INNOVATIVE TECHNOLOGY FOR URBAN PLANNING AND MONITORING

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Abstract

The monitoring of land use change forms an integral part of the urban planning process whereby policies and strategic plans are reviewed and updated. This task typically involves the identification of emerging land use patterns which are normally linked with other planning statistics such as employment, housing and population before the full significance of land use change are apparent. This requires planning programme to be adapted during their implementation as and when incoming information requires such change. Given the dynamic nature of planning and management, it is particularly important to have a well conceived information system, which can serve as the eyes and ears to a regional development planning and monitoring process. This paper will discuss various innovative technology applied to facilitate the urban planning and monitoring process in different administrative levels.

INTRODUCTION

With the continued development of Information and Communication Technology (ICT), there is a major opportunity for the authorities to use it to manage the allocation of scarce resources in a rapidly changing environment. The quality of urban planning and management can be upgraded when available and valid data are handled in an advanced manner with the aid of computers. The adoption of 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, to model different scenarios and to evaluate alternative solutions generated by various modeling procedures.

NATURE OF PLANNING PROCESS

The idea of urban and regional planning in Malaysia is said to have originated from the planning concept first introduced in Britain, whereby planning is defined as 'a process of human forethought and action based upon that forethought. It aims at the best use of land and greatest possible improvement in the human environment' (Chadwick, 1971, p.63). This definition sees general planning as a procedure in which suitable schemes are designed at the outset and actions are based on the chosen schemes. Physical planning, on the other hand, is seen as referring to the 'physical design or plan of some artifacts or buildings which might exist in the future' (Bruton and Nicolson, 1987, p.50).

According to Chadwick (1971), a plan is a general conceptual system. By creating a conceptual system independent of, but corresponding to, the real world system, we can seek to understand the phenomena of change, then anticipate them and finally evaluate them – to concern ourselves with the optimisation of the real world system by seeking optimisation of the conceptual system. Clearly this requires the planner to understand the system involved before a plan can be drawn. As McLoughlin (1969) pointed out, the preparation of alternative plans must be based on an understanding of how the urban system works, how it would react to different policies. Invariably the activity of planning is

more than producing plans and controlling development in accordance with these plans. The planning task embraces policy making and implementation which have a significant bearing on the spatial distribution of investment and the development and use of land at all scales.

Changes in socio-economic as well as physical development are known to the take a long time. Many factors should be taken into consideration to bring about changes since any one issue is often very complex (Pahl, 1970; Simie, 1974). In Malaysia, for example, at national level, attempts to deal with racial disharmony were related to, among other things, the distribution of economic activities, population, employment, and law and order. It is therefore ineffective to introduce social policy without having regard to the economic background. As in the words of Mason and Mitroff (1981, p.4), '…. Every real world problems and planning problems are no exception'. Acknowledgement of this situation is of vital importance to planners for it means that attempts to resolve a particular policy problem must consider the potential relationship between itself and other policy problems. Thus, policy-makers concerned with planning are faced with a range of problems which are inter-related in a most complex manner. The complexity, according to Simon (1962) is derived from the inter-relationships among the various elements in our organisations and the physical systems with which they interact.

Another characteristic of the planning which is very relevant is that "uncertainty characterizes all planning problems" (Christensen, 1985, p.66). Thus planners must assess the actual conditions of uncertainty that characterise the particular problem they are confronting and then select planning that suits those conditions. In short, if contingent approach must be adopted. However, there are dangers in moving entirely to a contingency approach, the most significant of which is that the objectives underpinning the overall strategy could be lost in the concern to adapt the complex and dynamic factors at the local level. What is required is an approach to planning which provides for a contingent approach, set within a strategic framework.

THE NEED FOR ICT FOR STRATEGIC PLANNING

Much of planning has to do with the use of the land and how the different types of land use relate to one another. Spatially reference data including parcel boundaries, building on site, and ownerships of land and buildings are a fundamental part of an information based approach to urban planning. This information combined with socio-economic data, such as census data or natural and environmental data, provide more meaningful information for planners and decision-makers. Hence, the planning development process requires a good support system to ensure a more rational and effective decision wherever planning management and development control are concerned.

The major functions required from an information system can be identified as follows:

i) The descriptive function – information should help to describe a situation;
ii) The cognitive function – information system also contribute to improve understanding of urban and regional problems by providing the key factors and variables that can be analysed using urban and regional modelling and other statistical technique;
iii) The normative function – the information system can also contribute to improved action by reducing the cost of actions with known consequences or by reducing uncertainty about the consequences of actions already taken or about to be taken.

