

GIS As New Approach And Method In Preparing And Implementing The Development Plan In Malaysian Planning System

Ahris Yaakup and Susilawati Sulaiman

Department of Urban and Regional Planning, Faculty of Built Environment, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia.

Email: b-haris@utm.my / ugisp_bip@yahoo.com

Abstract

Malaysian planning methodology has changed over the years as emphasis has shifted from producing plan, which described a state of affairs expected of some future date, to one which acknowledged the continuous and cyclical nature of planning. Thus planning should be based on the identification of needs and goals, the formulation and evaluation of alternative courses of action and monitoring of adopted programmes. By tracing the evolving view of planning, this paper will discuss the development of Geographical Information Systems (GIS) as a new tool and approach for planning in Malaysia. Using examples from current GIS implementation projects namely the Application of GIS for Klang Valley Region (AGISwlk) and GIS for Negeri Sembilan (GIS9), this paper will discuss GIS development and application for plan's preparation and monitoring of urban development. A well-integrated and comprehensive database is part of the important elements that could determine the ultimate success of GIS application in plan making. The application indicates that the functionality of GIS can be enhanced by adding new model and analytical tools to existing system and by using the GIS toolkit to the best effect. Consequently, it will be used to assist decision-making, taking into account among other things, the current scenarios of the proposed development, physical constraint and future impacts. The paper will also discuss various modeling and spatial analysis techniques appropriate for different stages and form of planning which will integrate GIS and other information system for plan generation and plan evaluation such as Spatial Multi-Criteria Evaluation. Lastly, the paper will address the potential development of web-based GIS for monitoring the implementation of development plan and for project monitoring.

1.0 Introduction

Malaysian planning methodology has changed over the years as emphasis has shifted from producing plan, which described a state of affairs expected of some future date, to one which acknowledged the continuous and cyclical nature of planning. As such, planning should be based on the identification of needs and goals, the formulation and evaluation of alternative courses of action and monitoring of adopted programmes. This paper will discuss the development of Geographical Information Systems (GIS) as a new tool and approach for planning in Malaysia using examples from current GIS implementation projects namely the Application of GIS for Klang Valley Region (AGISwlk) and GIS for Negeri Sembilan (GIS9).

2.0 Information System And Spatial Planning

Proper and effective planning generally involves close monitoring of development growth, plans review as well as policy appraisal which calls for comprehensive information concerning the past, present and future. As spatial representation is critical to environmental problem solving, the attribute data related to the problems or issues to be addressed need to be translated into spatial manifestation to ease the process of analysis and decision making. Apparently, data and information that need to be analysed will be coming from various sources either in the primary or secondary forms. Due to the scope, process and methods involved in land use planning, a development programme does not only need a broad set of data and information but they should also be easy to be processed and manipulated base on requirement and situation. This has set the need for planning agency to develop a planning

information system appropriate with its planning and monitoring functions, especially to facilitate the assembly and integration of information from a wide range of sources.

Information system can serve as the eyes and ears to development planning and monitoring process. It provides for the monitoring and surveillance of compliance with planning regulations and it serves as an early warning system with regard to sources of friction, imbalances, shortfalls and failures in the process of planning and management (Yaakup *et al.*, 1997).

The introduction of computers into planning in the 1950s and 1960s was part of a more fundamental transition from the profession’s traditional concern with the design of the physical city to a new focus on the quantitative techniques and theories of the social sciences. As suggested in Table 1, computers were assumed to play an important role in this task by collecting and storing the required data, proving systems models that could describe the present and project the future, and helping unambiguously to identify the best plan from the range of available alternatives (Harris and Batty, 1993; Brail, 2001).

Table 1: Evolving Views of Planning and Information Technology

1960s	System Optimisation	‘Planning as applied sciences’ Information technology viewed as providing the information needed for a value-and politically neutral process of “rational” planning
1970s	Politics	‘Planning as politics’ Information technology seen as inherently political, reinforcing existing structure of influence, hiding political choices, and transforming the policy-making process
1980s	Discourse	‘Planning as communication’ Information technology and the content of planners technical analyses are seen as often less important than the ways in which planners transmit this information to others
1990s	Intelligence	‘Planning as reasoning together’ Information technology seen as providing the information infrastructure that facilitates social interaction, interpersonal communication, and debate that attempts to achieve collective goals and deal with common concerns

Source: R.K. Brail and R.E Klosterman (eds), 2001. *Planning Support Systems: Integrating Geographic Information System, Models and Visualization Tools*. United States of America: ESRI Press

Although computers have been applied in urban planning almost since their inception, only recently with the development of graphics, distributed processing, and network communications has software emerged that can now be used routinely and effectively. At the basis of these developments are geographic information systems (GIS) but gradually, these are being adapted to the kind of decision and management functions that lie at the heart of the planning process (Batty and Densham, 1996).

