DEVELOPMENT
- Application: Desktop | Web GIS | Mobile
- MIS
- Web Design & Development

BUILDING INFORMATION MODELLING
- Facility Management/ Asset Management
- BIM Infrastructure & GIS
- Consultancy

ENGINEERING DESIGN & MEDIA
- Data Conversion
- Reverse Engineering & 3D Modelling
- Process Assembly & Detailing
- Digital Marketing (SEO)
- 2D & 3D Animation • Advertising

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1,900 + Employees