The evolving concept of ICT has been accompanied by equally fundamental but largely independent changes in the prevailing views of proper ICT in public and private sector organisations. As shown in Tables 1, the developments can be viewed broadly as an evolving concern with data during 1960's, in which the prevailing technology was batch processing of custom design, single-purpose, and transaction based information systems on mainframe computers. Then in the 1970's, the emphasis changed from data to conversion into meaningful form known as information. In relation, data

processing for operational needs shifted to Management Information Systems (MIS) and integrated with the development of Urban Information System (UIS), Geographical Information Systems (GIS) and Land Information System (LIS). Next in the 1980's, the change of MIS into knowledge reflected to decision makers on desire for analytical modelling capabilities. Toward intelligence-base information technology in 1990's, Planning Support System (PSS) should be designed to facilitate collective design, social interaction, interpersonal communication, and a community debate.

Table 1: The Evolving Concerns of Information Technology

1960s	Data	'Observations which have been cleaned, coded, and stored in machine-readable form' Primary concern of electronic data processing (EDP) which promoted efficient transaction processing to improve operational tasks.
1970s	Information	'Data which has been organized, analysed, and summarized, into a meaningful form' Primary data concern of management information system (MIS), which integrated diverse data sets to serve management needs.
1980s	Knowledge	'Understanding based on information, experience, and study' Primary concern of decision support systems (DSS), which facilitated semi-structured decision making to support executive decision making.
1990s	Intelligence	'Ability to deal with novel situations and new problems, to apply knowledge acquired from experience, and use the power of reasoning effectively as a guide to behaviour' Possible concern of planning support system (PSS), which will promote discourse and interaction to facilitate collective design.

Source: Richard K. Brail, et.al (eds), 2001. Planning Support Systems: Integrating Geographic Information System, Models, and Visualization Tools. United States of America

ICT and Good Urban Governance

The tasks urban government is expected to continue to perform include a) provide infrastructure for the efficient operation of cities; b) provide services which develop human resources, improves productivity and raise raises the standard of living of residents; c) regulate private services that affect community welfare and the health and safety of the urban population; and provides services and facilities that support productive activities and allow private enterprise to operate efficiently. Although local authorities have historically been concerned with the social and economic well being of their communities, the quest for sustainable development means that they have to maintain comfort, convenience, efficiency and preserve their built and natural environment, while reducing both resource-use and emission of local and global significance (Mohamad Saib, 2002). This quest for sustainable development also means that the urban government has to be more efficient in their approach since they have to manage the current urban condition, while at the same time keeping in mind the needs of future urban population.

Good urban governance undoubtedly needs an effective role played by local governments. Criteria for good urban governance that have been commonly advocated comprise five basic characteristics i.e. equity, effectiveness, accountability, participation and security. Local authorities can be said to have practiced good urban governance within their communities to the extent that their actions are efficient, effective, accountable and fair. This clearly requires that local authorities improve or change their approach to city management. Currently, the employment of Information and Communication Technology (ICT) is seen as an evolving approach to better urban governance, especially in realizing sustainable development. This is due to ICT capabilities which include the followings:

- It improves the storage, manipulation and display of spatially referenced data (including land use, linear services and infrastructure, population, etc.).
- Automated data handling (i.e. payroll administration, valuation, billing and collection; storage tracking and retrieve development application).
- It improves the availability and flow of information in and amongst organisations responsible for urban management, with a view to improve and mainly change anticipation of issues and monitoring implementation.
- Predictive and prescriptive models of urban interaction facilitated by ICT technology can be used to forecast the impact of changing land use and transportation infrastructure on the distribution of population and other activities.
- Increased access to information via increased access to computer and the development of web means that a wide range of people can be informed about planning and management issues.

INNOVATIVE TECHNOLOGY IN DEVELOPMENT PLANS PREPARATION

The role of development plan in the Malaysian planning system is quite clear. The Structure Plan is seen as a means of translating sectoral policies and programmes into spatial terms, while the Local Plan "fleshes out" the broad strategy for physical development in greater detail. Together they are expected to serve as guide to developers and provide the basis for coordinating public and private investment in development.

Since the activity of planning should be seen as a process (McLoughlin, 1969; Chadwick, 1971), plans cannot be made once and for all. The plan making procedure does, however, indicate that plan making may have to move in a direction that would substantially improve its ability to use information systems. This philosophy is based on the concept of feedback of information to evaluate plans and plan making process (Geddes, 1939). In the plan making process Calkins (1972, p.78) suggested that, "better planning will be achieved through better information, and better information will necessarily flow from and information system'.

It has been argued that the introduction of GIS enhances the rationality of the decision-making process by improving data accuracy and accessibility and as a consequence leads to "better" decisions (Coulson and Bromley, 1990). Information is utilised to perform two sets of task in organisations. Firstly, information has a role in the process of deciding what actions to take, including both operational and strategic decision-making and secondly, how the activities of an organisation are organised in terms of managerial control.

