

King Fahd University for Petroleum & Minerals

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Geographic Information Systems (GIS)

Project Title

GIS in Urban Planning and Managment: Malaysia Experience

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Executive Summary

Malaysia is one of the developing countries in the Asia region having rapid urbanization. The development plans in Federal Town and Country Planning Department had been prepared at various levels. These plans provide the development framework and guidelines which needs continuous updating based on the present development situation. With the integration of the Geographic Information System (GIS) in the development planning process, especially in the preparation of development plans, we can find out alternative solutions to urban planning problems. In this paper, we will focus on the development plan implementation and urban management utilizing the GIS based on experience in Malaysia field. This paper will also focus on the challenges of incorporating GIS in the development plan processing in terms of data availability, reliability and human resources.

1- Introduction

The rapid urbanization process in the developed countries has become an important issue globally. It needs to be controlled well, otherwise, would produce negative impacts to the physical, social and natural environment. Malaysia is one of the developed countries that face this phenomenon of urbanization. Apparently, urban problems in Malaysia are virtually unfeasible and challenging, due to physical, socioeconomic and environmental factors, in addition to the fast developing-growth. The annual growth rate of 4.2 per cent in Kuala Lumpur alone makes it among the fastest growing region with the targeted 2.2 million populations by 2020 (Dasimah et al 2009). Therefore, effective urban planning and management process are necessary to delineate the limit of urbanization in Malaysia.

2- Planning Process in Malaysia

The Malaysia administrative system is divided into three levels: federal government, state government and local government. At federal level, the federal department of Town and Country Planning is responsible for formulating and administering all national policies regarding to town and country planning. At state level, the state department of town and country planning is an advisory body to the state governments. At local level, local authorities are responsible for executing town and Country Planning function as prescribed in the local plan. The state and federal governments are responsible for planning matters in Malaysia, where land use planning is a state issue and federal government is the supervision with the overall land use planning activity.

The first draft of the Town and Country Planning Ordinance of Malaya was prepared in 1966 (Dasimah et al 2009). The Town and Country Planning Act 1976 (Act 172) made by the Parliament was aiming at introducing a uniform system of law and policy for town and country planning in Peninsular Malaysia. Act 1976 also introduced two-tier Development Plan System: Structural Plan and Local Plan. The 1976 Act was amended in 1995 through the Town and Country Planning (Amendment) Act 1995 (Act A933) which emphasized environmental management in planning, such as conservation of topographical features and trees. In 2001 the Act was again amended through the Town and Country Planning (Amendment) Act 2001 [Act A1129] which seeks to balance the power between the Federal and State governments in matters related to town and country planning. The latest amendment was in September 2007 through the Town and Country Planning (Amendment) Act 2007 [Act A1312] which is to confer the executive authority on the Federal Government over certain matters in relation to the control and regulation of town and country planning in Peninsular Malaysia.

3- Geographic Information System (GIS)

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. It is a useful tool for analysis of spatially distributed features on and under the earth surface, and helpful for the documentation of spatial plans and in the approval process for the development, building and installation permits.

3-1 Urban Planning Application of GIS

Chadwick (1971) was defined planning as “a process of human forethought and action based upon that forethought and it is aiming at the best use of land and greatest possible ‘improvement in the human environment’”. The planning process with the computer-aided techniques is essential to acquire as much scientific and technical information, and find optimal solutions through scientific analysis and mathematical models. All of these stages are available in GIS. GIS systems enable data from wide variety of sources and data formats spatially to be integrated together in a common scheme of geographical referencing, thus providing up-to-date information.

GIS have become of increasing significance for urban and regional planning in recent years. With the huge number of spatial data with their attributes involved in urban planning, GIS represents a highly efficient instrument for such planning tasks.

3-2 Planning Support System and Decision Support System

The Planning Support System (PSS) can support decision-making and urban problem solving. PSS incorporates GIS data that serve as a display and communicative device producing maps and charts that describe past and present condition and model outputs that support decision making. GIS is also part of the Decision Support System (DSS) in which decision makers could rely on in making decisions. This evolution of Information Technology towards PSS and DSS make the exploitation of GIS so essential.

4- GIS Application in Development Plans System in Malaysia

The Federal Town and Country Planning Department in Malaysia had published the manual for preparation of development plans at various levels, with provision that all plans need to utilize GIS technology in their formulation. The plans include:

- The National Physical Plan, 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, which sets out the policies and proposals for the development and use of the land in a state.
- The District Local Plan, which translates the state policies at local level.

