A review on Geographical Information System (GIS) in Town Planning: Malaysia Experience

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Abstract

Development growth in most developing countries has become one of the issues, as rapid planning process can no longer be controlled. Planning process is a widely accepted way to handle complex problems of resource allocation and decision making. Apparently, the planning system has an important role in managing and controlling the development trends. In Malaysia, to control, monitor and planning systematically town, the method used is development plan preparation method and urban development monitoring and the blue print method. However, the process has changed and planning process have to faced with complex town problems due to rapid development of the country. The rapid town development due to increasing population and economic growth have to faced an uncontrolled planning process and takes a long time to complete the process. Hence, to overcome the town planning problem by implementation Geographical Information System [GIS] as the main tool in plan making operations. GIS is able to support the town planning process in capable of input, storage, manipulation, analysis of data useful in planning, decision making and implementation. It is a powerful tool which helps the user to view the different scenarios so that the best strategy may be choosen for planning development. The use of GIS in town planning can develop database for the both data which attribute and spatial data. From that, it can generate planning needs analysis according to the Town and Country Planning Department. Therefore, this paper discusses the use of GIS in town planning. This paper will also highlight on how GIS is applied for town planning process in Malaysia level. The findings showed the implementation of GIS in town planning can improve the result based on quality of town planning process, saving time and costs and data can be obtained faster.

Keywords: Geographical Information System, town planning, planning process, Malaysia.

1. INTRODUCTION

Nowadays, technology development provides an opportunity for the planning authority and the city administration to develop a rapid city. Planning and urban management has been introduced in Malaysia for a long time, mostly using the method of preparation and monitoring of development plans and town development of the 'blue print' in which this method to do the mapping in the drawing. This method used to analyse potential and development problems, produce development plan and review the town background [1,2].

However, this method makes it difficult to monitor the process of uncontrolled town planning. In addition, according to Milad Bagheri et al. al. [2006], the method is difficult to monitor the implementation of the development process too much [3]. According to Yusoff et al. al. [2010], method used previously taken long time to be resolved and also have planning process stages

and complicated [4]. Thus, the ability of Geographical Information System [GIS] used to solve the problem of attribute data processing and spatial data simultaneously. Then GIS is a suitable technology tools to solve problems of town planning [5]. Hence, objective this paper will enlighten the need for GIS in town planning process based on Malaysia experience.

This paper has divided into six parts. First part is introduction on background problems in town planning process. On the other hand, part two focused the explaination in the Geographical Information System. This part will discused GIS in general and implementation GIS in Malaysia. Besides that, section three in this paper focus on the town planning in Malaysia. After that part four concentrate on the outcome of the study in usage GIS on town planning from the previous researchers. Last part in this paper will discussed overall conclusion that achieved from the research results.

2. GEOGRAPHICAL INFORMATION SYSTEM

Geographical Information System [GIS] is a computer system capable of capturing, storing, checking, integrating, manipulating, analyzing and displaying data in digital form related to the position of the earth surface [6.7]. GIS development has grown in line with the rapid development of technology during the past decades have expressed specific challenges in storage and spatial data analysts [9]. It also functions as an important tool in the process of problem solving and decision making [10].

Geographical Information System is a digital map-based technologies that rely on database management system that can be used to display and information, spatial analysis and produce results in the selection process [11]. Fundamentally, a GIS is able to support all the stages of spatial data processing including manual digitizing, checking and editing of digitized data and output of information to graphics devices. Besides that, GIS technology has long been applied in planning activities, which essentially include plans formulation as well as development control [36]. Figure 1 list five categories of GIS component which are people, data, software, hardware and methods [39, 40].

GIS has been put into practice by many countries which China used GIS for disaster monitoring and proven to be very effective. It is also used to track the effect of town development on agricultural area. While Singapore is another example which has promoted the use of information technology in business by using the Integrated Land Use System. Besides that, in Culcutta used GIS as a tool for preparing development plan including the framework of future land use. Another example includes the application of GIS in tourism planning in Canada studying the environmental impact of tourism on fragile reefs in the Cayman Islands [37].

