Handbook of Research on E-Planning:
ICTs for Urban Development and Monitoring

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Chapter 23
GIS Implementation in Malaysian Statutory Development Plan System

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ABSTRACT

The chapter presents the current state of GIS implementation in Malaysian development plan system. It offers an overview of GIS implementation worldwide, touching briefly on the history of GIS, planners' early acceptance of the system, factors that promote GIS implementation, level of usage among planners, and factors that impede successful GIS implementation. At the end, the chapter provides a comparison between the state of GIS implementation in Malaysian statutory development plan system with the state of GIS implementation worldwide. The evidence was derived from three main sources: literature, empirical observation of GIS implementation in Malaysia, and a survey conducted in 2008.

INTRODUCTION

After over two decades since its introduction into the planning fields, geographical information systems (GIS) has become one of the important tools-of-the-trade for planners (Ceccato & Snickars, 2000; Drummond & French, 2008; Gocmen, 2009). Despite planners' early resentment towards GIS, they have now become one of the most frequent users of the systems (Budic, 2000; Ceccato & Snickars, 2000; Geertman, 2002; Gilfoyle & Wong, 1998; Gocmen, 2009). In describing planners' early resentment towards GIS, Klosterman (1997) points out that this was largely due to past failures of efforts to computerize planning, such as the failure of large-scale urban modelling. Early GIS implementation was also expensive, and the software was highly complicated for planners liking.

Beginning in the middle of 1980s, the adoption of GIS among local governments in the United

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States of America began to increase slowly, and then sharply in the 1990s (Drummond & French, 2008). Researchers attributed this change in GIS adoption rate to better and cheaper hardware and software availability, as well as better GIS data accessibility (Drummond & French, 2008; Geertman, 2002; Gilfoyle & Wong, 1998; Klosterman, 1999).

Key actions by governments also helped to accelerate GIS adoption in the 1990s. For instance, the publication of Chorley Report in 1987 has helped to increase GIS awareness and provided fundamental directions for GIS development in Britain (Gilfoyle & Wong, 1998). In Wisconsin, U.S.A., the state-funded Wisconsin Land Information Program and the enactment of the Comprehensive Planning Law of 1999 have significantly contributed to increase GIS adoption in the state (Gocmen, 2009).

Since the 1990s, the use of GIS among planners has been widespread. Planners began to adopt this 'new' method in the course of their work, especially in terms of map-making and land data storing. GIS-based information systems were developed and deployed to allow planners and stakeholders better access to information and data (Craglia & Signoretta, 2000; Gilfoyle & Wong, 1998; Heeks, 2002). However, widespread implementation of GIS in the planning field does not translate into full utilization of GIS application. Research indicates that planners' regular use of GIS has been largely limited to the basic functions of the systems, such as mapping and accessing land information, for routine operational and management tasks including permit processing, land data storing and map presentation (Budic, 2000; Gill, Higgs, & Nevitt, 1999; Klosterman, 1997; Mennecke & West, 2001). Even at present, prevalent use of GIS among planners continues to centre on rudimentary applications while advanced applications, such as spatial analysis and modelling, remain underutilized (Gocmen, 2009).

While GIS application among planners continues to be underutilized, the fate of GIS-based information systems is more difficult to assess, mainly because such assessment is highly subjective and timing-dependent (Heeks, 2002). What is considered a success to one person may be a failure to another, and what is considered a success today may be a failure tomorrow. The difficulty in assessing the success and failure of GIS-based information systems is made worst by the propensity of system developers to only report success story. However, several authors suggest that there are many cases of failed GIS-based information systems (Abdullah et al, 2002; Heeks, 2002; Lee & Ahmad, 2000). For instance, Heeks (2002) says that,

On the basis of…these surveys, one may estimate that something like one-fifth to one-quarter of industrialized-country IS (i.e. information system) projects fall into the category of total failure category; something like one-third to three-fifths fall into the partial failure category; and only a minority fall into success category. (p. 102)

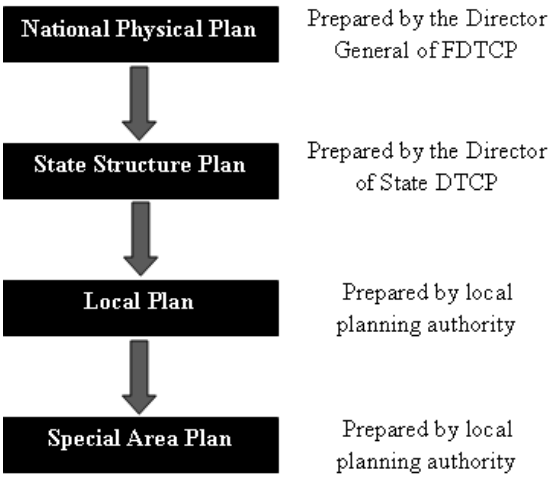
Nevertheless, researchers tend to agree that organisational factors are more important than technological ones in ensuring a successful implementation of an information system (Abdullah et al., 2002; Heeks, 2002; Innes & Simpson, 1993; Ramasubramanian, 1999). Organisational mission to implement and support information system, retaining key and trained staff involved in the development and implementation of the system, data availability, and system designers' understanding of users' needs are among the organisational factors identified as key ingredients for a successful information system.

