# Implementing GIS for City planning and Management in Thane city

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***Abstract***— GIS organizes geographic data so that a person reading a map can select data necessary for a specific project or task.
Today, planners utilize GIS around the world in a variety of applications. The capabilities needed for decision making readily available in a single system make GIS a great tool for integrating in planning processes. This article describes a study that showed how GIS spatial analytical tools can be used to effectively shape decisions that foster urban growth management.

***Index Terms***— Applications of GIS, Urban Planning, City development using GIS.

## I. Introduction

A **geographic information system** (**GIS**) is a system designed to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data.

## II. Applications of GIS

### A. *Disaster Management*

Hurricane Katrina is seen by many as the first time that GIS was used a disaster management tool. Thanks to newly available technology, the first responders on the ground shared a great deal of data about street plans - particularly which streets were and were not accessible and the extent of the flooding. Despite that FEMA and the government came in for criticism, many agree that the efforts of data transmission both prior to and during initial relief efforts were vital to relief efforts

2014 was a terrible year for drought for the SW United States. Increasingly, GIS is being used to manage environmental problems and specifically in disaster relief. Environmental experts have plotted the reporting of official droughts in most of these areas and shape files are now available **(9)** of the affected region.

### B. *Crime Statistics*

GIS is now vital to law enforcement and planning in terms of crime statistics. Though most police forces in the USA have used them for a long time, automated and digital mapping of reported crime has made the process much easier, especially when looking at different types of crime from different departments in larger cities. The ability to share maps and look for correlations between different types of crime can give police a much better idea of an overall picture of a wider region **(11)**. The study cited here also permitted community leaders and the police to get a better understanding of each other, facilitating two-way dialogue.

### C. *Archaeology*

GIS is now critical to many elements of archaeology as it takes on more elements and characteristics of an environmental science. There are many applications in the field of historical research but none has been more beneficial than the prediction of historic site location **(12)**. Several US universities recently plotted an area to the south of the Caucasus to identify prehistoric sites and areas that may have potential for future on-the-ground research, most notably of the migration route out of Africa in antiquity. The project successfully identified a number of potential new sites for future investigation.

### D. *Civic Planning*

GIS has been a superb tool for rural and urban planning for the last few decades, working out local tax rates, planning desirability and mapping social deprivation, where new roads could go or which should be prioritized for repair. It is now a vital part of our green future too **(13)**. As with regular and previous methods of planning utilities, using the landscape is far more critical to planning. Cascade in Montana is a prime site for wind farms and there is a website that uses GIS data to plot wind speeds over the course of a year in order to best site the wind farms.

### E. *Medical Resource Management*

GIS is vital to the proper planning and analysis of the provision of cancer services for the UK socialized healthcare system, the NHS (National Health

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Service)**(14)**. The package is used to plan and examine a number of issues including catchment areas for GP surgeries. A study recently found that there was greater provision for cancer treatment in the midlands than the actual population. Such maps are used to better manage resources of the NHS.

F. *Transport*

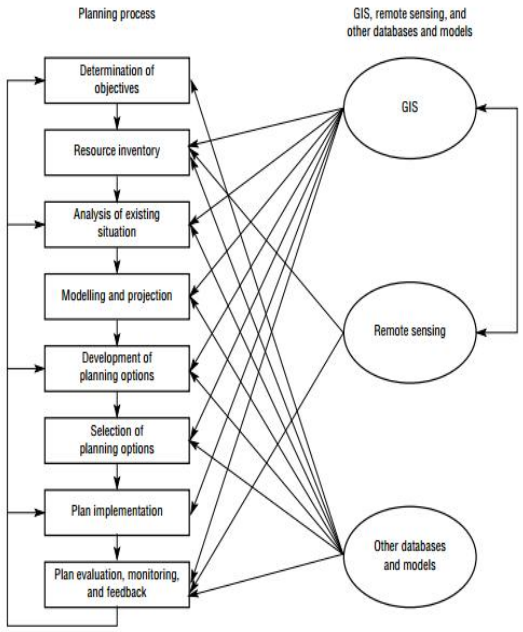
One of the biggest public works in the UK right now is the planned High Speed 2 (HS2) rail connection between London and Manchester and then later beyond that. It plans to upgrade and revolutionize the rail network in the UK, arguably starved of much-needed modernization since privatization in the 1980s. Because of the massive amount of planning involved, including that many agencies have input into the project, it would have been a logistical problem with the massive amounts of data available and collected on a dedicated GIS site in order that the best decisions are made while respecting local infrastructures and the environment **(15)**.