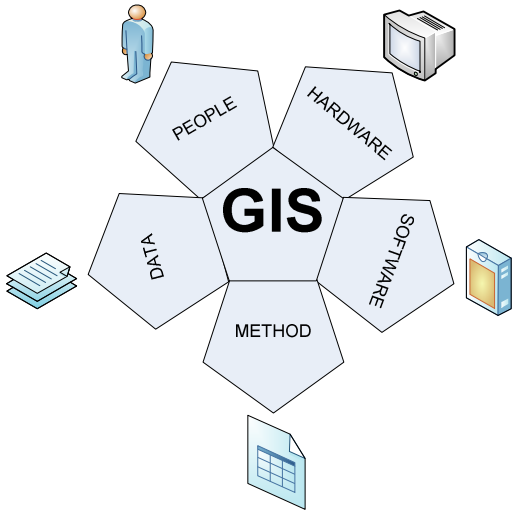

FIGURE 1: Component of Geographical Information System

2.1 Application of Geographical Information System

Information technology has helped expand the use of GIS in city planning in Malaysia. History of the use of GIS started in 1960s. GIS technology at the time, it can be a planning tool for its ability to handle the processing of spatial data and attribute data simultaneously. However, the GIS must be combined with other information systems to enhance the capacity and role in the various fields [8.13]. In Malaysia, the history of GIS began in the 1980s through the digital cadastral database [DCDB] and the National Topographic Database developed by the Department of Survey and Mapping [19]. GIS is widely used in various fields such as urban planning, education, and agriculture [14].

1) GIS in Education
   According to the Lateh et al. [2011] in a study of the challenges and potential applications of GIS in geography education in Malaysia, noted that to this day teaching and learning methods [P & P] still practice delivery methods using oral and written facts on a blackboard. Through this traditional method, students do not fully master the basic skills such as locating the state, drawing and reading map coordinates. However, GIS has the potential applied to the R & D because it provides an attractive environment and further develop students creative thinking, critical and innovative [14].

2) GIS in Town Planning
   The study by Yaakup et al. [2004] that applies geographical information system to improve the planning system of Negeri Smbilan authorities, especially in monitoring the development in the area of jurisdiction. Negeri Sembilan geographical information system [GIS9] includes the development of the database. In addition, it is also used to analyze each planning decision by showing the consequences of such an action is taken on an area and can anticipate the effects of development occurring in the future [10, 15].

   In another study by Samat [2006] which focuses on the use of geographical information systems area management in Malaysia. In his studies, he said that Malaysia is a country that has experienced rapid development of the use of the area to achieve progress. To solve the problem of uncontrolled use of the area, urban and regional departments responsible for planning, forecasting and conduct research with the aid of GIS use. GIS to produce information and it is a mechanism used to implement the planning function involving the daily administrative management operations. In addition, its platform to plan for economic growth and impact on society and the environment [1].

In another study by Zaini [2007] who apply GIS in preserving the historical heritage buildings in Taiping, Perak. Any development carried out cannot change the identity of the historic buildings that have become hallmarks of pride in Taiping. GIS is used for this system's ability to manipulate data. In addition, GIS is also capable of efficiently generating a variety of scenarios required by the authorities in controlling the development of Taiping [17].

3) GIS in Medicine
In medicine, the application of GIS has been applied in the study of dengue fever in Bandar Baru Bangi and Kajang by Shaharudin et al [2002]. GIS functions in this study are in mapping the distribution of health facilities and dengue disease in the affected areas. In addition, GIS services are also applied in the health care database for the study area [9].

4) GIS in Geogology
GIS applications have also been used in a study conducted by Manap et al. [2009]. In this study, the interactive display capability of geographical information systems for geological assessment in the Klang Valley, Malaysia. 1:10 000 scale topographic maps used to generate digital elevation models stored in the geological map of elevation models digital to produce 3D-shaped display. Interpretation issued by the DEM information made by using technological capabilities of geographical information systems software in the form of 3D. Results from this study states the results produced through the use of digital elevation models in the application in geology [18].

5) GIS in Crime
The study by Suryavanshi [2001] stated that GIS has emerged as a powerful analysis tool to support the decision-making process involved in crime prevention. Besides that, GIS also as a tool to support analysis of information as a means for understanding the relationships of variables affecting the link between land use and opportunities for crime. GIS allows integration of crime information systems with spatial data and assist in the production of accurate and high quality maps that clearly show the locations of different kinds of crimes as crime-spots [34]. Example of technology GIS in criminal is the Safe City Monitoring System used for prevention of crime.