BACKGROUND

Malaysian Statutory Development Plan System

Town and country planning system in Malaysia is governed by the Town and Country Planning Act

Figure 1. Malaysian statutory development plan hierarchy



1976[1] (Johar, 2003; Abdullah & Ariffin, 2003). Central to this Act are the requirements for planning authorities in Malaysia to formulate planning and development policies through preparation of statutory development plans and to regulate development through development control process. The statutory development plans required under the Act are national physical plan, state structure plan, local plan and special area plan.

The administration of this Act is carried out at three different governmental levels which are the Federal, the State and the Local Government (Ahmad Sarkawi, 2006). Planning authorities are established at each level of the government to undertake planning of different scale and functions.

The Town and Country Planning Act 1976 was amended in 2001 to make provision for an improved system of statutory development plans in Malaysia. The 2001 amendment introduced additional set of plans into the system, which aims at introducing a more integrated and holistic approach to planning, and enhancing the control and regulation of planning in Malaysia (Ahmad Sarkawi, 2006). Prior to the amendment, the Malaysian statutory development plan system was a two-tier system consisted of structure plans and local plans. Following the amendment, the system now consists of a hierarchy of development plans ranging from national to local levels. At the top of the hierarchy is the national physical plan. This is followed by the state structure plan, the local plan and the special area plan (Figure 1).

The national physical plan sits at the top of the hierarchy of statutory development plans in Malaysia. Prepared by the Federal Department of Town and Country Planning (FDTCP), the plan provides strategic development framework for the whole of West Malaysia. The plan was approved by the National Physical Planning Council in 2005 and shall be in effect until 2020. It is subject to revision every five years.

The state structure plan is prepared by the State Department of Town and Country Planning (State DTCP). The plan translates the development framework of national physical plan to state level, and provides planning policies and proposals for the whole area within the state boundary. The form and functions of state structure plan remain similar to the 'old' structure plan prior to the 2001 amendment of the Town and Country Planning Act 1976. The only difference is that the current state structure plan is a state-wide plan, while the previous structure plan was prepared for a part of an area within state boundary. At present, eight out of eleven states in West Malaysia already had their state structure plans published in the official gazette. Once published, the plan becomes a legal document that guides the planning and development within the state.

The 2001 amendment also affects the local plan. Although the form and functions of local plan remain the same as before the amendment, the plan is now a district-wide plan. Previously, it covered only a part of an area under a local planning authority's jurisdiction. Thus, the present local plan is commonly referred to as the 'district local plan' in order to distinguish it from the 'old' local plan.

Local plan is prepared by local planning authority to set out detail policies and proposals

pertaining to development and use of land in the district. The plan also translates strategic policies and proposals of state structure plan into details to be implemented at the district level. Usually this involves detailing the exact location, components and the cost of development. At present, a total of 108 local plans have been published throughout West Malaysia.

Similar to the local plan, the special area plan is also prepared by local planning authority. Nevertheless, special area plan covers a smaller area in comparison to the local plan and contains proposals that are more detailed in nature. Special area plan is prepared for an area that requires special planning because of its unique character. At present, special area plans have been prepared for areas that require special conservation efforts because of their historical or natural environmental value, and for areas that are subjected to intense development pressure.

In general, the contents of these statutory development plans consist of written statements and maps. The written statements present the planning policies and development proposals for the planned area, while the maps act as supporting documents that clarify the policies and proposals through graphical representations. The national physical plan and the state structure plan are subject to revision every five years. On the other hand, the revision of a local plan can be performed by the local planning authority whenever necessary.

Preparations of all statutory development plans in Malaysia are outsourced to private planning consultants. A team of planning consultants is appointed for each statutory development plan preparation project and is responsible for collecting data, performing analyses and writing reports. Meanwhile, the planning authorities administer the preparation process by providing supervision and funds, as well as handling the publicity and the gazette process of the plan. The planning consultants, based on analyses of the collected data, propose planning policies and development proposals for the planned area for commentary by the planning authorities. Once finalised, the plan will be put on public display before being published in the government's gazette. Figure 2 presents the flow chart of a typical statutory development plan preparation process in Malaysia.

Although there are other types of development plans prepared by planning authorities in Malaysia, such as regional plans and rural growth centre plans, their preparations are not bounded by the requirements in the Town and Country Planning Act 1976. Thus, these plans are sometimes termed as non-statutory development plans. For the purpose of this chapter, any reference to development plans in the following discussions will refer to the statutory development plans.