2.1 Role of GIS in Spatial Planning

The evolution of sciences and technology has effected the change of planning decision method. Planning support system (PSS) and decision support system (DSS) are among tools for achieving planning quality in optimum development. They combine traditional tools for urban and regional planning with other technologies such as expert system (Han and Kim, 1989), decision support aids such as multi-attribute utility theory (Lee and Hopkins, 1995), hyper media systems (Shiffer, 1992), and group decision support systems (Armstrong, 1993; Finaly and Marples, 1992). However, GIS still remain as the core of these systems. The use of GIS as a major component of the planning support system is significant due to the need for frequent organization and updating of relevant spatial information concerning planning and development.

GIS which come as a complete package with the capability in capturing, storing, updating, manipulating, analysing and displaying of all forms of geographically referenced information, has proven to be an appropriate tool for planning and monitoring. An important GIS capability is in handling both digital cartographic data and the associated databases of attribute information for map features. Another main driving mechanism of any GIS is the ability to inter-relate data sets. Since the relative positions of different map features across geographical space can also be performed. The innovative technology can support planning and decision making by offering relatively quick response on analytical questions and monitoring issues. Some of the important functions include the ability to retrieve information rapidly and efficiently scenarios and to evaluate alternative solutions generated by modelling procedures.

2.2 Malaysian Planning System and Incorporation of GIS

The Town and Country Planning Act, 1976 (Act 172) (amended in 2001) requires the formulation of plans at various spatial and administrative levels to ensure effective planning. The various plans include:

- The National Physical Plan (RFN), which outlines the strategic policies for the purpose of determining the general direction and trend of the nation physical development.
- The Regional Plan, which establishes policies to guide and coordinate development for a region especially in the provision of infrastructure and facilities within the region.
- The State Structure Plan (RSN), which sets out the policies and proposals for the development and use of the land in a state.
- The District Local Plan (RTD), which translates the state policies at local level.

The strategic policies which set out the national physical trend of development will be translated at the State Structure Plan. The control of development at the local level is tied to the District Local Plan which is the detailed land use plan that incorporates the national as well as the state development policy. For implementation of the long-term plans and in order to achieve the goals and objectives under the long-term perspective, it is necessary to mobilize all sectors in a systematic manner so as to sustain high rate of economic growth and social progress. This calls for effective methods of creating, obtaining and distributing information for the purpose of mid-term reviews, which determined policy and implementation issues for further attention during the remaining plan period are imperative. As for monitoring purpose, the need for vertical integration of the developed and maintained datasets at the federal, state and local levels should be given due consideration (Yaakup *et al.*, 2006).

The Malaysian development planning system was refined in line with the amendment of Act 172 in year 2001. The amended Act plays a major role in the reform of the development planning system in the sense that it insists the incorporation of the GIS into the development plan preparation process at all planning hierarchy, be it the macro or micro level. As such, GIS technology has long been applied in planning activities, which essentially include plans formulation as well as development control (Johar *et al.*, 2003).

The concern of adopting GIS in the development planning process, especially in the preparation and review of development plans as well as development control involving evaluation of planning applications had encouraged many local/planning authorities to embark on small scale, multi-faceted GIS applications to suit their functions and work procedures. While geospatial information are being used daily by almost every agency of the federal, local and regional governments, as well as public authorities, recently much concern is given to effective methods of creating, obtaining, distributing and sharing information especially for and consequently better decision making (Yaakup *et al.*, 2005).

3.0 Urban Metropolitan Planning And Monitoring Using GIS: The Klang Valley Region's AGISwtk Project

The activities of controlling and monitoring urban development are crucial for areas undergoing metropolitanisation process such as Klang Valley. The process considerably brings numerous benefits to the quality of urban life and environment but at the same time leads to problems such as uncontrolled development, urban sprawl, congestion and the increasing cost of public services to cater for new infrastructure apart from the risk of socio-economic disparity between regions becomes more significant, compounded by increasing rate urban poverty and the risk of social exclusion.