Use Of Geographical Information System (GIS) In Development Plans Formulation

Development planning requires an effective planning approach to achieve the desired goals and objectives, evaluate alternative as well as control development programs that are in line with the current and future prospects. GIS technology has long been applied in planning activities which essentially include plans formulation as well as development control. The Manual for preparing the various levels of plan has provided that all plans use GIS technology in plan formulation. The different spatial level and form of plans requires different support in term of information system. Various skills are also required for preparing development plans using GIS. They include the ability to build up and manage the database which should incorporate socio-economic attributes of the local population. Managing services at local level would also call for contiguity and proximity analysis. Cartographic skills are of importance if plans are to be exhibited.

Successful implementation of GIS for sustainable urban and regional planning will largely depend on four factors. The first requirement is the automation of the database. It is costly to collect, store and shift through large quantities of unnecessary data. Hence, the most cost effective approach is to collect

only the data required for the specific task, in this case for urban and regional analysis and planning. Secondly, data collected either from existing records, aerial photography or field survey will need to be integrated using GIS methods. The urban and regional GIS will be organized to facilitate adhoc query and analysis. Thirdly, the ability to perform spatial modeling, so that alternative scenarios can be generated. Lastly, application of valid criteria to evaluate the effectiveness of possible planning strategies before the final solution is determined.

i. The National Physical Plan

The National Physical Plan outlines the strategic policies for the purpose of determining the general directions and trends of the nation physical development. At national level, GIS is used mainly for data compilation, land suitability analysis and generate suitability maps.

Several study objectives were addressed for achieving the aims of providing comprehensive database and management system manual for spatial planning, providing indicative maps, providing policies and planning strategies for national spatial development as well as providing public institutional structure responsible for management, implementation and monitoring of the National Physical Plan. The study approach for the National Physical Plan provides for cyclic and continuous feedback on data compilation, analyses and strategies from the relevant agencies/departments. The National Physical Plan study will only focus on major and significant factors determining the level of suitability of areas for future urban development at a macro level. Thus, further detailed criteria would need to be looked into at other levels of planning such as the state and local level studies.

At the National level, the plan essentially requires information of broad land use. It uses GIS to determine land availability according to various criteria taking into account major factors such as existing urban areas, areas with physical constraints, agricultural areas to be preserved and so forth. Objective for carrying out the land availability analysis is to identify land which would be available for future urban development based on the two objectives of maximizing existing resources/investment and the preservation of the natural environment and national assets. The land availability analysis is carried out based on the sieve map technique. Criteria for identification of land available for development include existing urban areas, areas with physical constraints, as well as agricultural, water catchment proposed dams and environmentally sensitive areas to be preserved.

ii. The Regional Plan

GIS is also identified as the main tool in the formulation of regional plan. Its functionalities are widely used to generate current and future development scenarios, which further facilitate among others, in determining future trend of infrastructure investments. Introduction of GIS for regional analysis will enhance the rationality of the decision-making process by improving data accuracy and accessibility and as a consequences leads to 'better' decision. The information at this level should help to describe the existing situation. It also contribute to improve understanding of regional problems by providing key factors and variable that can be analysed using regional modeling and other spatial modeling techniques. Example of GIS application at this level is the Application of GIS for Klang Valley Region (AGISwlk), which was meant as a planning support system for decision makers in planning and monitoring of the region.

The database for AGISwlk was designed and first developed to support eight application modules namely built up area, green and recreational area, traffic and transportation, squatter and low cost housing, environment, utilities and community services, industrial and commercial development as well as population and socio-economics. This required as many as ten elements of data including base map, administrative boundary, physical characteristics, land development, population and socio-economic, environmental quality, traffic and urban transportation, green and recreational area, public facilities and utilities (Yaakup *et al.*, 1999). Subsequently, the application modules of AGISwlk were developed base on relevant sectors for planning and monitoring of the region. Various analyses were

carried out under each module through adoption of the spatial modeling techniques using various GIS spatial analysis functions. They were used to generate scenarios and predict "What-if" situation base on the various sets of predetermined criteria.

Meanwhile, the dynamic nature of planning and monitoring of development in Klang Valley region calls for a continuous evaluation and analysis of the current environment as well as the carrying capacity for future development. 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). In the past, the number of alternative planning scenarios was rather limited due to the difficulties in producing them. This is mainly due to the time consuming procedures of creating scenarios as well as the evaluation that follows. Policy-makers, like most decision-makers, face the difficult task of evaluating and examining the impact of various resource allocations. In the past, the evaluation process appeared to be quite static and limited. Having prepared the evaluation model, the operation can be accomplished within a much shorter time frame by computer processing of the data and computer mapping of the results.

Integrated Land Use Assessment (ILA) is a new concept recently introduced within AGISwlk, aimed at developing an integrated spatial analysis model with the ability to generate alternative development scenarios by integrating physical and socioeconomic information. The concept of integrated approach in ILA is focused on the aspect of integration of the applications previously developed in AGISwlk, which are more towards sector-based. 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 model developed is expected to dynamically support the preparation of the Klang Valley Regional Master Plan (PELAWI). Figure 1 shows the model developed and implemented for integrated land use assessment of Klang Valley. ILA is also expected to cater BKWPPLK'S main tasks which are regional planning, facility management as well as problem solving.