6) GIS in Remote Sensing
Remote Sensing techniques are useful for selection of sites for specific facilities such as school, industry, hospital, restaurants and solid waste disposal. Remote sensing also can provide an important source of data for urban land use/land cover mapping and environmental monitoring. Platforms used to acquire remote sensing data such as aircraft and satellite [39].

2.2 Development of Geographical Information System in Malaysia

At the national level, GIS is used mainly for land suitability analysis, data compilationand generate suitability maps. GIS systems enable data from wide variety of sources and data formats to be integrated together in a common scheme of geographical referencing thus providing up-to-date information. Thus, GIS applied to a wide range of land management and land use planning issues including the interpretation and formulation of land use policy [38].

In general, there is the role of geographical information systems produce accurate information in an efficient analysis. The second role is to predict the results of GIS analysis in the future and the third role is to facilitate and expedite the administration in analyzing the problem. In general, Figure 2 shows the development of Geographical Information Systems in various sectors of the field [5, 15-16, 18, 21-22, 24-30, 32-33]. However, this study only focuses on the application of geographical information systems in town development in Malaysia.

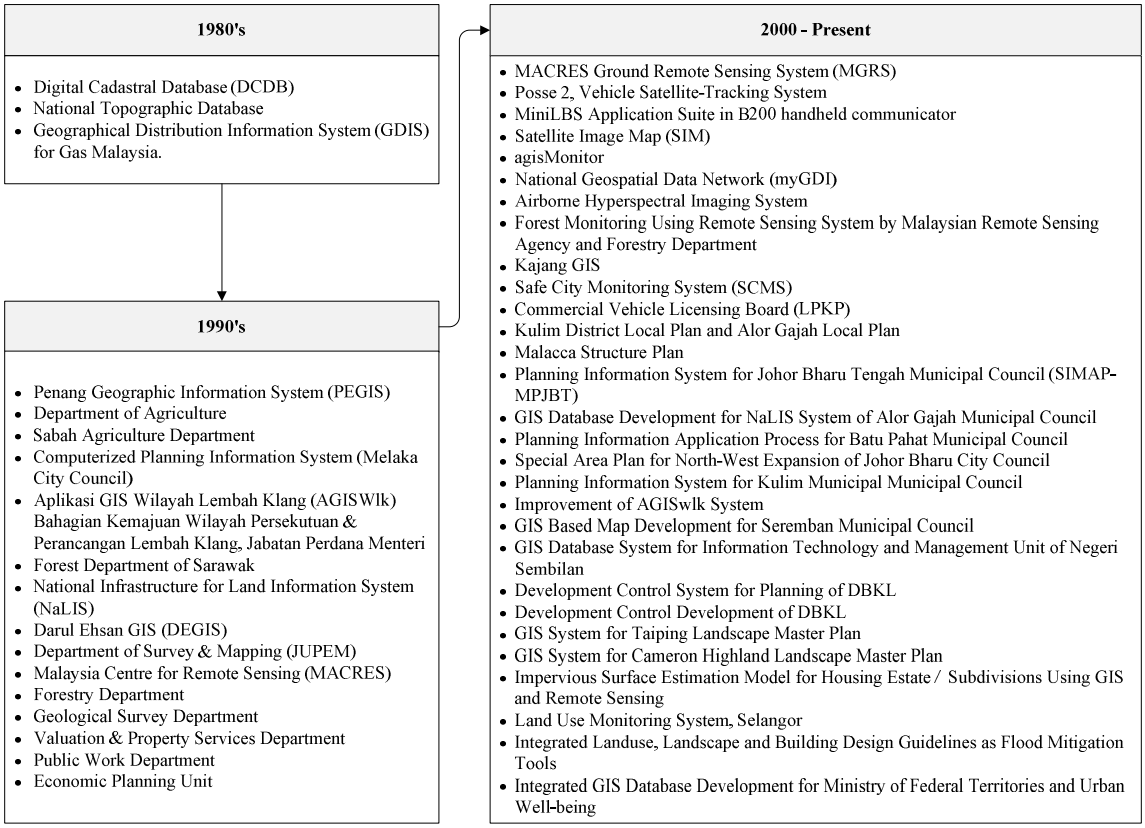

FIGURE 2: Development of Geographical Information System from 1980-Present.