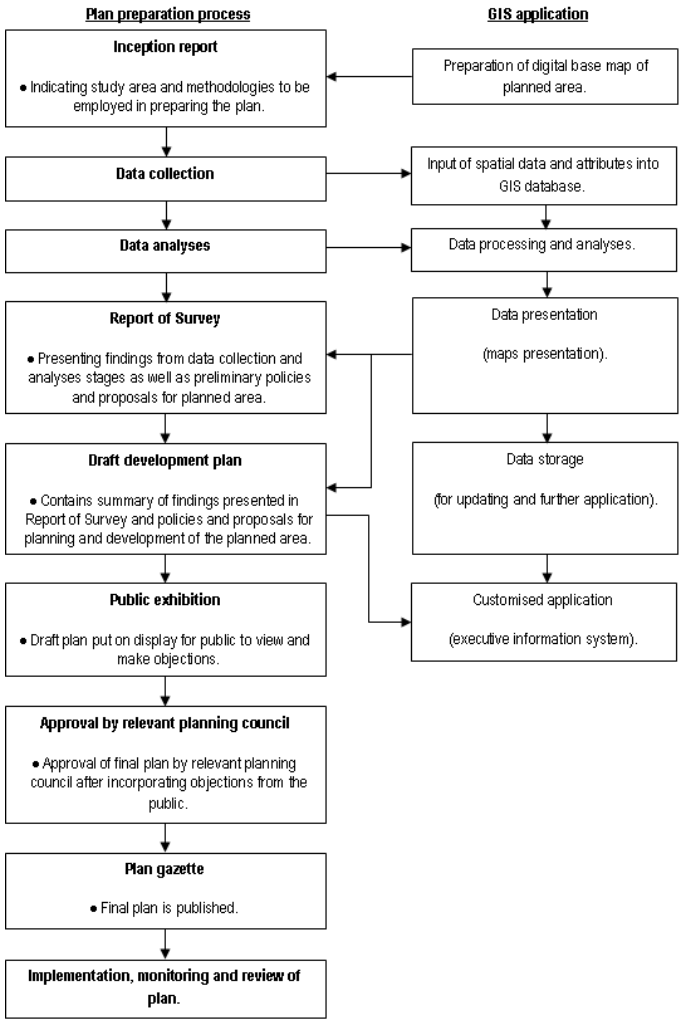
History of GIS Implementation in Malaysian Statutory Development Plan System

GIS was introduced in Malaysia in the early 1980s. Early record shows that GIS was first used by Malaysian Department of Agriculture in 1981 (Idrus & Harman Shah, 2006). It was only over a decade later that GIS was officially used in planning in Malaysia.

The year 1993 marked the first GIS use in Malaysian planning when Putrajaya, the new Malaysian Federal Government Centre, was being planned (Abu Bakar, 2004). In the process, GIS (MapInfo version 1) was used, but only for map presentation. In that same year, the Local Plan for Parit Buntar and Bagan Serai area was also being prepared. This presented another opportunity for FDTCP to try to use GIS in planning. Thus, the first executive information system for a development plan, known as SMaRT, short for *Sistem Maklumat Rancangan Tempatan*, or Local Plan Information System, was developed for that local plan (Abu Bakar, 2004).

Beginning with these two GIS initiatives, GIS use in Malaysian planning gradually increased. Early widespread implementation of GIS centred on its implementation in the preparation of devel-

Figure 2. Typical development plan preparation process and integration with GIS (Adapted from Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2001 and Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007)



opment plans. By 1997, GIS was already embedded into the preparation process of development plans in Malaysia (Ibrahim et al., 2004). From the initial focus on development plan preparation, GIS was then implemented in other activities of planning including development control and land use change monitoring, as well as being the platform on which tailor-made e-planning systems were developed (Abdullah, 2004).

Today, GIS is a common knowledge among planners in Malaysia. Formal GIS training is now offered to all planning graduates at all planning schools in the country (Ibrahim et al., 2004). On-demand GIS trainings are also offered by various parties, including universities and private GIS companies, to public and private planners. GIS research and development are being pursued actively with universities playing significant roles in developing GIS model and exploring new areas where GIS can add value in the planning process (Abdullah, Abdullah, & Ibrahim, 2009; Samat, 2006; Tan, 2005).

Information System Planning Masterplan

In 1996, the Malaysian Government launched e-government initiatives as part of its efforts to employ information and communication technology (ICT) in order to reinvent the way it operates. E-government was one of the seven flagship applications initiated under the Multimedia Super Corridor programme (Lee & Ahmad, 2000). Under the programme, government departments were required to formulate and implement proposals for integration of ICT in their work in order to achieve speedier and better service delivery. In line with the Malaysian Government's e-government aspiration, in 1997, FDTCP introduced its Information System Planning Masterplan. This masterplan outlines the department's approach towards integration of ICT into planning in Malaysia. Nevertheless, many of the ICT systems proposed to be developed under the masterplan have some GIS elements in them. According to Mohd. Nazri Abdullah (2004), based on the detail explanation in the masterplan, it can be concluded that 80% of the proposed systems would lead to some GIS applications in planning. Among the ICT systems proposed by the masterplan are:

- Development and Planning System;
- Planning Monitoring System;
- Planning Approval System;
- Counter Service System;
- Appeal Board System;
- State Planning Council Decision Support System; and
- Data Warehousing and Information System.

The masterplan recognizes the benefits of GIS to planning, and thus outlines measures to integrate GIS into planning in a more coordinated approach. Among the key thrusts of the masterplan pertaining to GIS are to increase GIS awareness and knowledge among FDTCP officers, and to promote GIS use in planning, especially in the development plan preparation process.

GIS Implementation in Statutory Development Plan Preparation Process

The Information System Planning Masterplan's proposal to promote GIS use in development plan preparation process is perfectly appropriate for several reasons. Firstly, development plan preparation involves the production of a significant number of maps. For instance, Terengganu State Structure Plan contains 62 maps and Perak State Structure Plan contains 52 maps (Table 1). Nevertheless, it has to be noted that these are just the number of maps included in the published plan. The number of maps prepared throughout the entire plan preparation process is notably higher since there are also other reports like the inception report and the report of survey (Figure 2), which have to be produced in the process and these reports contain a sizeable number of maps as well. In fact, report of survey usually contains more maps than the published plan itself. Therefore, even though the number of maps included in Pahang State Structure Plan is only 15 (Figure 2), the total number of maps produced during the Plan's entire preparation process is considerably higher. Due to the high number of maps produced during development plan preparation process, many opportunities to use GIS arise in that process. Maps, which were usually prepared using computer-aided design (CAD) software (and in some cases using Microsoft PowerPoint) previously, can now be prepared using GIS software.