The understanding of the urban system that promotes urban growth is imperative for the purpose of policy making, formulating development strategies as well as development plans preparation. Apparently, the dynamic nature of planning and monitoring of development in Klang Valley, the fastest growing region in Malaysia, necessitates a 'tool' for continuous monitoring, evaluation and analysis of current environment as well as assessing the capacity for future development. As such, the development of a comprehensive database and GIS-based planning application under the project named "Application of Geographical Information System for Klang Valley Region (AGISwtk)" was initiated in 1995. The implementation of AGISwtk had been directed toward organisation of the system to facilitate immediate query and analysis, monitoring of development planning as well as spatial modelling. The project had since undergone intensive enhancement in its database structure, data quantity and quality, analysis approach and techniques as well as system customisation and integration to include the ability to provide alternatives in development scenarios.

3.1 Database Development

The AGISwtk's database formerly developed adopted the coverage data model approach which consisted of various elements and data layers prepared to cater for nine application modules as identified by the regional authority including base map, administrative boundary, physical characteristics, land development, population and socio-economic, environmental quality, traffic and urban transportation, green and recreational areas, public facilities and utilities (Yaakup *et al.*, 1999). A considerable time and effort was spent in the data gathering and bringing it up to a common platform and standard data format. The data was used to support various regional level analyses under each application module. This project has significantly contributes to the understanding of the development characteristics of the Klang Valley region and thus helps in planning, coordinating and monitoring development programmes of the area by utilising every potential of the system mainly as a regional planning and monitoring support tool (Figure 1).

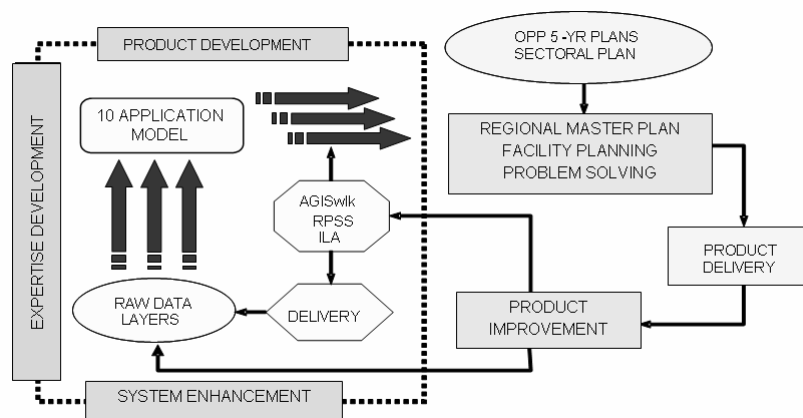


Figure 1: Framework of Product Development
(Ministry of Federal Territories, 2004)

The recent enhancement of the database took into consideration the need for multi-user and simultaneous access especially for the purpose of data updating. These require an effective database management system and GIS tools to manage the large pools of geographic data. Hence, the enhancement framework had adopted the geodatabase data model approach, using Microsoft SQL Server as the DBMS and ArcSDE which provides open interface to the relational database for data storing, updating and management apart from serves as the application server for exchanging data with various application including ArcGIS Desktop and the internet. The database previously developed based on macro data approach was subsequently upgraded to provide comprehensive lot-based data especially for supporting analyses needed for deriving solutions to specific problems at micro level.

AGISwlk provided three medium for access to its database i.e. via ArcGIS Desktop, AGISwlk User Interface and Web. The web function provide user to access and make operational function at the ArcIMS data layers through internet to integrate data centre from AGISwlk database. The hardware and software for implementation of AGISwlk had been upgraded from time to time based on the need of user and GIS application function. Altogether, three types of server were used i.e. AGISwlk Web server (ArcIMS), ArcGIS application server and AGISwlk database server (*Geodatabase*) located in SAN. Accessibility to the database had also been enhanced through installation of high speed network system in the Ministry's building. For security purpose, *firewall* (hardware- and software-based) is placed at the web server and database (software-based) to protect from illegal access.

3.2 Planning Analyses and Integrated Land Use Assessment

Relative to the rapid land use growth, various issues and problems arise especially those pertaining to environmental pollution, land use conflicts, as well as the availability of land for future development. The changes that occur necessitate continuous monitoring to ensure sustainable development in the environmental as well as socio-economic aspects. More important, assessment of these changes is crucial not only to understand and review current development scenarios, but also to predict changes that will occur, formulate policies and strategies, as well as control development. Toward better management of the metropolitan growth, faster planning decisions and careful management are imperative (Yaakup *et al.*, 2005).