## III. GIS IN URBAN PLANNING

GIS finds its use in urban planning as an analytical and modeling tool. It can be applied to a wide array of problems. This comprises addressing problems related to data base structures, simple and complex analytical models alike. GIS is also useful in monitoring of an area or conducting a feasibility study of a location for a specific purpose e.g. ascertaining the suitability of a location for the construction of a bridge or dam. Feasibility study of even smaller structures like schools and hospitals is essential and can be easily conducted with the help of GIS. However, areas where variants of a design or alternate plans are required, the use of GIS are supplemented with more specialized equipment to produce better results.

## IV. WORKING OF GIS IN URBAN PLANNING

**2.1 Resource inventory** Geographical information, when integrated with remote sensing, can save time in collecting land use and environmental information. Remote sensing images are becoming an important source of spatial information for urban areas (Barnsley, Chapter 32; Paulsson 1992). They can help to detect land use and land use changes for whole urban areas (Barnsley et al 1993). In particular, stereoscopic pairs of digital aerial photographs can be used to derive 3-dimensional CAD models of buildings for dynamic visualization of a city, or for direct import into a GIS database (Dowman, Chapter 31**).**




**2.2 Analysis of existing situations** GIS can help to store, manipulate, and analyze physical, social, and economic data of a city. Planners can then use the spatial query and mapping functions of GIS to analyze the existing situation in the city. Through map overlay analysis, GIS can help to identify areas of conflict of land development with the environment by overlaying existing land development on land suitability maps. Areas of environmental sensitivity can be identified using remote sensing and other environmental information (Yeh and Li 1996).

**2.3 Modeling and projection** A key function of planning is the projection of future population and economic growth. GIS can be used for prediction and projection (Longley et al 1994). Spatial modeling of spatial distributions makes it possible to estimate the widest range of impacts of existing trends of population, and of economic and environmental change. For example, a range of environmental scenarios can be investigated through the projection of future demand for land resources from population and economic activities, modeling of the spatial distribution of such demand, and then using GIS map overlay analysis to identify areas of conflict. Using socioeconomic and environmental data stored in GIS, environmental planning models have been developed to identify areas of environmental concern and development conflict (Schüller 1992). GIS can also be used to model different development scenarios. It can show the modeling results in graphic form, making them easy to communicate with the decision-makers (Shiffer, Chapter 52; Armstrong et al 1992). Planners can use such information to formulate different planning options and help guide future development so that they avoid such conflicts.

**2.4 Development of planning options** Land suitability maps are very useful in the development of planning options. They can be used to identify the solution space for future

development (Yeh and Chow 1996). The association of spatial optimization models with GIS can help to formulate and develop planning options which try to maximize or minimize some objective functions (Chuvieco 1993). The simulation of different scenarios of development with GIS can help in developing planning options (Landis 1995).

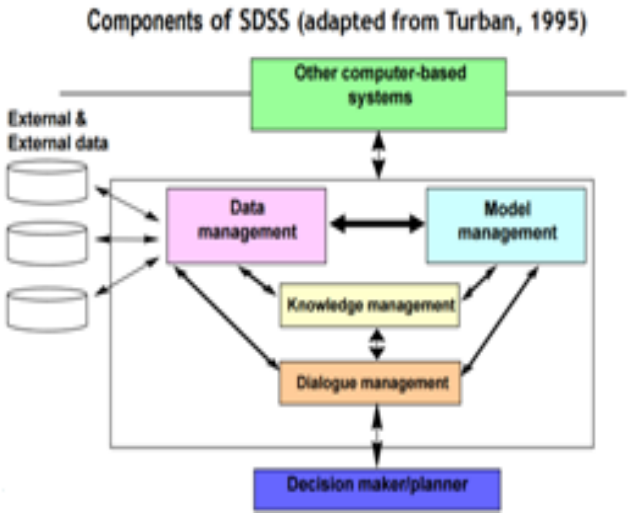
**2.5 Selection of planning options** The final selection of a planning option is increasingly a political process, but planners can provide technical inputs to this process in order to help the community in making their collective choices. The integration of spatial and non-spatial models within GIS can help to evaluate different planning scenarios (Despotakis et al 1993). The use of GIS with multi-criteria decision analysis can provide the technical inputs in the selection of planning options (Eastman, Chapter 35; Carver 1991; Eastman et al 1993)

**2.6 Plan implementation** GIS can be used in the implementation of urban plans by carrying out environmental impact assessment of proposed projects to evaluate and minimize the impact of development on the environment (Schüller 1992). Following such work, remedial measures can be recommended to alleviate the impacts.

**2.7 Plan evaluation, monitoring, and feedback** When used together with remote sensing, GIS can help to monitor the environment. It can, for example, be used to monitor land use changes (Yeh and Li 1996). It can also examine whether land development is following the land use plan of the region, by overlaying a land development map produced from the analysis of remote sensing images on the land use plan. In addition, GIS can be used to evaluate the impact of development on the environment to see whether adjustments of the plan are needed. GIS can also be used in the monitoring and programming of land development (Yeh 1990).