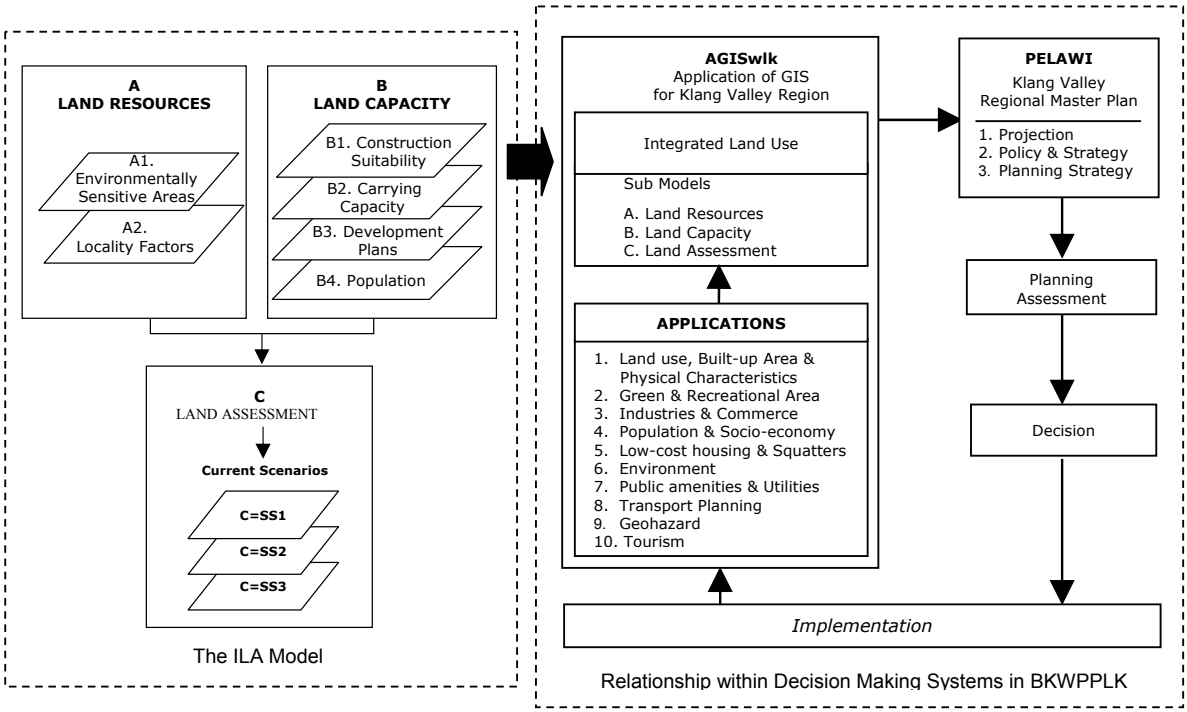


Figure 1: The model developed and implemented for Integrated Land Use Assessment of Klang Valley

iii. The State Structure Plan

At the local government level, the development plans are legal document that become the basis of development guidelines and control. Section III of the Town and Country Planning Act (Act 172) with reference to section 4, 5, and 6 stated the State Structure Plan (RSN) as a written statement emphasizing on the policies and general proposal of the State Authority regarding development and use of land for an area (JPBD, 2001). According to the RSN Manual, the preparation of RSN is crucial for the planning authority to initiate inspection on the state development when required by the State Planning Committee or if changes in the sectoral policies occur, which will consequently affect the trend and pattern in the state development.

The inspection and reevaluation process involve enormous collection of data to be analysed for the purpose of policies, strategies and key diagram formulation, which support in determining the direction of the state development. The state level GIS should provide a comprehensive database of spatial information which include land use, utilities, environmental quality, agricultural land, etc. The role of GIS is made explicit in the design and development of a system for spatial as well as attribute data entry, storing, updating, analysis and presentation. The choice of GIS as a planning support tool is mainly to assist in the preparation of the key diagram that is highly reliable and rational. GIS capabilities in handling spatial analysis will be used to identify potential area for future development taking into account socio-economic, environmental as well as physical factors.

The system developed for the purpose of Pahang State Structure Plan formulation covers three main aspects where GIS is concerned. These are the database development, spatial analyses and development of an executive information system (EIS). The database developed was based on the guidelines outlined by the Department of Town and Country Planning (JPBD) to support sectoral studies and analyses relevant to the State Structure Plan formulation. The main concern of the State Structure Plan would be the preparation of the key diagram. The preparation of the key diagram involves a combination of analyses such as determination of area having potential for future development and area for conservation. In generating the development scenario (Figure 2) and conservation scenario of the State of Pahang, the Multi Criteria Decision Making (MCDM) method is adopted. The MCDM method used incorporates two different techniques which are the use of *What if?* software for generation of spatial scenarios and *Definite* for defining of the weight and rating as well as evaluation of the resulting scenarios.