As such, the Ministry of Federal Territories has embarked on developing a regional planning support system (RPSS) focussing on scenario building, measuring development impact and a tracking module to monitor and measure regional plan targets (including structure plans). To support the system, AGISwlk have concentrated on three types of planning applications: sectoral applications; Integrated Landuse Assessment (ILA); and specific case studies. Various analyses were carried out through adoption of the spatial modelling techniques using various GIS spatial analysis functions. The analyses include identification of land availability and area suitable for development; assessment of land use change and environment quality; as well as supply and demand for public facilities. Gradually, AGISwlk application is enhanced through improvement of analysis methods, model and criteria based on regional planning needs.

The application modules of AGISwlk were initially developed base on relevant sectors associated with development planning and monitoring of the region. Recently, more efforts are directed at assessing the ability to supply land and supporting infrastructure to meet future needs. What needed is a tool to better manage outward growth and channel development into designated growth areas so as to strike a sustainable balance for economic growth and protection of environmental assets. Also, in the planning evaluation process, it is important to have several alternatives in which various factors such as the cost-benefit and the socio-economic characteristics have to be taken into account (Yaakup, 1991).

Integrated Land Use Assessment (ILA) is introduced and developed within AGISwlk, aimed at providing an integrated spatial analysis model with the ability to consider alternative spatial

development strategies as well as visualise development potentials involved in land use planning by integrating physical and socioeconomic information. The introduction of ILA as an integrated land use planning approach that applies the GIS analysis capabilities while supported by the use of planning support system (*What if?*) is seen as a good alternative for achieving better and more rational decisions. The developed model is expected to dynamically support the preparation of the Klang Valley Regional Master Plan (Figure 2). The methodology was developed and organized based on the GIS spatial analysis process and planning support system framework as well as the identification of policy and strategy to be used as guideline and direction of study in achieving the desired output. The ILA Model is dynamic in approach, providing flexibility for users in manipulating the selection criteria and organising them on priority basis for the development of the scenarios. The assessment technique in ILA adopts the GIS spatial analysis technique combined with the weighting and sequential techniques. ILA involves two type of assessment namely Land Resources Assessment and Land Capacity Assessment.

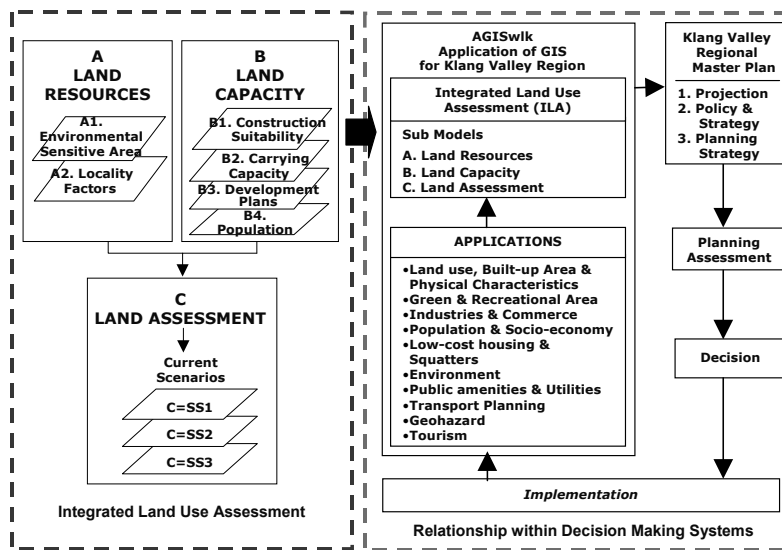


Figure 2: Klang Valley Integrated Landuse Assessment (ILA) Framework

3.3 Distributed Data Access

The use of web-based GIS is seen as the best approach in overcoming the uncertainty, contradiction and disputes involved in the planning process. It provides huge potential for improving the planning system especially in terms of transparency and accessibility and consequently contributes to better governance. The AGISwtk Web Application for Klang Valley was developed as an extension to the database and application modules of AGISwtk. The application developed adopted the three-tier client/server architecture comprising three main parts namely Clients, Middleware/Application Server and Data Storage (Yaakup *et al.*, 2001). Two modules were developed to serve two different target user groups base on the requirement and role of each one. The web application was prepared using the ArcIMS software and provides two types of web viewer namely the HTML Viewer for Public Interactive Maps Application and Java Viewer for Stakeholders Application.