Secondly, statutory development plan forms the basis for development control for the planned area. The plan would determine the type of development allowable in an area, or land parcel, as well as any restrictions (such as development density, plot ratio and building height) associated to that land. The use of GIS would development

Table 1. Number of maps in published state structure plans

No.	State Structure Plan	No. of maps	No. of policies
1.	Terengganu State Structure Plan	69	**158**
2.	Perak State Structure Plan	52	**49**
3.	Melaka State Structure Plan	29	**165**
4.	Pulau Pinang State Structure Plan	29	**79**
5.	Selangor State Structure Plan	26	**100**
6.	Negeri Sembilan State Structure Plan	25	**111**
7.	Pahang State Structure Plan	15	**29**
8.	Johor State Structure Plan	n/a	**n/a**

of an information system and its usage in the development control process. Such information system would allow users, especially council planners, to quickly search for the land parcel affected by a planning application using computer and to ascertain the planning policies and the development control requirements related to that land. Such system would also help speed up the development control process considerably as compared to manual search and reference tasks, especially when a plan may consist of more than one hundred policies (refer Table 1). The less time taken to process a planning application would fit very well into the e-government initiatives, which seek for speedier service delivery.

Problems Faced During Early GIS Implementation Period

Following the introduction of the Information System Planning Masterplan, FDTCP began its promotion of GIS. Officers from the department were sent to GIS trainings and road shows were conducted at various town planning departments in the country. FDTCP also conducted several workshops to discuss in detail the areas where GIS can be used in the development plan preparation process and, later on, introduced GIS to private planning consultants who were involved in development plan preparation projects (Ibrahim et al., 2004).

Early attempts to integrate GIS into Malaysian statutory development plan preparation process were not without problems. When initially introduced, GIS received lukewarm reaction from FDTCP officers, created confusion among private planning consultants and failed to achieve what it was intended to do. Mohd Ali Abu Bakar (2004) reports that despite the promotion and the road shows, GIS was not initially well received by many officers from the professional category, such as planners. Many of them perceived GIS merely as a mapping tool and thus only useful to sub-professional officers, such as technical assistants and technicians.

When GIS was introduced to private planning consultants, the reception was not any better as well. To many of them, GIS was completely a new thing and most were unclear about how GIS was to be integrated into the development plan preparation process. When further clarification was sought, FDTCP's response suggested that what the department wanted was for digital maps to be used in the preparation of the plans. However, as stated by Mansor, et al. (2004), initially many consultants still decided not to use GIS. As digital plans and maps could be produced easily using CAD software, not all consultants decided to venture into using GIS software in their work. Instead, many of them opted to continue using CAD software, which they were already using prior to the GIS introduction.

Early implementation of GIS in the development plan preparation process also faced the problem of standardisation, or the lack of it (Bahagian Teknologi Maklumat, 2006). At that time, FDTCP did not provide any detail guidelines on land use colour classification, database structure, metadata structure and the like. Lack of detailed guidelines led to non-standardised GIS outputs prepared by the few consultants who decided to use GIS in the plan preparation.

The absence of detailed guidelines from FDTCP and lack of GIS knowledge among consultants also resulted in limited use of GIS in the development plan preparation process. GIS was viewed as a map drawing tool and thus, used as one. Maps were drawn using GIS software but without data attributes. Spatial analyses were still conducted manually despite the availability of GIS software and digital maps. However, the results of these analyses were then drawn onto the maps using GIS.

Quality Control of GIS Outputs

Having learnt lessons from the problems faced during the early period of GIS implementation in the development plan preparation process, in 1999, FDTCP introduced measures to control the quality of GIS outputs from the process. A guideline on GIS application for local plan preparation process was produced (Abu Bakar, 2004). Although brief in nature, the guideline was rather useful as foundation towards standardisation of GIS outputs. The guideline was tested on several local plan preparation projects before it was finally improved. In 2001, it was officially included in the revised FDTCP's Manual for Local Plan Preparation (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2001; Abu Bakar, 2004).

Similarly, the FDTCP's Manual for State Structure Plan Preparation was also revised in 2003 to include guidelines for GIS application in the plan preparation process. Other guidelines concerning map preparation, metadata and database structure were also produced. These guidelines are constantly revised and improved. Today, the level of details provided in these guidelines is quite remarkable. For instance, the latest version of FDTCP's *Manual Penyediaan Pelan GIS* (or GIS Plan Preparation Manual) goes to the extent of providing step-by-step instructions on how to prepare land use data layers (Bahagian Teknologi Maklumat, 2007b). The guideline for *Format Metadata dan Struktur Pengkalan Data Sistem Maklumat Geografi (GIS) Kajian Rancangan Tempatan* (or Format for Metadata and GIS Database Systems for Local Plan) is similarly detailed in contents. The 78-page guideline includes samples of metadata format for each land use layer and pre-determines the name of each of the layers (Bahagian Teknologi Maklumat, 2007a).