3. TOWN PLANNING IN MALAYSIA

Planning in the context of town planning process can be defined as physical performance related to map drawing [1]. Urban planning is the process of arranging an area based on the plans provided as well as control over the development process [2]. Those responsible the duties of this town is the Town and Country Planning Department [TCPD]. The following is a description of the role of Town and Country Planning Department [TCPD] in Malaysia.

3.1 The Role of Town Planning Department of The Land Use Planning and Control

Town planning in Malaysia started in 1929 by Charles Reade who is a person responsible for improving the development of Kuala Lumpur [1]. At present, town planning and monitoring under the responsibility of the Town and Country Planning Department. DTCP is responsible for ensuring that development planning, land use and preservation. There are three levels of exercise DTCP functions of a] the federal role was to advise the Federal Government on the issue of land development; b] the state as a state adviser on land planning; c] the local level governing the use of land and buildings in the area Local Authorities [20].

There are some areas in the Town and Country Planning Division of Management Services, Corporate Plan, the National Physical Development Plan, Regional Planning, Legal and Regulatory Planning, Legal Unit, the National Land Use Information, Internal Audit Unit and the Division of Research and Development. Division of Land Use Information [BMGN] seeks to manage the planning data of interest used in the development of national land use. One function is to coordinate advice BMGN in the field of Geographical Information System [GIS] [20]. According Samat [2006], town planning is important to achieve efficient use of land, infrastructure and urban environmental quality by using GIS technology to enhance the quality of town planning. Good urban planning aims to achieve a more orderly placement [1].

3.2 Use of Geographical Information System in Town Planning in Malaysia

Use of Geographical Information Systems in the field of urban planning has shown a good level of development, for example a] AGISwlk of GIS for Klang Valley Region b] GIS9 which is the Negeri Sembilan planning system which acts as a manual system to monitor the structure plan document and c] PEGIS which is an application of GIS to Penang played a key role in providing information to the Economic Planning Unit of Penang. [21-29].

The integration of Geographical Information System has provided a tool which can contribute to much clearer understanding of real planning problems as well as prescriptive planning scenarios to enhance the quality of urban planning and management. GIS provide the ability to store and display maps and associated information from the various sources [37]. On the whole course of the Geographical Information System is described in detail by the flow of the framework in Figure 3 [8].