The first module, which is the Public Interactive Maps Application aimed at providing information on Klang Valley apart from inviting public participation from the general public. Through access to the interactive maps interface, users are allowed to retrieve information base on the eight applications provided namely public facilities, industries and commerce, tourism, physical characteristics and built up areas, green and recreational areas, land use, housing as well as population and socio-economy. The map display and GIS functions offered including *Zoom In*, *Zoom Out*, *Pan*, *Hyper Link*, *Full Extension* and *Identify* enable users to access and retrieve the required information easily and interactively. Apart from that, several analyses results are also made accessible, for example, those

associated with the *Integrated Land Use Assessment (ILA)* study to encourage users to participate in evaluating the model as well as final results for further improvement.

The second module is known as the Stakeholder Application (Figure 3). The web-based GIS application for stakeholders was developed to integrate the data set and to encourage data sharing between various agencies involved in shaping the urban environment in Klang Valley region. The stakeholders application has the interest of promoting data sharing and collaborative planning between government agencies and planning authorities in Klang Valley through distributed data access. This helps overcome the problem of costly other than time-consuming database development. This application cater for two types of data to be shared, which are the AGISwlc's data and Stakeholder's data. Users will be able to access the data either in the vector format or image, such as IKONOS, directly from the AGISwlc's database apart from carrying out simple GIS operations such as *overlay and buffer* through integrating data from diverse sources. Certain AGISwlc data believed to be of common needs, will be made accessible to all relevant agencies while data known to be confidential and require certain extent of control will be made available upon request. This is done through agreement with data providers. Stakeholders will still perform their own task of capturing, storing and maintaining data relevant to their organisational operations.

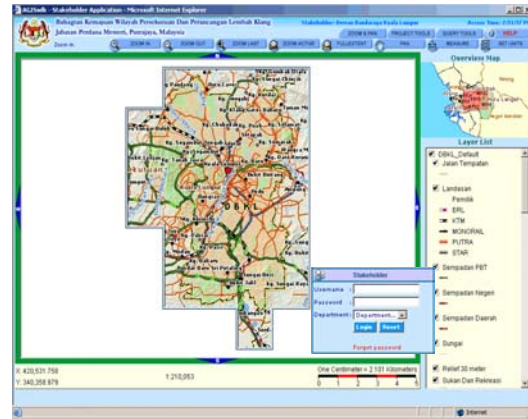


Figure 3: Stakeholder Application

The stakeholders application which act as the 'hub homepage' will provide access to aggregated subset of transactional data, present a visual user interface and allow for cross-disciplinary analysis. This application provides function such as *Graphical buffer, mapnotes, Editnotes, save as project file* and *image capture* to allow users to carry out analyses as well as share their views on-line by graphically adding to, as well as, editing or deleting the displayed area being discussed.

4.0 Implementation And Monitoring Of Development Plan In State Of Negeri Sembilan

Monitoring the implementation of development plans are crucial to ensure that activities are in line with the implementation schedule and whether the resources or implementation procedures are used effectively. Monitoring procedures enable timely action to be taken to correct the deficiencies detected. While the planning and management process involves many stages of decision-making and expertise from various fields and hence necessitates for collaboration among the parties involved. In addition, public participation is essential as a means of improving information and to facilitate the adaptability of the planning system.

The State Government of Negeri Sembilan had taken an early initiative toward the implementation of ICT in its administrative management through the preparation of *Negeri Sembilan ICT Strategic Plan* in 2003. Among others, the plan identified the operational supports in term of information systems to be implemented by the state government base on priorities for facilitating implementation of projects (MAMPU, 2003). Realising the need for a more dynamic development planning management system at the state level, the State Government of Negeri Sembilan decided to develop its own GIS-based planning support system to monitor the implementation of its development plans. Integration and coordination of data developed to bridge the gap between state policies and local circumstances is crucial for planning at state level. This would certainly need a common base of information and data which can help coordinate planning and development programmes at the local authorities level (Yaakup *et al.*, 2006).

4.1 State Level Planning Approach and GIS9 Data Sharing Framework

The State of Negeri Sembilan forms the southern part of the greater KL conurbation identified in the National Physical Plan as the main growth engine of the Malaysian economy. It is made up of 7 Districts with 8 Local Authorities.