Another measure taken by FDTCP to ensure standardisation of GIS outputs is the appointment of GIS consultant into the team of consultants that are involved in preparing a development plan. When GIS was initially introduced into the development plan preparation process, the responsibility to prepare GIS maps was on each of the planning consultant in the team. Such arrangement lacked the necessary coordination to ensure that all the maps produced were uniformly formatted. With GIS consultant in the team, the responsibility to coordinate maps preparation is on the GIS consultant. Because of their advanced knowledge in GIS technologies, GIS consultants are also tasked to conduct GIS analyses, develop GIS database and develop executive information system for the plan (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007). In terms of map preparation *per se*, the responsibility remains with individual consultants in the team. However, increasingly, in many development plan preparation projects, GIS consultants are also given the task to prepare maps on behalf of the planning consultants. In such cases, the planning consultants still provide the required information for GIS maps preparation to GIS consultants..

Level of GIS Application in Statutory Development Plan Preparation

Despite having GIS consultants' expertise at disposal, present GIS use in most statutory development plan preparation projects is still limited to map preparation and presentation with minimum GIS analyses being performed (Ibrahim et al., 2004; Nor Salehi Kassim, personal communication, December 11, 2008). In most instances, GIS analyses performed are restricted to basic analyses like overlays and catchment (buffer) analyses (G. L. Chua, personal communication, December 12, 2008). Nevertheless, although rare, there were cases of advanced GIS analyses performed in development plan preparation, such as in the preparation of the national physical plan and the Kulim District Local Plan (Abdullah, Abdullah, & Shahbuddin et al., 2009). In both cases, GIS was coupled with decision support systems to conduct analysis and generate maps for land suitability (Amandus Jr, 2006; Kassim & Islam, 2009).

In explaining the reason behind the limited use of GIS analyses in the development plan preparation process, Ibrahim, et al. (2004) states that:

...the current limitations in terms of GIS use in development plan preparation arisen due to inadequate comprehension among private planning consultants on the analyses capability of GIS and also on how GIS can help to ease their work. In addition, the preparation of development plan does not solely involve analyses of spatial data, in many instances, analyses of aspatial data, or a combination of both, are equally important. Marrying the spatial analyses with aspatial ones might be a little on the complicated side to many planning consultants. (p. 3)

Although planning consultants who are involved in the development plan preparation are aware of GIS functions, they are not aware of GIS full capability for analysis. In particular, they do not know whether any of the GIS analyses can be used to replace what they have been doing manually. In the same time, GIS consultants also tend to overlook their responsibility to advice planning consultants on GIS analyses because they are too preoccupied with developing GIS database and the executive information system, which are deemed as the core of their work. Additionally, they receive no request for GIS analyses to be performed from planning consultants (G.L. Chua, personal communication, December 12, 2008).

The superficial knowledge of GIS among planning consultants, as described above, can be attributed to the lack of GIS training received. It should be noted that many of the planning consultants involved in preparing development plans are seniors in their fields. Many never received any formal GIS training during their university days. Although commercial GIS training is available at present, senior consultants prefer to not attend the training sessions. Instead, younger staff are sent for the training. A common idea shared by many senior planning consultants is that GIS (and ICT) suits younger people better.

Executive Information System for Statutory Development Plan

Executive information system (EIS) is another aspect of GIS application in the statutory development plan preparation process. The requirement to produce EIS for development plan is now mandatory in all development plan preparation projects (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007). EIS for development plan is basically a computer system that stores all GIS maps prepared for a development plan. Users can then access these maps through the EIS and perform some GIS functions using the toolbar on the system's graphical user interface. Usually, the toolbar includes only basic GIS functions such as calculating distance, accessing information of land parcels and displaying selected layers of information. There are also EIS that stores the digital version of the published development plan

as well. As such, the system is frequently used by the planning authorities' officers as a substitute for the hardcopy version of the plan.

The development of EIS for development plan is advancing. Earlier, EIS was developed mainly as a stand-alone system to store GIS maps and reports produced during the development plan preparation process. The database of the system was fixed and only updated when revision was done to the plan. However, recently, EIS began to be developed as a multi-user system and deployed over local area network. The system also now includes features of a charting[2] system, where the database can be easily updated through the system's interface. With these features, planners are able to update the land information in the database without having to actually use GIS software.

EIS for development plan targets three types of users, which are:

- Executives, including council planners, who make decisions about planning applications;
- System administrators who are usually planners and technical staff of planning authorities;
- The general public, including developers and land owners.

Access to information stored in EIS database is restricted according to the type of users. Executive users have access to all information including the digital version of both the report of survey and the published development plan. However, they do not have access to update the GIS database. Public users neither have access to the reports nor to update GIS database. Instead, they can only access information regarding the proposed land use of a particular land parcel and the development restrictions attached to that land. System administrators, obviously, have access to all information and to update the GIS database.

Besides being used as a medium for quick access to planning information, EIS is also used in development control, counter services and public exhibition of development plan. FDTCP has also begun to encourage the development of internet-based EIS (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007). It is hoped that by being internet-based, future EIS can be accessed more easily by users, especially the public. With the present system, public users can only access the system at planning authorities' offices, either at the information kiosk or service counter.

EIS Implementation Problems

While EIS development is mandatory for all statutory development plans in Malaysia, the success of its implementation is uncertain due to lack of research on this issue. Nonetheless, it seems that some planning authorities are more successful in implementing EIS than others. EIS implementation at planning authorities such as at Melaka State DTCP, Petaling Jaya City Council and Seberang Perai Municipal Council are often referred to, by those in the planning fraternity, as examples of successful EIS (G. L. Chua, personal communication, December 12, 2008; Mohd Ramzi Mohd Hussain, personal communication, December 10, 2008).