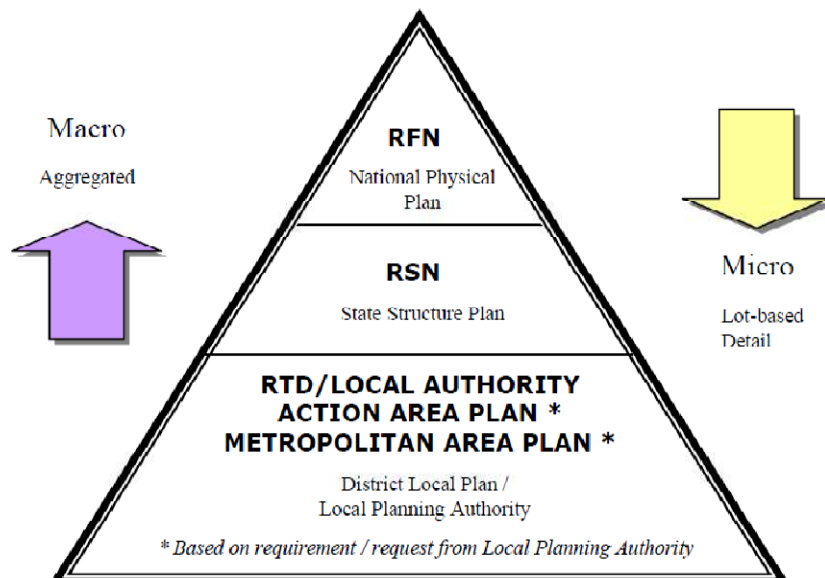


Figure 1: Hierarchical framework of development plan system (FDTCP, 2003)

4-1 The National Physical Plan

The National Physical Plan outlines the strategic policies for the purpose of determining the general direction and trend of the nation physical development. Therefore it requires a comprehensive information system to determine the development trends within a specific time frame.

GIS in this plan is mainly used for data collection, land suitability analysis and generate suitability maps (Yaakup, 2001) as shown in Figure 2. These maps are then analyzed, to study for example the relation between jobs and population in a region. These analyses will be helpful in projecting future requirements of schools, housing, entertainment facilities and any making future economic decisions.

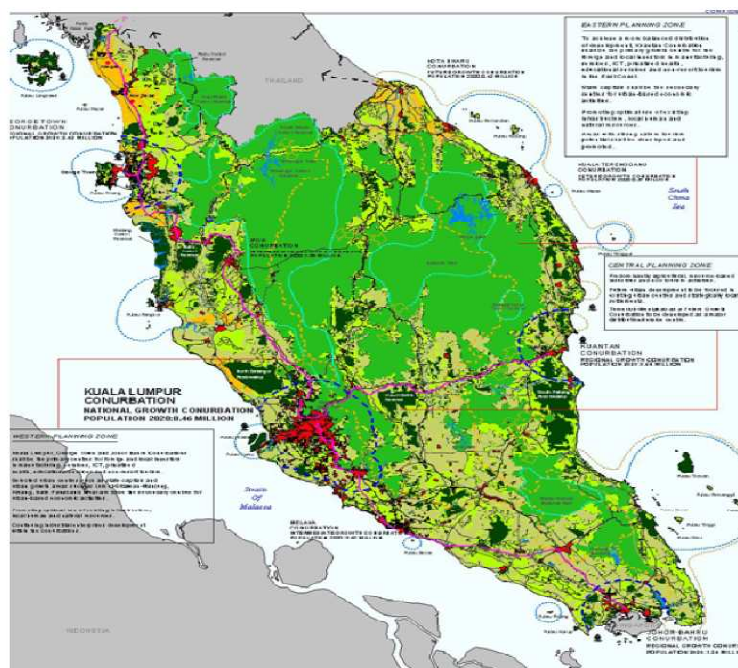


Figure 2: National Physical Plan: Alternative Development Plan Strategy (Technical Report of National Physical Plan, FDTCP, 2003)

4-2 Regional Plan

The information at this level helps to describe the existing situation to improve the decision-making process. Introduction of GIS for regional analysis has improved the decision-making process through improved data accuracy and accessibility which leads to a better decision. Therefore, GIS is identified as the main tool in the formulation of the regional plan.