The development of GIS components for Negeri Sembilan (GIS9) which comprise the database and system integration essentially took into consideration the different functions and roles of the JPBDNS and stakeholders involved. GIS9 was initially developed primarily for execution of the functions of Town and Country Planning Department of Negeri Sembilan (JPBDNS). As each technical department or agency applies rather different administrative and management procedures, GIS9 approach for planning at the state level took into account the needs and functions of JPBDNS as well as other technical departments concerned with planning, implementation, maintenance and management of development programmes in Negeri Sembilan. This is to ensure that the developed data can be shared in attempt to strengthen the

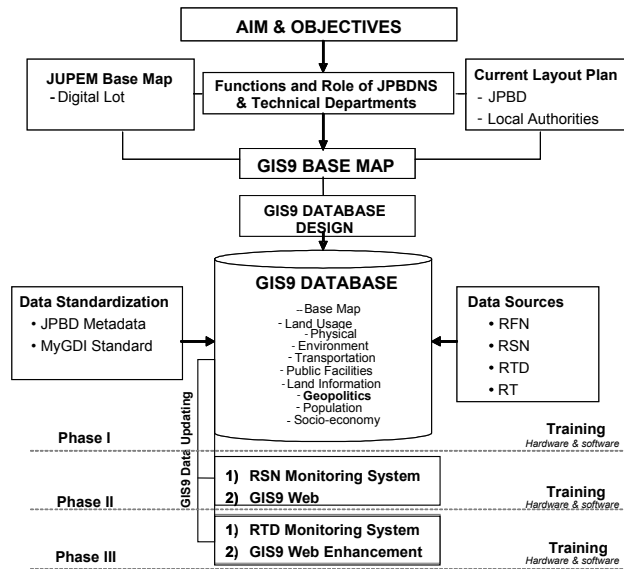


Figure 4: GIS9 Development Approach

development planning management system at the state level. Development of GIS9 was approached in three phases to ensure the success of its implementation and future sustainability especially in the aspects of hardware, software and human resources.

GIS9 accommodates geospatial data for the whole state of Negeri Sembilan. The development of GIS9 database involved the routine process of data collection, manipulation, standardization, updating and storing. Due to the requirement of various stakeholders, the database was designed base on the geodatabase model approach. The database was developed using data from various sources which is channeled through JPBDNS with the support of the other technical departments. The base for GIS9 data development is the lot cadastral map from Department of Survey and Mapping Malaysia (JUPEM), which was further enhanced with reference to the layout plans provided by JPBDNS. Other data providers include the local authorities which supplied data concerning the local plans and planning applications, and various technical departments. Data from multiple sources was standardized based on the GIS9 database format and structure. GIS9 database structure was designed to conform to JPBD's metadata as well as MyGDI data standard (MS1760).

4.2 GIS9 Accessibility

GIS9 was developed primarily for executing the functions of the Department of Town and Country Planning of Negeri Sembilan (JPBDNS) but was meant be extended to support the functions and requirements of all the state technical departments. These include the Land and Mining Department, Agriculture Department, Health Department, Department of Mineral and Geoscience, Police Department, Fire Department, Public Works Department, Waterworks Department, Drainage and Irrigation Department, Forestry Department and Department of Environment. For the time being, GIS9 data is made available to all the state technical departments located within the same building (Wisma Negeri) through the local area network (LAN).

The data sharing framework in GIS9 provides a more efficient, more effective, and less expensive method of sharing and coordinating information between stakeholders. GIS9 provides two alternatives for access of its data i.e through the customised user interface and the web.

The GIS9 customised system and user interface was developed to ease and make data accessible to all level of users in JPBDNS. It serves as an executive information system for data display and organisation for analyses purposes. Planning analysis is imperative to ensure that development is well-controlled and comply with the policies and guidelines, both at the state and local level. The application was developed to facilitate JPBDNS in organising data for analysis and retrieving analysis results when needed, for the purpose of monitoring development, preparation of development plans as well as development control. The comprehensive database constructed has made it easier for modeling and analysis based on predetermined criteria which is required in the formulation and review of development plans, such as identifying ‘potential areas for development’. The GIS9 interface is equipped with several security features to prevent unnecessary exploitation and corruption of data.

The GIS9 web-based application was designed to enable dissemination of information both via intranet and internet. Access of information through the web is less time consuming and reduces the need for manpower, apart from enables smooth management and administration flow across government agencies. Generally, the modules developed include the main page, articles, stakeholders, login, activities and public’s interactive maps. The main page provides brief information on GIS9 apart from access to the GIS9 database and applications for stakeholders and the public. GIS functions such as *zoom in*, *zoom out*, *pan*, *full extent* and *identify* were provided to assist user to retrieve the required information. The web application was developed and updated in stages based on the updating of information in the database.