As mentioned previously, EIS for development plan is developed during the plan preparation process. The cost to prepare the plan, including EIS, is jointly funded by FDTCP and the planning authority whose area is being planned for. In most cases, the former contributes towards a major portion of the funding. Once EIS development is completed, the GIS consultant will create an installation disc of the system and hand it over to the planning authority. A manual on how to use the system is also prepared and printed out by the GIS consultant for the planning authority's use. It is then up to the planning authority to install, maintain and upgrade the system. Yet, it is common for planning authorities to fail to maintain the system. Often times, the reasons cited for such failure are lack of personnel and financial capacities.

In hindsight, the EIS for development plan is actually forced upon planning authorities by FDTCP. When EIS became a mandatory requirement in development plan preparation, planning authorities had to accept the system when it is handed over to them although they may not have the resources to maintain the system. Unfortunately, many of the planning authorities do not have the resources to maintain the system. The problem of not having sufficient personnel, especially trained personnel, and funds to maintain EIS is quite significant among many planning authorities, especially those operating in the rural area. In terms of personnel, some planning authorities in the rural area do not even have a planner on their payroll. In cases like this, it is usually the technical assistant who will act as the planner for the area. There are also cases where a planning authority has only one staff, either a planner or a technical assistant, to handle planning matters of the area. To worsen the matter, some of these planning authorities are not even equipped with a computer in which the system can be installed (Aishah Abdullah, personal communication, November 18, 2008; Muhammad Hakimi Mohd. Hussain, personal communication, November 18, 2008). Their existing computers are obsolete that they do not have the right specifications to run EIS applications.

GIS-Based Statutory Development Plan Monitoring System

The monitoring of statutory development plan implementation has not been given sufficient attention by planning authorities in Malaysia, even at present. In fact, many planning authorities do not monitor the implementation of their development plans. In the event where monitoring of development plan is undertaken, the focus is solely on land use change. Meanwhile, other aspects of the plans, such as protection of environmental resources, management of traffic and provision of public facilities, are not included in the monitoring exercise.

Although the monitoring of development plan implementation is not widely practiced, the need for it is clearly identified, especially for the state structure plan. The Manual for Preparation of Structure Plan proposes a procedure that can be employed by States DTCP to monitor their state structure plans (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007). Additionally, all published state structure plans include a section that outlines the monitoring programme that the States DTCP intend to undertake. Interestingly, while the manual does not specifically propose the use of any ICT application in state structure plan monitoring, the plans describe the possibility of GIS being used for monitoring purposes.

The only GIS-based monitoring system for state structure plan in Malaysia is the one developed by Negeri Sembilan State DTCP. Known as GIS9, the system was developed for the purpose of monitoring land use change in the state and evaluating the change in relation to the land use allocation proposed in Negeri Sembilan State Structure Plan. The system is placed on a server located at the Negeri Sembilan State DTCP office. The system is also connected to all local planning authorities in the state in order to enable them to update the system's database when change of land use occurs in their area. The updated data will then be used to determine the actual land use allocation in the state. This information will then be compared with the land use allocation proposed by the state structure plan. Thereafter, the difference between actual land use allocation and the proposed one will be calculated and the results will be presented in terms of percentage (UGisP, 2006).

GIS-Based Monitoring System Implementation Problems

Despite being potentially useful, the implementation of GIS9 is rather unsuccessful. This is due to the failure of local planning authorities in updating the data for their area and poor system's infra-

structure. As aforementioned, the system is very dependent on local planning authorities updating the land use data for their area whenever there is a change of land use. However, the local planning authorities failed to do this. As in the case of EIS previously, lack of personnel was often cited as one of the reasons for their failure to update the data (Anuar Maidin, personal communication, November 11, 2008). As a result, the land use data in the system database is outdated and does not reflect the actual land use allocation in the state. Thus, the data cannot be used to provide accurate monitoring results.

The system is also plagued by poor infrastructure set up. The server experiences too many problems that lead to numerous down time, which at times extending well over two months (Haibernarisal Baijuri, personal communication, November 16, 2008). The long down time leads to data updating exercise being put on hold and discourages users from using the system.

Impacts of GIS Implementation in Statutory Development Plan System

The implementation of GIS in statutory development plan system has impacted Malaysian planning scene in a number of ways. Perhaps, the biggest impact is how it has contributed towards the increase of GIS critical mass in the country. Although Rogers' diffusion of innovation theory (as cited in Ramasubramanian, 1999) suggests that critical mass precedes adoption of technology, in the case of GIS implementation in Malaysia, the reverse may have happened. When FDTCP introduced GIS in the development plan preparation process, few planners were aware of what GIS was all about. Nevertheless, FDTCP had already decided to make GIS implementation in the plan preparation process mandatory. This created the demand for planners with knowledge on GIS.

Warnecke, Beatie & Lyday (as cited in Drummond & French, 2008) traced the beginning of large-scale introduction of GIS into planning back to 1984. So, while it was already 13 years that planners elsewhere in the world have been using GIS in their work, many Malaysian planners still found GIS a completely new invention when it was officially introduced into Malaysian development plan preparation process in 1997 (Mansor Ibrahim et al., 2004). However, the result of a survey conducted among planners in Malaysia revealed that by 2004, already more than 50% of the planners have used GIS software. A similar survey in 2007 showed that the figure had risen to almost 70% (Abdullah, Abdullah, & Ibrahim et al., 2005). Looking from this angle, one can see the profound impact of GIS implementation in development plan preparation process in creating GIS critical mass in Malaysian planning. It took only 10 years since GIS was officially introduced into the development plan preparation process for it to become widespread among Malaysian planners.