A typical 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. A well integrated and comprehensive GIS database, called Integrated Land Use Assessment (ILA), have been designed and developed regionally to support ten main application modules through a developed model as shown in Figure 3 .These are built up area, green and recreational area, traffic and urban transportation, squatter and low cost housing, environment, utilities and community services, industrial and commercial development, population and socio-economic, geohazard and tourism. The developed model is expected to dynamically support the preparation of the Klang Valley Regional Master Plan, based on the planning process and PSS framework as well as policy and strategy considerations which act as guidelines and direction for alternative scenario generation.

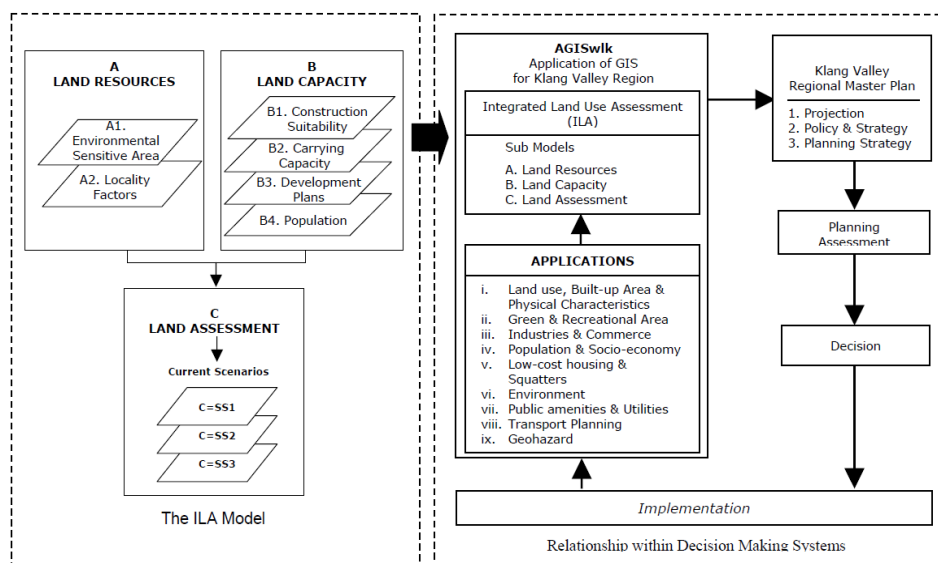


Figure 3: Model developed and implemented for Integrated Land Use Assessment of Klang Valley

Figure 4 below shows example of alternative development scenarios generated using GIS functions such as overlay, classification and measurement.

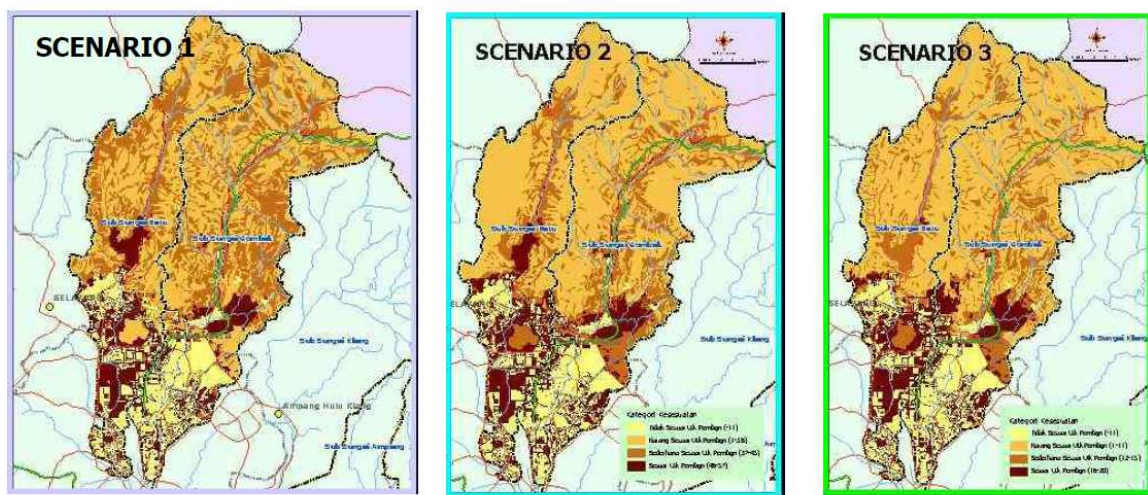


Figure 4: Integrated Land Use Assessment Development Options

4-3 State Structure Plan

According to the State Structure Plan Manual, the preparation of the state plan is fundamental to initiate inspection on the state development when required or if changes in the sectoral policies occur, which will consequently affect the pattern of the state development.