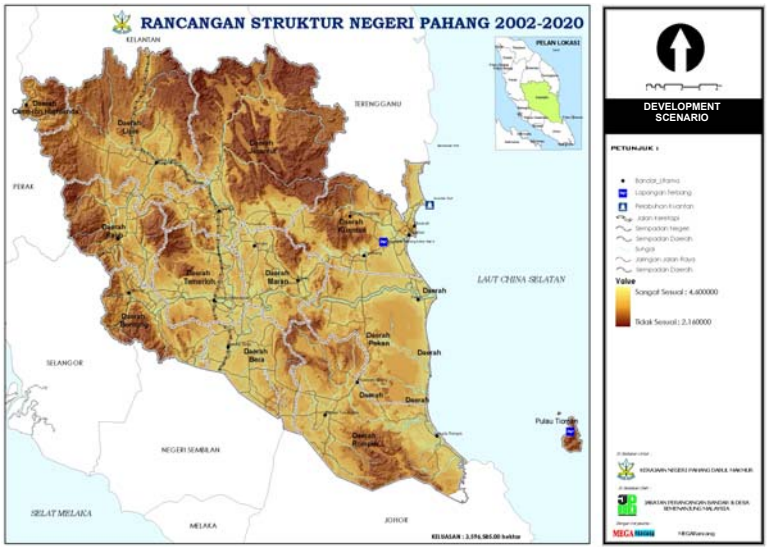


Figure 2: The resulting development scenario for State of Pahang generated using MCDM method

iv. The District Local Plan

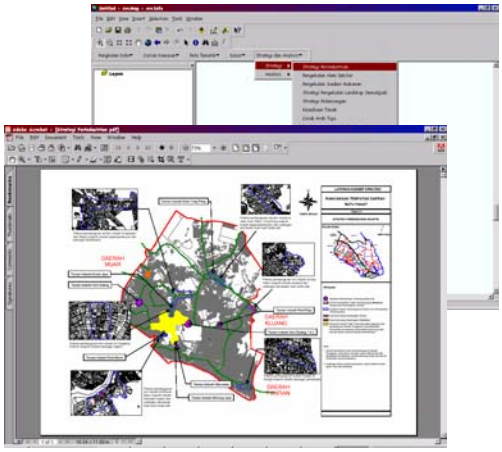
At the local government level, the district local plans are legal document that become the basis of development guidelines and control. These plans contains such details as land use zoning, development density, building height, plot ratio, etc. which require detailed information of each plot of land to be formulated. The tasks of preparing and analyzing this information can be speeded up and made easy with the help of GIS. A zoning plan, for example, covers a large area that contains various land uses. It will be a great advantage to be able to evaluate each alternative of a zoning plan using GIS (Yaakup and Healey, 1994). GIS allows for selection of suitable locations of social amenities, different size of housing, as well as evaluating potential impact on the environment.

As in the case of Batu Pahat, the GIS database was developed for facilitating the preparation of the District Local Plan. The Batu Pahat District covers an area of about 187,702 hectares, located in the west cost of the State of Johor and comprises two local authorities, which are the Batu Pahat Local Authority and Yong Peng Local Authority. A well-integrated and comprehensive database was designed to meet the local authority's requirement. The district database was developed to support ten components namely land information, urban planning, administrative, transport, environment, infrastructure, utility, public facilities, base map and sectoral studies. Lot based GIS is used for the District Local Plan. At this level, spatial analyses involve determination of land suitability, combining the technique of multi-criteria evaluation.

GIS display capabilities are also utilized for the purpose of public participation which is legally required in preparing the plan. An executive information system (EIS) was also developed to assist display and query of information through a user-friendly interface especially for those without or with limited GIS skills (Figure 3). This is important to gain feedback from the public for the review of the plan.

Apart from that, a customised system was also prepared especially for the handling and monitoring of planning application for the area. The Planning Information System (Figure 4) is implemented base on the workflow of planning application processing. The database was built using a database management system software (Microsoft SQL Server 2000) and could be accessed through the local area network. The use of the database management system (DBMS) helps simplify the administration and maintenance of the database as it provided components for managing data as well as users. The data query process and display of requested information is made easier and faster through a friendly user interface which was developed using the Microsoft Visual Basic software.

Executive Information System



Planning Information System

Figure 3: The Executive Information System and Planning Information System developed for the Batu Pahat Local Authority

MONITORING THE URBAN DEVELOPMENT

The monitoring of land use change forms an integral part of the urban planning process whereby policies and strategic plans are reviewed and updated. This task typically involves the identification of emerging land use patterns which are normally linked with other planning statistics such as employment, housing and population before the full significance of land use change are apparent. This requires planning programme to be adapted during their implementation as and when incoming information requires such change. Given the dynamic nature of planning and management, it is particularly important to have a well conceived information system, which can serve as the eyes and ears to a regional development planning and monitoring process.