Based on our observation, we would like to offer two main reasons for the popularity of GIS among Malaysian planners after its use was made mandatory in the development plan preparation process. Firstly, in the late 1990s, Malaysia and several other countries in the Asian region were faced with economic recession due to the currency crisis. Prior to the recession, Malaysia was developing rapidly and many private planners were involved as consultants in the construction industry, especially in terms of formulating masterplans for new townships and submitting planning applications for new development. However, during the recession, the construction industry in Malaysia was badly hit that it almost halted. Suddenly, many of the private planners found that there was no job in the construction industry. Around the same time, FDTCP began commissioning a new batch of development plan preparation projects and was looking for private planners to be appointed as consultants in order to prepare these plans. Since planning jobs were scarce, many private planners had no choice but to get involved in those development plan preparation projects. It was through their involvement in

those projects that they began to obtain exposure to GIS and GIS software.

Planners from the public sector also involved in development plan preparation projects, although not as consultants, but usually as a project manager, as a technical committee member or as owner of the plan. Thus, similar to private planners, their involvement in the projects helped to expose them to GIS. Additionally, many of them had the benefit of attending formal GIS training. FDTCP, for instance, had established a programme under which GIS trainings are offered to planners from the public sector. The programme, known as Geotechnical Spatial Analysis Research and Development, was established in 2000 as a platform for FDTCP to undertake research and training on spatial planning and decision-making tools relevant to planning such as GIS, multi-criteria evaluation and spatial decision support systems (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2008).

Secondly, the implementation of GIS in the development plan preparation process has also led to planning schools in the country to begin to offer, or place greater emphasis on, GIS subjects with the aim of producing more marketable graduates. Graduates are not only trained through GIS-specific subjects, but also through heavy GIS integration, both theoretically and practically, within other subjects such as design studios, urban design, planning theory and practice, environmental planning and so on (Ibrahim et al., 2004). In fact, during the late 1990s and early 2000s, having the knowledge to operate GIS software became one of the, if not the most, important criteria for planning graduates to secure employment at planning firms and authorities. Today, although the importance of GIS knowledge in securing employment has reduced slightly (but still important nonetheless), planning schools continue to offer GIS-specific subjects and the integration of GIS in other related subjects remains high. These ensure that planning graduates in the country continue to get exposure to GIS, at least into the foreseeable future. In turn, it helps to retain the critical mass needed to support continued use of GIS in Malaysian planning.

FUTURE RESEARCH DIRECTIONS IN GIS APPLICATION IN MALAYSIAN STATUTORY DEVELOPMENT PLAN SYSTEM

Recent developments indicate that the use of GIS in Malaysian statutory development plan system will continue to flourish. Two areas of great opportunity lie in the integration of GIS with decision support systems in the process of development plan preparation and the development of GIS-based systems for monitoring development plan implementation.

Within the past few years, efforts to institutionalise decision support systems into Malaysian planning have been on-going (Abdullah, Abdullah, & Ibrahim, 2009). Experimental projects in which GIS was coupled with decision support systems in order to provide better decision making during the development plan preparation process were undertaken. Whether those projects have added value to the plan preparation process is, however, unclear at the moment. Presently, it seems that there is lack of research on this issue. Nevertheless, those projects had contributed towards creating among Malaysian planners on the integration of GIS with decision support systems and had laid the foundation for further application of GIS and decision support systems. FDTCP is also working on a guideline on decision support systems implementation in the development plan preparation process at the moment. How this guideline will turn out remains to be seen.

Recently, the development plan monitoring is getting increasing attention from planning authorities. FDTCP is currently working to develop a GIS-based development plan monitoring model (Nor Salehi Kassim, personal communication, November 4, 2008). There are also efforts to develop GIS-based systems for development

plan monitoring at other planning authorities. For instance, Selangor DTCP will begin developing their own GIS-based systems soon and Kuala Lumpur City Hall is also looking into the idea of having GIS-based systems to help them monitor their local plan.

CONCLUSION

Looking at GIS implementation in Malaysian statutory development plan system, one can identify several common problems in relation to GIS implementation in planning worldwide.

These are:

- The use of GIS is largely limited to basic functions.
- The implementation failure is due to organisational factors rather than technical.
- Data availability limits the success of GIS-based information systems.

The implementation of GIS in Malaysian development plan preparation process faces several persistent problems. For instance, advanced GIS applications in the preparation of development plans are still underutilized. Despite increased GIS awareness among planners, GIS application in the development plan preparation process continues to be rudimentary in nature. This is most likely caused by insufficient GIS knowledge among senior planning consultants who are involved in the plan preparation. To mitigate the problem, in the short term, it may be necessary for FDTCP to produce a guideline that details out the types of GIS analyses required in the plan preparation process. At present, the same measure is already undertaken by FDTCP in order to promote the use of planning analyses in development plan preparation process. In its Manual for Preparation of Structure Plan, FDTCP has identified a list of required planning analyses that need to be undertaken during the state structure plan preparation process. These analyses include, for example, consistency analysis between plans' objectives and policies, policy impact analysis, land requirement analysis and cost benefit analysis (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia, 2007). Similar approach may be taken by FDTCP for GIS analyses.