The main concern of this plan would be the preparation of the key diagram (Figure 6) that involves a combination of analyses such as determination of area having potential for future development and area for conservation.

The system developed for the Pahang State Structure Plan, for example, covers three main aspects where GIS is concerned. These are the database development, spatial analyses and development of an Executive Information System (EIS). Figure 5 shows the Multi-Criteria Decision Making (MCDM) method adopted to generate the various development scenarios.

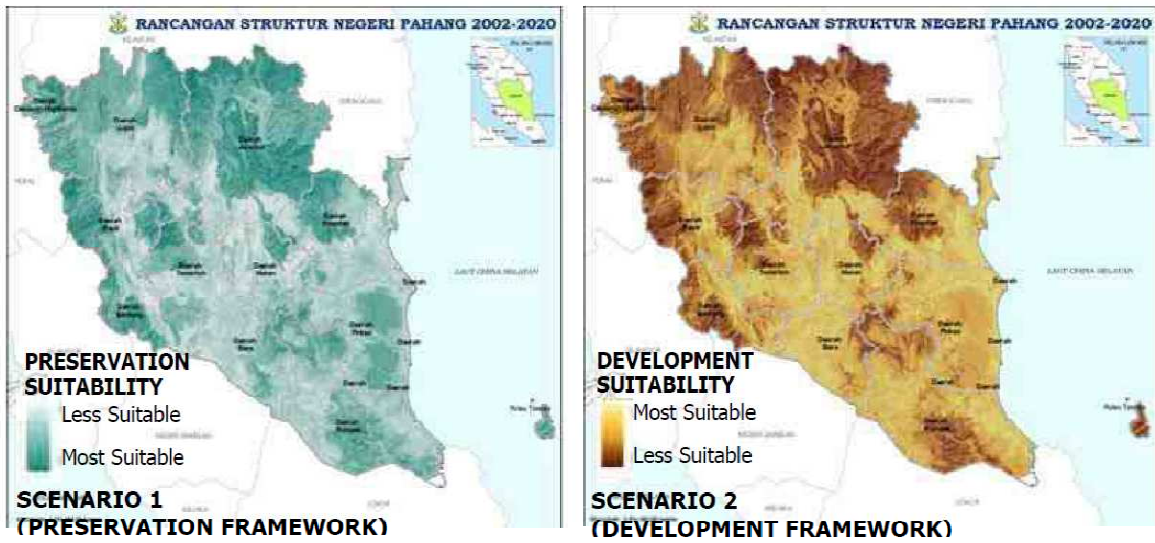


Figure 5: Development Alternatives for the State of Pahang (Interim Report, Pahang State Structure Plan, 2003)

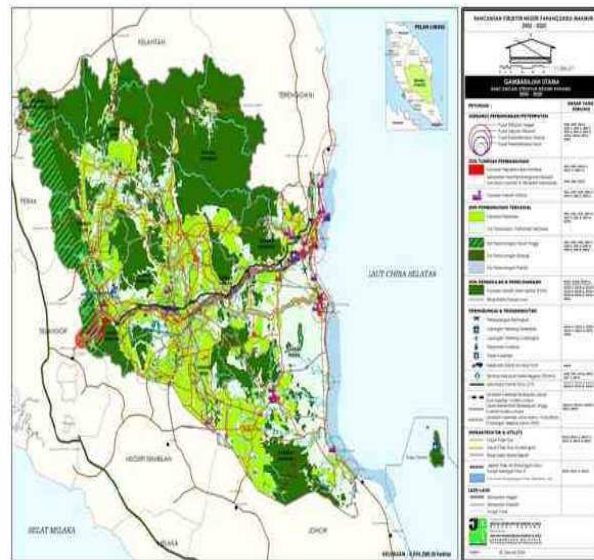


Figure 6: Key Diagram of Pahang State Structure Plan (Interim Report, Pahang State Structure Plan, 2003)

4-4 Local Plan

At the local government level, the district local plans are considered as the basis of development guidelines and control. These plans contain details such as land use zoning (Figure7), development density, building height, plot ratio, etc., which require detailed information of each plot of land.