GIS and Metropolitan Planning

The main challenge in planning and monitoring of an urban region like Klang Valley is the rapid growth of the region itself, resulting in the urgent needs for land development to cater for settlement/housing and facilities. Among the myriad of urbanisation issues faced by the local authorities in Klang Valley region includes traffic congestion, provision of house and amenities and declining environmental situation. With rational planning approach, the quality of planning and decision making process can be substantially improved with valid data appropriately and efficiently handled.

Above all the applications and analysis developed in AGISwlk, a user interface and web-based GIS were developed to facilitate an easy and friendly use of the system. Web-based GIS for Klang Valley is initiated as an extension to the prior developed AGISwlk, which is aimed towards inviting public participation apart from providing information in the form of maps and data for public access, and paving the path for data sharing with agencies having the same interest (Yaakup *et al.*, 2001). The operations offered a means for the users to display maps, submit query as well as display data sources and data structure base on selected maps (Figure 5). The Web-based GIS for Klang Valley serves as a web development model for a more interactive GIS application in Malaysia that offers opportunities for public participation which is useful in making decision for urban planning and management. At the moment, web-based GIS can be seen as an effective means that allows transparency in planning processes.

To coordinate development in Klang Valley, the use of GIS for planning and monitoring extends beyond the development of a comprehensive database. The AGISwlk database needs to be integrated with the local authorities as well as agencies directly involved in planning and monitoring of the region. A web-based GIS for Klang Valley was developed to integrate the data set and to encourage data sharing between various agencies involve in shaping the urban environment in Klang Valley region. At this moment, arrangement has been made for sharing of data between AGISwlk and some government agencies in Klang Valley such as the Department of Education and Department of Mineral and Geoscience. Using Web-Based GIS as a new tool for exchanging and gathering information brings numerous benefits. It will be a simple way for the public or local governments to provide or exchange spatial information on the Net. The integration of data through distributed GIS is expected to minimise data redundancy as well as time and cost of database development. The Klang Valley region provides a good case study for the use of high technology to improve the urban planning and management in Malaysia.

Development Control System

Development control is a tool being used by the local government to control development in satisfying all parties by maintaining comfort, convenience and efficiency and preserving their built

and natural environment. The need for development control for an area is due to several important factors as follows (Zainol H., 2000):

- Development control is the main aspect of urban planning for certain states and local authority since it relates to development programmes.
- Development control stresses on the planning function as a discipline that organise the natural resources as well as focus on the well being of the natural environment and community as a whole. It plays an important role guiding development based on the guidelines and standard imposed.
- Development control is a process that requires the local authority and state government to enforce the laws in controlling all kind of development so that they comply with the development plan.
- Development control supports the planning process as well as protects the public from the impact of ineffective development.

Development control is the most important activity for a local authority. To increase the development control efficiency, planners require the most up-to-date planning data while considering development applications as the basis for decision making. It is seen as a problem for the local authority, especially in collecting planning data which undoubtedly need for the use of new techniques. Thus, an information system is necessary to not only keep and display data pertaining to planning application for the purpose of administrative functions but should also be designed to facilitate planning and development control at strategic level. The control of development which involves the process of analysing the appropriateness of planning applications, requires various data from the relevant agencies. A planning application will be assessed in terms of current development scenario, land information, planning requirements and planning design (Yaakup *et al.*, 2002).

Ideally, consideration for planning and building approval involves a technique for the systematic compilation of expert quantitative analysis and qualitative assessment of project land use and property development viability, including its effect on the surrounding area, and the presentation of results which indicate the resulting scenarios (Yaakup *et al.*, 1997). It should also indicate the scope of modifying or mitigating these adverse effects. This allows the proposed development to be properly evaluated by the relevant decision making body before a planning permission is rendered.

Table 2: Stages involved in planning and building approval and relevant functions of information system

Stages	**Activities**	**Functions**
Initial Discussion	Consultation to owner/developer regarding potential, planning requirement, policies involved in the area	Data Retrieval: • existing development development status • development plan planning policies
Processing of Planning Application	• registration • site visit • gathering data from various departments • identify planning issues • preparing technical report • analysing the application	• identify potential land for development • translate policies formulated into spatial context • identify development pressure area
Consideration by Urban Technical Committee	• comment on technical requirement • recommend the technical amendment to applicant	• data retrieval from various agencies • able to facilitate technical evaluation
Consideration by Town Planning Committee	• formulate and review planning policies • considering planning application	• capable of analysing the development strategy • provide information to evaluate the planning implication