## V. SPATIAL DECISION SUPPORT SYSTEM IN URBAN PLANNING

DSS provide a framework for integrating database management systems, analytical models, and graphics, in order to improve decision-making processes. They are designed to deal with ill- or semi-structured problems which are poorly defined and partially qualitative in nature. The decision support system concept was extended to the spatial context in the development of SDSS (Armstrong and Densham 1990; Armstrong et al 1986; Densham 1991; Densham and Rushton 1988). The architecture of a SDSS is shown in Figure 4. SDSS help decision makers to make decisions on different locational alternatives (for example, optimal location of service centres). Because of the lack of analysis functions in




the past, GIS have not been considered as part of SDSS. Instead GIS have been used to generate and store spatial data which were then used as inputs for the analytical models. Results of the analytical models were then displayed by GIS

Five Main Concepts relevant for setting up a SDSS
1. Types of spatial decision problems and definition of decision problems
2. Models for structuring the decision making process
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3. Collaborative decision making, participants and stakeholders
4. Methods for spatial decision support
5. The role of scenarios in spatial decision making
CHANGES workshop – SDSS Concepts & Requirements (Flacke) 27/11/2012 9
2.1 Types of spatial decision problems and definition of decision problems Spatial decision problems Semi-structured problems (multi-dimensional, goals
♣ & objectives not compy g ) letely defined, larger number of alternatives) Degree of uncertainty inherent
♣ Potential conflicts between stakeholders involved
♣ Types of spatial decision problems
1.Site selection
2.Location-allocation
3.Land use selection
4.Land use allocation
Number Recognition and definition of a decision problem
Decision problem is defined as a situation where an individual or a group perceives a difference between a present state and a desired state and where:
The individual or group has alternative course of actions♣ available
The choice of action can have a significant effect on this
The choice of action can have♣ a significant effect on this perceived difference
The individual or group is uncertain a priori as to which♣ alternative should be selected alternative should be selected
CHANGES workshop – SDSS

  

Concepts & Requirements (Flacke) 27/11/2012 11 (Ackoff 1981)
2.2 Models for structuring the decision making process
Decision making process is transforming information into♣
instructions prototypical sequencing of process phases
prototypical sequencing of process phases♣
at any phase during the process, the workflow can go back to a
♣ previous phase if needed.

## VI. Implementation of GIS in Actual City Building

While we performed some research on Thane city based on some research and field study performed.

1. **Gathering information about area or locating the area:** Let us consider a scenario where we choose the Ghodbunder area in Thane city for Development and management. The area selected for field study is located near the west side of the city and below the average sea level due to which it is being prone to water logging and being also close to the forest makes it remote from local public amenities and services. Information about the area can be obtained through local maps, field survey and 3D visualization tools such as the Google earth.
2. **Planning to build city:** Planning the development for the selected area requires certain effort as being below the sea level creates requires elevation for any construction to take place on the site. Spatial analysis show the various elevation points which must be avoided to balance the structure. A statistical survey of the area is required to get a detailed view of the housing projects and crime ratio to plan out the development. Also performing an underground study would help in planning underground projects such as the waste drainage system, Water pipeline and subway stations in future.
3. **Resources required to Plan:** In order to plan a well-developed area we need to have the exact resources which includes a high end computer system, ArcGIS application, volunteers for field study and training in using ArcGIS software.
4. **Analysis and Decision making process:** The analysis is performed using SDSS and geo-statistical surveys about the probabilistic land utilization and management. Making use of the GIS we can plan out the region which is optimum for a road construction and residential or public amenity construction such as Hospitals, Fire stations or Police station etc.

GIS can be used as an important tool in an architect's arsenal. GIS can be used for land surveys without the need to actually visit the field.

GIS can be used to plan various civic and public amenity buildings constructing roads and railways for navigation within the city. You can also use it to propose further redevelopment. Using the satellite imagery obtained from the satellite relays we can also monitor the tectonic plate moments below the oceans or underground and determine the earthquake prone areas. We are also able to measure the land elevation and compare the sea level to find out the areas which might get water logged during floods or heavy rains.

## VII. Conclusion

GIS are increasingly being used in planning agencies in the developed and developing countries (Worrall 1990; Yeh 1991). Many planning departments that have acquired mapping systems in past have since shifted to GIS in lieu of mapping software (French and Wiggins 1990). With the increase in user friendliness and the number of functions of GIS software, and the marked decrease in the prices of GIS hardware, GIS is now an operational and affordable information system for planning. It is increasingly becoming an important component in the planning models, Visualization, and the internet will make GIS more useful to Urban planning. Today, the main constraints on the use of GIS in urban planning are not technical issues, but the availability of data, Organizational change, and staffing.

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