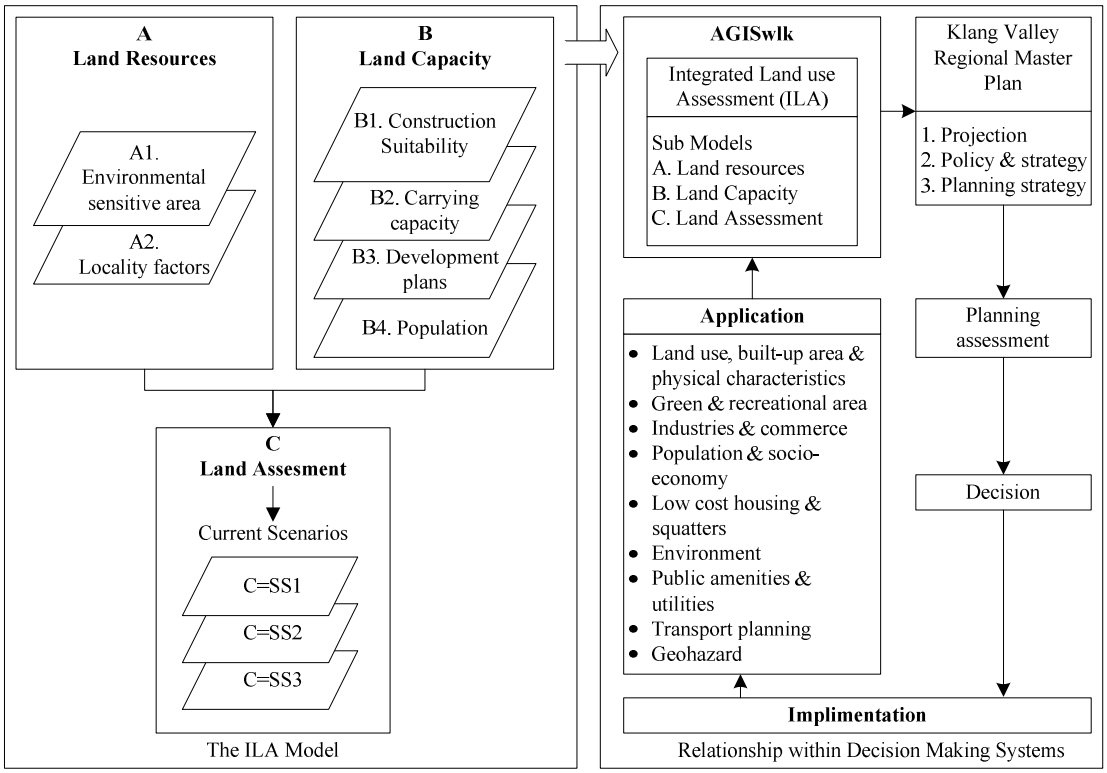

FIGURE 3: Integrated Land Use Assessment of Klang Valley.
Source: A. Yaakup *et al.* [2005]

GIS approach can store and analyze information to assist in making decisions related to urban planning. Therefore, the information required in this application consists of spatial and attribute data for each plot of land, land acquisition and infrastructure. GIS has long been accepted as the appropriate solution to address spatially referenced data. According Yaakup et. al. [1994], Table 1 shows the main areas of application of Geographical Information System [15].

Field	Usage of GIS
Property	• Urban development • Control land use
Facility Management	• Pipe location and underground cable • Utility planning coordination

Field	Usage of GIS
	• Telecommunication network service • Energy consumption planning • Building site selection
Environmental Management	• Waste management • Disaster management • Analysis of environmentally sensitive areas • Study the suitability of crops, forest management, agricultural land, water resources, wetlands
Road Network	• Vehicle navigation • Home and road location • Site assessment • Ambulance service • Transport planning
Design and Engineering	• Development strategy • Population growth and migration • Availability of land for development • Highway route location • Utilities development
Land Information System	• Cadastral administration • Tax • Land use zoning • Use of space information such as water, air and soil • Reclaimation of land

TABLE 1: Main Areas in Town Planning that Apply GIS.

4. RESEARCH STUDIES ON USAGE GIS IN TOWN PLANNING

Research study proving the Geographical Information System was developed in Malaysia and applied in the field of town planning in Malaysia. Each Geographical Information System development in Malaysia in specific on town planning field as a whole reviewed the results of the studies made by previous researchers. Table 2 shows the previous research that applies GIS in town planning in Malaysia. This table discusses the types of use of GIS in town planning and the problems that faced by applying GIS. In addition, this study focuses on the development of data and results from the use of GIS.

Researchers	Problems	Type of Data	Results
Yaakup et al. [30]	• Difficulties in planning and development at the state level. • Use of the 'blue print' where the mapping is done using the drawings. • No monitoring system planning. • No development of urban planning database.	• Social and economic • Land Infromation • Physically • Utility • Traffic and transportation • Land Use • Environment • Geopolitics • Public facilities • Administration • Population	• Geospatial data storage efficient and uniform format. • Facilitate the update and evaluation of information. • Geospatial information easily produced, analyzed and displayed. • Geospatial information can be shared with other departments. • Saves time and cost because there is no repetition of the process data. • Improve the results of the development and approval.
Ibrahim et al. [12]	• The existence of squatters in a dense population in urban areas. • Difficulty in determining the site of government	• Basic map • Utility • Population • Public facilities • Land information • Environment	• Assist the Johor Bahru City Council to develop squatter resettlement program more regularly.