The Computerised Development Control and Approval System implemented by the Planning and Development Control Department, City Hall of Kuala Lumpur, is one of the ICT applications undertaken to facilitate the procedures to control and monitor the city development (Yaakup *et. al,* 2003). The system being developed integrates several sub systems (Figure 6) to execute specific functions, while at the same time interact with one another by sharing information sources:

i. Planning Authorisation Sub System

The Planning Authorization Sub System operates to process planning application, beginning from the submission of an application until the Policy Approval or Development Order is issued. To support the processes involved in planning authorization, this sub system was designed to encompass six modules including the Advisory Module, Registration Module, Task distribution and LPP Module, Agenda Module, Decision Documents Module and Monitoring Module. This sub system allows user to observe the related policies and spatial information while evaluating the planning applications and requirements. Apart from saving time and space, it helps to minimize workload and reduce the use of paper. Besides, the data-sharing concept will minimize overlapping of data stored in the database as well as information processing and thus, increase the quality and productivity of work.

ii. Building Control Sub System

The Building Control Sub System is meant as a support for the building approval process. This sub system begins from the submission of application for building plan approval through the process of producing Certificate for Occupation. The features are similar to the Planning Authorization Sub System, which include graphic and interactive interface and enable interaction between sub systems. This sub system will assist the Building Control Division in managing their activities through the five modules developed which are the Registration Module, Evaluation of Application Module, Agenda Module, Decision Acknowledgement Module and Monitoring Module.

iii. Enforcement Sub System

The Enforcement Sub System assists the Planning and Building Control Department in planning and carrying out enforcement actions. These include generating reports on site investigation, issuing warning notices, implementing control activities and reports on certain decision made by the Planning and Building Control Department. This sub system also helps the public to file complaint and receive feedback from the local authority. It also facilitates the management in acquiring investigation reports faster so as to act in a more effective and timely manner. Four modules were developed for this sub system, namely the Enforcement Module, Planner Module, Building and Sanitary Module as well as Monitoring Module.

iv. Geospatial and Planning Information Sub System

The Geospatial and Planning Information Sub System is developed to provide a complete spatial database along with the attribute data, which recorded the Development Order Approval, Building Order Approval, and Building Occupation Order. The implementation of this sub system involves of the GIS database development, data collection, data conversion and updating of spatial and attribute data. This sub system also provides support in terms of spatial data for the other sub systems, while at the same time enable other divisions to retrieve the spatial information they need through the interface programs developed. Users can specify the type of information they want to retrieve using the query functions based on 'parcel', 'road', 'section' or 'county' identifications. This sub system will help the management to make decisions more systematically and rationally.

v. Information Kiosk Sub System

The Information Kiosk Sub System is built for internal users as well as the public to gather information through the Planning and Building Control Department's web site. This kiosk provides detail information on Kuala Lumpur, the Planning and Building Control Department as well as development control and enforcement. Through the system, users can retrieve information related to

City Hall of Kuala Lumpur apart from obtain various forms provided. The system also allows the City Hall to announce important issues to the public. In general, this sub system provides function for enforcement plan approval result, function for accessing spatial data (GIS web), function for accessing information on planning and building legislation and function for accessing application support documents.

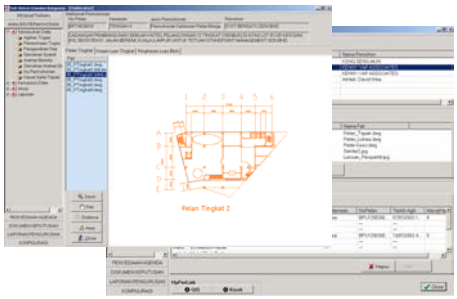
vi. Document Processing Sub System

The Meeting Presentation Sub System enables the smooth progress of a meeting through facilities for displaying related information on development application including plans, GIS related data and other associated information being discussed such as documents, maps and so forth. Meetings should be able to run smoothly as location plans, site images, perspective diagrams and proposal plans can be illustrated with a clearer image compared to conventional procedures. Furthermore, the information needed can be retrieved promptly.

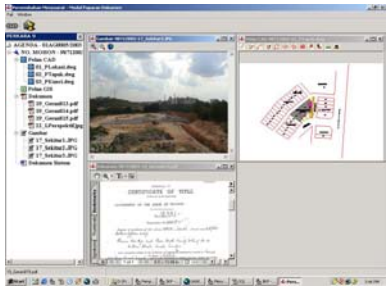
vii. Meeting Presentation Sub System

The Documentation Processing Sub System is designed to store and retrieve all documents in a more systematic manner. This may solve the problems of storing physical files and locating of files. The documents will be transformed from hardcopy to softcopy and stored in the system database. Hence, user can manage the documents more efficiently and simply as and when the document is needed.