A Zoning Plan for Pekan District Local Plan , for example, covers a large area that contains various land uses (refer Figure 7), where The district covers an area of about 380,500 hectares, located in the east coast of the State of Pahang. A GIS database and base map were designed to meet the local authority's requirement. At this level, spatial analyses involve determination of land suitability and allocation using the multi-criteria evaluation technique, Figure 8.

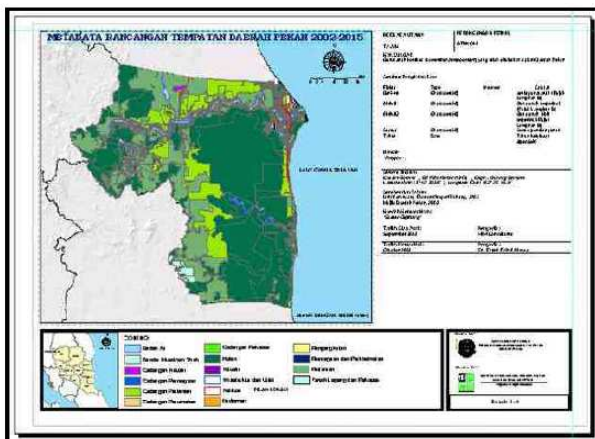


Figure 7: Zoning Plan for Pekan District Local Plan (Technical Report, Pekan District Local Plan, 2003)

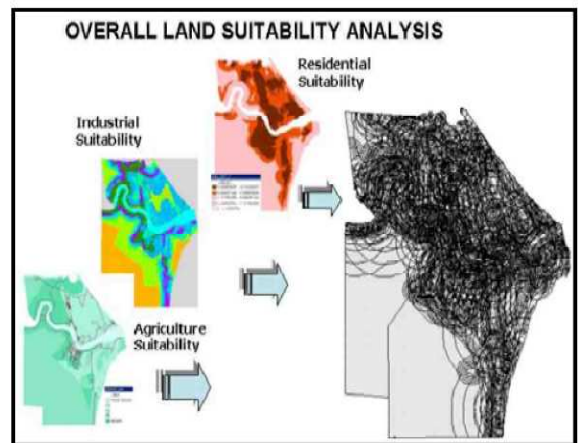


Figure 8: Land Suitability Analysis

4-5 Development Control Systems

Development control is a part of the urban management procedures. However, the local authority in Malaysia is empowered to grant or refuse any planning permission for development application in its area. Therefore, The recent amendment to the planning statute requires that certain planning application be accompanied by a development proposal report which include a written statement and a plan to (i) describe the present condition of the land to which the application relates; and (ii) describe the proposed development, in particular on how it would be likely to have a significant effect on the built environment (Ali, 1990).

In most cases, a preparation of development proposal report involves a technique for the systematic compilation of expert quantitative analysis and qualitative assessment of the proposed project's land use and development viability. This Information should include the following major aspects:

- a.* Status of land and restrictions;
- b.* Land use analysis and intensity of development – this includes land use zoning, population density zoning, height limit, plot ratio, plinth area, predetermined public area;
- c.* Analysis of issues and potential of sites – this includes site location, existing drainage system, topography and slope, existing road system, existing land use, natural features which must be preserved and development potential;
- d.* Analysis of surrounding development – this includes infrastructure, type, intensity and facilities available in the surrounding area;
- e.* The policies of the Structure Plan and Local Plan if available.

Given the wide range of activities over the years, the local authorities have combined a huge amount of information of which a significant portion is geographical in nature such as layout of housing scheme, road and drainage system, composition and distribution of population, distribution of land use and so forth. An information system is therefore necessary not only to keep and display data pertaining to planning application for the purpose of administrative functions but should also to facilitate planning and development control. GIS for development control has been applied in the City Hall of Kuala Lumpur (CHKL) through the development of an integrated system that can be seen as an innovative approach to urban planning. In the case of Development Control System for

CHKL, GIS application has been integrated with seven subsystems that developed to interact with and support one another by sharing information sources as shown in Figure 9.