Figure 5: Public’s Interactive Maps Application

The web application has also contributed to better means of public participation. Public participation is essential as a means of improving information and to facilitate the adaptability of the planning system. In Malaysia, the preparation of the development plans called for participation as a value consensus mechanism, not only from the public at large but other agencies to allow data sharing and to ensure more informed decision.

4.3 Development Plans Monitoring System

The development plans monitoring system for Negeri Sembilan was designed base on the crucial need for assessment of the progress and effectiveness, as well as, review of development programs and policies. The monitoring framework had considered the issues of coordination, institutional responsibilities and linkages, indicators and timeframe to establish mechanism for measuring performance against targets.

The modules for development plans monitoring in GIS9 supports the State Town and Country Planning Department in controlling and monitoring development projects. The accomplishment of development targets is evaluated in terms of specific indicators and a particular time frame. The implementation is strongly supported by the GIS9 database which provides the planning information needed through continuous data gathering, updating and, storage. The system which was developed to

operate at both the state and district levels make it possible to evaluate the success of plan implementation.

The State Structure Plan Monitoring Module provides means for assessing the accomplishment of the state structure plan. It translates gazetted structure plan policies into achievement and compliance units. The State Structure Plan (RSN) involves the general policies, subject policies and specific strategies. The policies can be translated into qualitative and quantitative form of measurement. The accomplishment of RSN is measured through the assessment of changes in development scenarios based on evaluation of the outlined strategies through comparison with the key diagram.

The Local District Plan Monitoring Module emphasizes on physical planning involving spatial data, location and land use activities of proposed development. It will be possible to check whether land use development in the district complies with the zoning strategies in the district and local plans (RTD) by comparing current land use development with that proposed in the district and local plans (Figure 6). Progress of projects' implementation at the district level can be constantly monitored and development control can be carried out more systematically.



Figure 6: Checking on achievements of RTD implementation

5.0 DISCUSSION

Common problems of major cities are usually associated with sources of friction, imbalances, shortfalls, failures in the process of urban planning and monitoring, rapid growth, high development pressure, inadequate development plans and difficulties in obtaining relevant information, making the process of development control more complex. Thus, it is particularly important to have an effective planning and decision-making process. This can be achieved through the availability of information that is valid, of good quality and handled with appropriate, effective and efficient method. Up-to-date and reliable information is apparently needed at all levels of planning and monitoring, from the national level right through the local authorities, to facilitate administrative procedures of policy planning and plan implementation.

In planning, obtaining relevant information is crucial for the purpose of decision-making and good information would certainly lead to better decision. However, relevant information is usually unavailable due to factors such as lack of effectiveness in information sharing and communication between stakeholders and inadequate institutional support for communication among stakeholders as well as lack of effective means for public participation and do not allow for effective spatial planning. An information system is part of the mechanism for reducing uncertainty in the knowledge and understanding of the environment and can contribute to a much clearer understanding of real planning problems as well as prescriptive planning scenarios to enhance the quality of planning. Thus, the information system developed should be able to provide solutions to those issues and support the procedures of planning and monitoring as well as decision making. Database development and system implementation need to consider requirement for data integration and sharing between relevant agencies and departments involved. In addition, the system must expand correspondingly if anything like effective understanding and control is to be achieved.

For smooth and effective implementation of GIS, institutional arrangement is essential for directing implementation and monitoring proper and timely execution of development plans. To facilitate co-ordination of development effort at various levels, respective development committees at various levels were proposed. Apart from system development and maintenance, preparation of the human resources is also crucial. A such, programmes were outlined for users to acquire the appropriate

knowledge and skills. These include series of workshops and trainings to ensure smooth technology transfer to users apart from receive feedbacks to further enhance the components wherever appropriate for effective system implementation. The training modules prepared also serve as a supporting factor to GIS9 capacity building which cover various aspects including competency, infrastructure, procedures and resources essential for overall implementation.

All in all, acquiring and updating of data tends to be the biggest challenge in the implementation of a planning support systems such as AGISwlk and GIS9 as it influences the accuracy of data. Data availability would very much depend on the cooperation from all stakeholders involved either at the state, regional or local level. In addition, the understanding and commitment from all staffs involved would help speed up the process of acquiring, updating and use of data.

6.0 CONCLUSION

Planning Support System is often an important feature of countries undergoing rapid economic development such as Malaysia for the task of monitoring and reviewing plan progress involves the assembly and integration of geographic information. A PSS can also be applied to consider alternative spatial development strategies as well as visualise development potentials involved in land use planning for the purpose of development plans preparation.