In the long run, the number of GIS analyses used in the development plan preparation may increase as younger planners with GIS technical know-how become planning consultants in the future. Since GIS is relatively new in Malaysia, so are GIS courses at planning schools in the country. While the senior planners may not have the opportunity to learn GIS during their university days, younger planners have had formal GIS training at university.

Many researchers point out that strong organisational support is important to ensure successful GIS implementation (Abdullah, A. et al., 2002; Innes & Simpson, 1993; Ramasubramanian, 1999). Thus, relevant parties must continue the drive towards advanced application of GIS in statutory development plan system. More GIS research should be encouraged to discover the areas in which advanced GIS application can add value to the development plan preparation process, and funds must be made available for such research.

The need for strong organisational support is more visible in the case of GIS-based information systems implementation. EIS for development plan could prove useful for planning authorities in implementing the policies and proposals of their development plans, and as a medium to convey planning information to the general public. However, its implementation, especially at local authority level, is plagued by the problem of inadequate financial and personnel resources. Although FDTCP has been funding the development cost of EIS, it is one-off in nature and this proved to be insufficient. As Alias Abdullah, Muhammad Faris Abdullah & Fauzan Nordin

(2003) point out, information system like EIS is a 'living' system and thus:

...require maintenance and system capacity building from time to time. Accordingly, sufficient funding must be made available. Funding is required for manpower to operate and maintain the system, and for capacity building, which include hardware and software upgrades as well as the overall improvement of the system. (p. 79)

For planning authorities that face financial restriction in maintaining their EIS, regular funding from FDTCP may be necessary to subsidise part of the maintenance cost. Additionally, the planning authorities must be committed to EIS and not use the subsidy for other purposes, except for maintaining the EIS.

The effort to utilize GIS in monitoring the implementation of development plan has been severely hampered by the problem of data unavailability. This is hardly surprising because researchers have found that data unavailability continues to be one of the most prominent factors that limit successful GIS implementation in planning (Gilfoyle & Wong, 1998; Mennecke & West, 2001). Therefore, to overcome this problem, solutions have to be focused towards ensuring data availability. Very often data available are generally inaccurate and incomplete, but these are also the best available data (Klosterman & Abdullah, A., 2008). Thus, it is important that any GIS-based systems for monitoring development plan implementation do not require extensive data sets that are difficult to obtain in order for it to work. The system must also be flexible enough to accommodate the best available data.

Another interesting development pertaining to GIS implementation in Malaysian statutory development plan preparation process is the effort to institutionalise decision support systems in the process. These efforts are welcomed but it has to be implemented with care. For planners who are unfamiliar with, or have little knowledge of, decision support systems, it could be a daunting task to apply it in their work. If its implementation is rushed, it would only lead to planners finding it too difficult and consequently losing interest to continue to use decision support systems. Researchers have suggested that one of the important characteristics of successful technological implementation is that it must allow for incremental and small trials (Innes & Simpson, 1993; Ramasubramanian, 1999). Planners must be exposed slowly to decision support systems. The decision support technology and models adopted must be able to sustain planners' interest in the system and relevant to the planning tasks. We must not adopt complex models which are only of pedagogic value but not useful for plan making purposes (Batty, 2004).

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KEY TERMS AND DEFINITIONS

Decision Support Systems: Computerized systems that can be used to help users in making decision over complex and ill-structured problems.

Development Plan: A plan which is usually prepared by planners to guide or promote development in an area. It usually contains maps of the area, and planning policies and proposals for the area.

Executive Information Systems: Computerized systems that are developed to provide important information in a concise manner to senior executives. This information can be used by the executives in making decision over a business problem.

Federal Department of Town and Country Planning: Is the planning authority at the Federal level that is responsible in charting the general direction of planning and development for the nation. Its functions also include promoting town and country planning in Malaysia and providing advisory services to the Federal Government and planning authorities at State and Local levels. It also provides technical and monetary supports to State and Local level planning authorities in the preparation of their development plans.

Geographical Information Systems (GIS): Computerized systems that can be used to store, analyze and display spatially-referenced data.

GIS-Based Systems: Computerized systems which are developed using GIS software as the platform.

Local Planning Authority: Local planning authority of an area is usually the local authority of the area, such as city hall, the municipal council or the district council. It is responsible in regulating, controlling and determining the planning and development direction of its area.

State Department of Town and Country Planning: Each state in the Peninsular Malaysia has its own Town and Country Planning Department which oversees the planning and development matters within the State boundary and provides advisory services to the State government. State Town and Country Planning Department also acts as local planning authority, handling development control affairs for areas within the

state, which are not under the jurisdiction of any local authority.

Statutory Development Plan: Development plan which preparation is required by law.

ENDNOTES

[1] States in East Malaysia (e.g., Sabah and Sarawak), and the three Federal Territories (e.g., Kuala Lumpur, Putrajaya and Labuan) in Malaysia are not bounded by the Town and Country Planning Act 1976. They, however, have their own planning acts which are almost similar to the Act.

[2] Charting is a process where information about planning applications is 'drawn' onto standard cadastral map. Traditionally, this was done by hand where draughtsman would draw on the map the boundary of land parcel where planning applications were submitted, as well as other basic information about the applications. Many planning authorities have now replaced their manual charting with GIS.