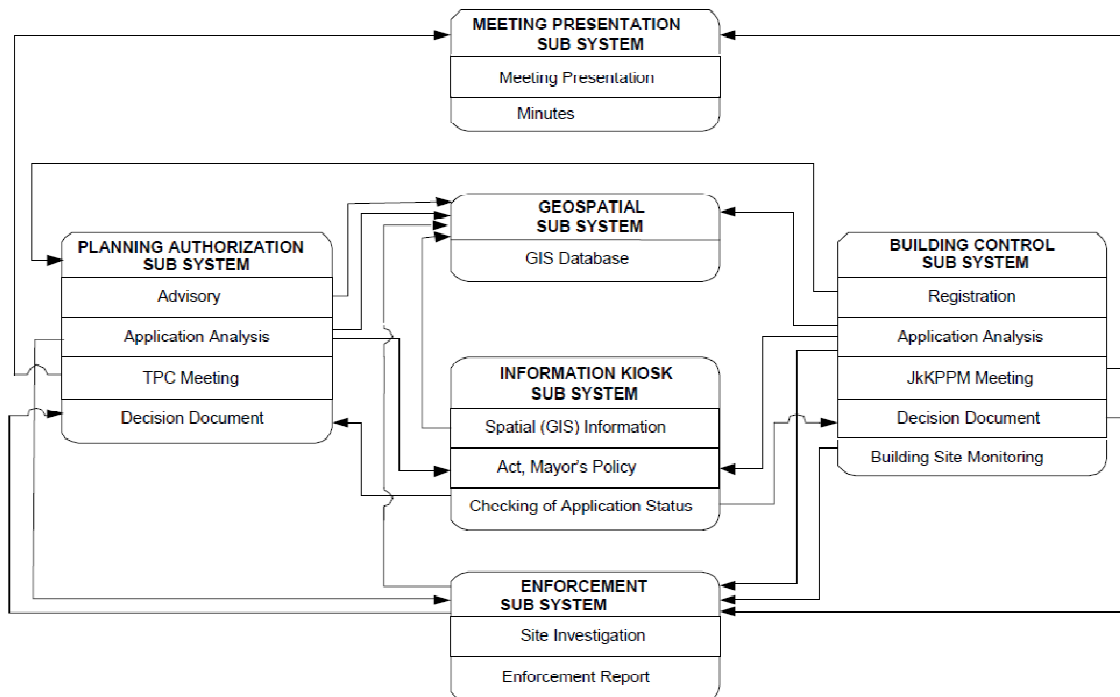


Figure 9: Subsystems interaction in CHKL's Development Control System



Fig.10 Interface for the interactive maps application for CHKL, whereby GIS was adopted and incorporated with the information system for planning for the purpose of development control.

5- Issues and Challenges of Incorporating GIS in Development Plans

Among the technological advancement, GIS is the one that has been most attractive to planners, which provides new tools to implement their work more effectively.

Planning is a process of determining appropriate future action through a sequence of choices. Following through the planning process, planners attempt to understand and define current issues, predict future developments, and propose feasible plans based on the availability and quality of information.

It should also be remembered that GIS was not originally designed or developed for the planning profession. For that reason, both users and developers have been trying to define ways to make GIS more useful for planning process.

According to 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. Hence, there is a need to integrate existing analytical techniques and GIS packages by adding modeling software directly into such GIS software.

An effective use of any technology depends on clear leadership within the organization 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 (Yaakup and Johar, 1995).

6- Conclusion

GIS has proven to be helpful tool for evaluating alternative solutions to urban planning problems, in which various scenarios that take into account the socio-economic characteristic of urban residents, the constraints of physical development, availability of land and land suitability for different kind of development can be generated. Planning database can be extensively interrogated to generate several alternative solutions to urban planning problems.

In the management aspect, the systems such as that had been developed have provided planners with new tools to implement their work more efficiently, especially with support of the interactive and user-friendly interface provided to ease the use of the sophisticated system without the need of advanced technical skill.

However, the ease with which a GIS can manipulate geographic information has 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. Generally, the success or failure in the adoption of GIS for urban planning and management depends on a variety of human, organizational and technical factors.

7- Discussions and Recommendations

1. Urbanization contributes many advantages in terms of economic, but if uncontrolled would produce negative consequences to the physical, social and natural environment.
2. Planning systems have a great role in managing and controlling the trend and pattern of developments within a specific time frame.
3. The advancement of geo-information technology (GIT), such GIS technology, has considerably affected the dynamic nature of urban and regional planning in Malaysia, and consequently improved decision-making, planning and management concerning urban area.
4. According to Harries, et al 1993, GIS alone cannot serve all the needs of planning, since planning requires 1) information that is effectively “a spatial” at a particular level of analysis; 2) information over time; 3) measures of spatial interaction. None of this can be easily incorporated into standard GIS packages.

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Appendix