Researchers	Problems	Type of Data	Results
	for the resettlement of squatters.	• Transportation	
Yaakup et al. [22]	• Difficulty in interpreting the data analyzed for urban planning.	• Use land • Physical • Environment • Public facilities • Land information • Geopolitic • Population • Basic map • Transportation	• Provide an interactive display of data using GIS. • Provide facilities to update easily.
Johar et al. [16]	• Urban planning process takes a long time.	• Basic map • Public facilities • Utility • Hydrographic • Transportation • Social and economic • Physical • Land information	• City planning data can be obtained quickly and accurately. • Easily to monitor progress of work and increase productivity.
Shamsudin and Musa [26]	• Improve the quality and data analysis.	• Basic map • Environment • Population • Social and economic • Utility • Physical • Transportation • Public facilities • Land information	• Increase the validity of the design criteria and output
Yaakup et al. [29]	• Difficult to monitor urban planning that is too fast to grow. • Difficult to control the process of urban planning that many and complex.	• Basic map • Use land • Physical • Population • Social and economic • Environment • Public facilities • Utility • Transportation	• Provide a technology tool that can give an insight in the actual planning concept. • Improve the quality of urban planning and management.
Kassim et al. [15]	• No planning system that facilitates monitoring of the planning process. administration. • No comprehensive geospatial database.	• Use land • Physical • Environment • Basic map • Transportation • Social-economy • Land information • Geopolitic • Population • Public facilities	• Standardize format is coordinated with the Department of Town and Country Planning. • The results obtained are more accurate in the development process and planning • Reduce the cost and time wastage. • There will be no repetition of the process in data development.
Zaini dan Nor [28]	• High crime rates occur in the scene and within the same time.	• Criminal record • Map address • Basic map • Public facilities • Land information • Population	• Able to handle criminal cases. • Able to identify areas of crime. • Sharing data with other relevant organizations.
Kassim [37]	• The main tools used in	• Use land	• Change the previous tools with

Researchers	Problems	Type of Data	Results
	every planning are drawing boards and T-squares are kept in paper files and missing without notice. • Planning has have to faced with town problems due to rapid development of the country.	• Environment • Land information • Basic map	the computer networking using GIS application. • Develop a systematic databases on landuses. • Monitoring tool evaluating landuse changes.
Yaakup et al. [36]	• Uncontrolled planning would produce negative consequences to the physical, social and natural environment. • Planning has have to faced with town problems due to rapid development of the country.	• Use land • Environment • Land information • Basic map • Physical • Social • Environment	• GIS becomes imperatives for better and improved decision making in town planning and management.

TABLE 2: The Previous Research that Applies GIS in Town Planning in Malaysia

5. DISCUSSION

Nows, land use have changes rapidly due to economic growth, increasing industrialization process and population. The effects from this issues has increased the usage of land use and will pressure on land and environment in big cities. With GIS, it become the main tools in planning, monitoring and analyzing of land use because GIS data can easily stored, retrieved and updated by listing the data type that use based on problem [34[. Landuse planning is very much dependent on its strength and contents in storing information which are analytical in function and well integrated.

According to Yaakup et al. [2006] stated that in their research the issues in town planning are difficult to plan and develop at the state level. The previous method used in town planning is blue print which the mapping is done using the manual drawings. The others problems that the paper highlights are no monitoring system planning and no development for town planning database. To overcome the solution, geospatial data storage efficient and uniform format has been implemented. Geospatial information can be shared with others department and easily to analyze and display the information.

The other researcher stated by Kassim et al. [2011] enlighten that no planning system that facilitates monitoring of the planning process administration. Due to the problems, no comprehensive geospatial database has been provided. So, GIS technology used to standardize the format with the department of town and country planning. Using this technology, the result obtained is more accurate in the town planning process. Hence, it can reduce the cost and time wastage which no repetition data in the flow process.

Kassim stated that •the main problems in town planning is the tool that used to plan the planning activity. The main tools used in every planning are drawing boards and T-squares are kept in paper files and missing without notice. It is because planning has have to faced with town problems due to rapid development of the country. Thus, to solve the problem, the come out with the idea to change the previous tools with the computer networking using GIS application. Besides that, develop a systematic databases on landuses for monitoring the data that used in planning activity.

6. CONCLUSION

Geographical Information System has been proven to be invaluable tool for evaluating alternative solutions to town planning problems. Planning database can be extensively to generate several alternative solutions to town planning problems. The use of GIS in town planning is an alternative to get better results and effectively. Apparently, GIS become imperatives for better and improved decision making in town planning process. The introduction of GIS has been helpful in transforming the challenges of land use planning into a more analytical and informative system.

7. ACKNOWLEDGMENT

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