Introduction of GIS for regional analysis will enhance the rationality of the decision-making process by improving data accuracy and accessibility and as a consequence leads to 'better' decision. The information at this level should help to describe the existing situation. It also contributes to improve understanding of regional problems by providing key factors and variable that can be analysed using regional modeling and other spatial modeling techniques such as in the case of AGISwlk.

As for GIS9, its implementation helps reduce the cost of RSN/RTD studies and preparation due to data availability. It was developed as a planning support system to consider alternative spatial development strategies as well as visualise development potentials. It enables smooth process of development management and implementation due to the data-sharing framework adopted. It can be used by various departments/agencies for the purpose of data updating and enhancement due to common data structure/format.

Acknowledgement

The authors would like to thank the Ministry of Federal Territory, Malaysia, as well as Town and Country Planning Department of Negeri Sembilan, and State Government of Negeri Sembilan for allowing and granting permission to use the case studies and present this paper.

References

Ahmad Nazri M.L. and Ahris, Y. (2006) Scenario-Based Spatial Modelling For Land Use Planning And Evaluation, Map Malaysia 2006, Kuala Lumpur.

Armstrong, M.P. (1993) Perspective on the development of group decision support system for local problem solving. *Geographical System*, 1, 67-81.

Batty, M. and Densham, P.J. (1996) Decision Support, GIS, And Urban Planning, Centre for Advanced Spatial Analysis, University College London, 1-19 Torrington Place, London WC1E 6BT, UK

- Brail, R.K. (2001) Planning Support Systems: A new perspective on computer-aided planning. In R.K Brail and R.E Klosterman (eds) *Planning Support Systems: Integrating Geographic Information System, Models, and Visualization Tools*. California: ESRI Press
- Finally, P. N., and Marples, C. (1992) Strategic group decision support systems – A guide for the unwary. *Long Range Planning*, 25, 98-107.
- Han, S.Y., and Kim, T.J. (1989) Can expert system help with planning. *Journal of the American Planning Institute*, 55, 296-308.
- Harris, B. and Batty, M. (1993) Locational Models, Geographical Information and Planning Support System, *Journal of Planning Education and Research*, 12:184-98
- Johar,F., Yaakup, A.B., Abu Bakar, S.Z. and Sulaiman, S. (2003) Geographical Information System for Development Planning in Malaysia, Proceedings 8th International Conference on Computers in Urban Planning and Urban Management (CUPUM'03), Sendai, Japan, May 27-29, 2003.
- Lee, I., and Hopkin, L.D. (1995) Procedural expertise for efficient multi-attribute evaluation: A procedural support strategy. *Journal of Planning Education and Research*, 14 (4, Summer), 255-69.
- MAMPU (2003) *Negeri Sembilan ICT Strategic Plan Final Report*, Malaysian Administration Modernisation and Management Planning Unit (MAMPU), Prime Minister Department
- Ministry of Federal Territories (2004) Laporan Akhir Aplikasi Sistem Maklumat Geografi Wilayah Lembah Klang 2001-2005, November 2004
- Shiffer, M.J. (1992) Toward a collaborative planning system. *Environment and Planning B: Planning and Design*, 19, 709-22.
- Yaakup, A.B., Johar, F. and Dahlan, N.A. (1997) GIS and Decision Support System for Local Authorities in Malaysia, in H. Timmermans, Decision Support Systems in Urban Planning, E & F SPON, London.
- Yaakup, A.B., Said, M.N., Shamsuddin, K. and Musa, N. (1999). GIS development and application for planning and monitoring of urban growth in Klang Valley Region, West Malaysia. Paper presented to 6th International Conference on Computerization in Urban Planning and Urban Management, Venice, Italy.
- Yaakup, A., Jama'an J., Abu Bakar, Y. and Sulaiman, S. (2001). Web-based GIS for public participation in urban planning and management case study: Klang Valley region. Paper presented to the Asia GIS 2001 Conference, Tokyo.
- Yaakup A.B., Abdul Kadir M.N. and Sulaiman S. (2005) Empowering people through geospatial information for urban metropolitan management: the case of Klang Valley, West Malaysia. Paper presented at *Map Asia 2005 Conference*, Jakarta, 22-25 August 2005.
- Yaakup A.B., Sulaiman S., Hamdan M.K. and Idris R. (2006) Monitoring The Implementation Of State Development Plan Using GIS: The Case of Negeri Sembilan, Malaysia. Paper presented at *Map Malaysia 2006*, Kuala Lumpur, 3-4 May 2006.