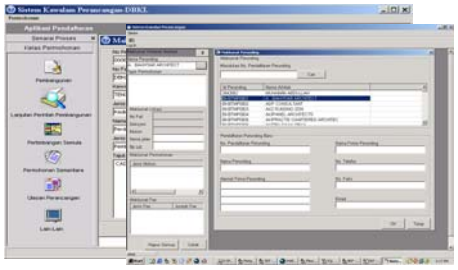
Building Control Sub



Meeting Presentation Sub



Planning Authorization Sub System



Enforcement Sub

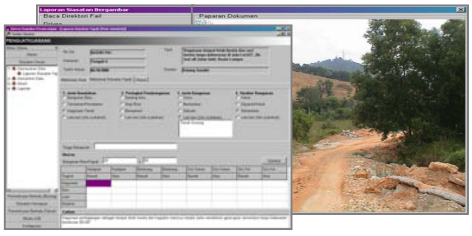


Figure 6: Some of the interface for the sub systems developed

ISSUES AND PROSPECTS

Among the main issues in employing such innovative technology are identifying the user needs and implementation requirements, developing system customisation and application, and recognising the needs of expertise and management.

Another requirement for an effective use of technology, such as ICT, is the personal commitment of individuals at all levels within the organisation with respect to overall leadership, general awareness and technical capabilities. Successful utilization depends on clear leadership and a commitment from

senior staffs aware of the potential opened up by the technology for urban planning and management. Training and education is also very much an essential component to ensure the smooth transfer of knowledge. Sophisticated system requires trained and experienced technicians to be operated and maintained, and, more importantly, sophisticated planners, analysts and managers to determine what type of information should be collected and to interpret and use the information that these systems produce.

Currently, much of GIS usage in urban and regional planning calls for its descriptive function. The area used for urban and regional analysis, are mainly descriptive in nature, whether describing the existing situations or future problems. In this instance, the main advantages of GIS are its graphical presentation, data management and spatial analysis and modeling capabilities. While its graphical presentation and data management has been its attraction factor, its spatial analysis feature is still underutilized. Thus, it is not surprising that most of the planning agencies in Malaysia use GIS package for digital mapping, survey mapping and development control. Under utilization of its spatial analysis feature has hindered GIS from becoming an important tool in solving planning problems.

Despite the proliferation of advanced equipment and software in GIS technology, there are still many constraints on the use of GIS in urban and regional planning, which limit their effective application. As pointed out by Scholten and Padding (1990), GIS systems are not advanced enough for mainstream urban policy making because of the rather limited possibilities for analysis built into them and are also rarely user-friendly. As such, they could be positively terrifying for ordinary citizens who would like to use data they contain in making informed responses to government policies. A filter between their professional use and their use as public information system is clearly required. Hence, there is a need to integrate existing analytical techniques and GIS packages by adding modeling software directly into such GIS software or developing easy to use interfaces with already developed planning models (Openshaws, 1987; Worral, 1989; Harris, 1990; Brail, 1990).

However, recently various studies are undertaken to further incorporate the use of innovative technology associated with GIS for planning and monitoring purposes. This include the development of planning support system with interactive and user-friendly interface to ease the use of sophisticated system without the need of advanced technical skill. The implementation of web-base GIS has been a good means for inviting public participation and acts as a doorway to better data integration and sharing, especially through adoption of distributed GIS.

Since the early 1980's, there have been major breakthroughs in the cost, speed and data storage capacity of computer hardware and software. With computer costs still dropping, with the emerge of powerful portable machines, and with the possibility of massively increased network bandwidths, enabling a larger and larger segment of the community to connect up, the prospects for new types of computer use in problem solving and policy domains have never been more promising. These trends in the development of computer technology have indeed benefited the relevant authorities. The application of such innovative technology will inevitably influence the existing structure and practice of planning and management. As such, a critical evaluation of the applications should be given priority before adopting such a technology. Success or failure in the adoption depends on a variety of human, organizational and technical factors (Yaakup, Johar and Dahlan, 1997).

CONCLUSION

The recent and widespread introduction of innovative technology such as the use of GIS has provided an exciting potential for geographic information to be used more systematically and by a greater diversity of discipline than even before. GIS has proved to be invaluable tool for evaluating alternative solutions to urban planning problems. Planning database can be extensively interrogated to generate several alternative solutions to urban strategic planning problems. Various scenarios which take into account the socio-economic characteristic of urban dwellers, the constraints of physical

development, availability of land and land suitability for different kind of development can be generated. On the other hand, the ease with which a GIS can manipulate geographic information has also created a major difficulty. Users unfamiliar with GIS techniques or the nature of geographic information can just as easily conduct invalid analyses as valid ones. Valid or not, the results have the air of precision associated with sophisticated computers graphics and volume of numerical tabulations. A better understanding of GIS technology by users, managers and decision-makers is thus crucial to the appropriate use of the technology.

The implementation of innovative technology such as the ICT, however, involves far more than hardware and software decisions. Effective implementation rests on a thorough and systematic evaluation encompassing planning, operational, organizational, institutional, personnel, financial and technical aspects. To optimize its use, more research and attention need to be directed toward organizational and institutional issues, as well as developing the technology for planning and management purposes.

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