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A Review on Application of Geographical Information System in Town Planning in Malaysia

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***Abstract*—** In line with advances in information technology, urban and regional planning area has been through several eras of change according to their needs and interests. Technology has evolved from the use of blue print to the implementation of Geographical Information System (GIS). The frequent problem faced is the difficulty to control, monitor or manage town planning in Malaysia. To overcome the problem, GIS application is used because of its ability to support the town planning process. This paper discusses the application of GIS in solving the problem faced in town planning. The results of this study found that the analysis performed from the results of GIS applications are the preparation of shaped spatial statistics and reports, digital information of map search and management of geographic information. This paper highlights the applications of GIS in town planning in Malaysia. It will focus on GIS applications by local government authorities and discuss the future direction in town planning in Malaysia.

Keywords: geographical information system, town planning, application

1. INTRODUCTION

In the last decade, Geographical Information System (GIS) has become an important and significant growth in the field of information technology worldwide [1]. This growth includes a GIS software, data and services [2]. In addition, the rapid development experienced by the urban community has come under pressure by socially and economically, and this has increased the difficulties in town planning and management [3]. In improving the efficiency of development control system, regularly updated planning data are needed by planner as the basis for decisions that are made in approving the planning application. Based on that, a computerized system known as the Development Control System is designed to help accelerate and simplify the staff duties, particularly in the Town Planning Department whose involve in the processing of applications for planning permission [4]. The idea of town planning in Malaysia was derived from the concept plan that was introduced in the United Kingdom in which planning is defined as a process of human forethought and action based upon that forethought [5].

Since the idea of town planning was introduced in Malaysia, the method of development preparation plans and monitoring of town development more the process of research and background study area, analyze the potential and problems of development and produce development plans that will reflect the expected period [6]. It is based on planning theory has received a systems approach to continuous and reciprocal process and is based on the identification of needs and goals, the formulation and evaluation of actions and monitoring the program that has been determined [7]. In Malaysia, the use of GIS in town planning regional development control around the year 1990 is expected to increase rationality in the process of generating better planning decisions. However, the success of GIS implementation planning and monitoring of urban and regional development strategy depends on the database preparation, analysis and display of GIS data space for planning and spatial development. Among the strategies is the determination of GIS, database development, model analysis and development of computer hardware, software and human resources [8].

Other issue in using GIS in urban planning is personnel who might be responsible for using GIS for updating land use map and evaluating strategic plan [6]. From the study, this approach requires a strong information system that can generate the development of proposal and evaluate the scenario alternatives that produced today. Besides that, this paper discusses on the functions of software applications as the result of this study. This paper attempts to explain the use of geographical information system in the development plans implementation and monitoring urban development based on Malaysian experience.

A. Geographical Information System

Geographical Information System is a computer system to capture, store, review, integrate, manipulate, analyze and present all types of geographically referenced data [9, 10]. GIS can be divided into three parts of definition, a computer-based, dynamic mapping system with spatial data processing, and the ability to query. Clearly, GIS is a computer technology and a dynamic system controlled by human. The system allows us to organize and view the map, change the colors, symbols, and labels, zoom the map to get detailed information, change the layer map, and obtain data that was recorded. Users of the system can put the dots on the map from scratch and be able to perform data query [11].

GIS is a computer-based technologies and methodologies for collecting, managing, analyzing, modeling and displaying geographic data. The system consists of databases, map information and functions to view, and interpret data in various ways such reports and charts [12, 13, 14, 15, 16]. GIS is an effective planning technique that gives an advantage to produce maps, present future idea, integrate information and develop valuable solutions associated with geographic components [17]. Figure 1 list five categories of GIS component which are people, data, software, hardware and methods [18, 19].

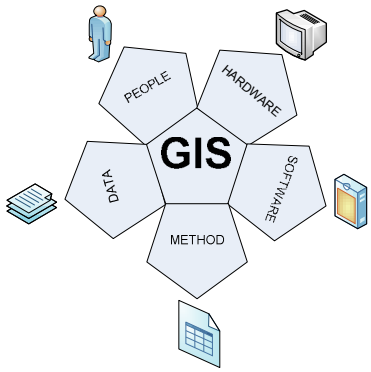

FIGURE 1: Component of Geographical Information System

GIS technology can be used in scientific investigations, resource management, planning development, environmental protection, disaster monitoring and field of national defense [20, 21, 22]. History of GIS in Malaysia showed gradually progress began in the 1980s [23]. To date, there are a variety of Geographical Information System which was established in Malaysia such as Kajang GIS, an open source system that can be accessed by people who want to know about EIS Web, land searching field, GIS open spaces module, Kajang Municipal Council crime module and Residents Representative Council module [24].

B. Town Planning in Malaysia

Urban land use is a dynamic phenomenon, varies with space and time. Comprehensive planning is important to ensure that new urban development does not generate negative effects on the economy, society and environment [25, 26]. Table 1 shows the urbanization level of the states from 1980 until 2010 which is divided into three types including the number and percentage of population distribution and average population growth rate of Malaysian [27].

TABLE 1: Distribution and Average Population Growth Rate Based on States, 1980-2010

State	Population				Percent				Average annual population growth rate (%)		
	1980s	1991s	2000s	2010	1980s	1991s	2000s	2010	1980-1991	1991-2000	2000-2010
Malaysia	13,136,109	17,563,420	22,198,276	27,565,821	100.00	100.00	100.00	100.00	2.64	2.60	2.17
Johor	1,580,423	2,069,740	2,584,997	3,233,434	12.03	11.78	11.65	11.73	2.45	2.47	2.24
Melaka	446,769	506,321	605,239	788,706	3.40	2.88	2.73	2.86	1.14	1.98	2.65
Negeri Sembilan	551,442	692,897	829,774	997,071	4.20	3.95	3.74	3.62	2.08	2.00	1.84

Melaka	446,769	506,321	605,239	788,706	3.40	2.88	2.73	2.86	1.14	1.98	2.65
Negeri Sembilan	551,442	692,897	829,774	997,071	4.20	3.95	3.74	3.62	2.08	2.00	1.84
Selangor	1,426,250	2,291,429	3,941,316	5,411,324	10.86	13.05	17.76	19.63	4.31	6.03	3.17
W.P. Kuala Lumpur	919,610	1,145,342	1,305,792	1,627,172	7.00	6.52	5.88	5.90	2.00	1.46	2.20
W. P. Putrajaya	(b)	5,730	11,501	67,964	(b)	0.03	0.05	0.25	(b)	7.74	17.77
Pahang	768,801	1,045,003	1,229,104	1,443,365	5.85	5.95	5.54	5.24	2.79	1.80	1.61
Perak	1,743,655	1,877,471	1,973,368	2,258,428	13.27	10.69	8.89	8.19	0.67	0.55	1.35
Pulau Pinang	900,772	1,064,166	1,231,209	1,520,143	6.86	6.06	5.55	5.51	1.52	1.62	2.11
Kedah	1,077,815	1,302,241	1,571,077	1,890,098	8.20	7.41	7.08	6.86	1.72	2.09	1.85
Perlis	144,782	183,824	198,288	227,025	1.10	1.05	0.89	0.82	2.17	0.84	1.35
Kelantan	859,270	1,181,315	1,287,367	1,459,994	6.54	6.73	5.80	5.30	2.89	0.96	1.26
Terengganu	525,255	766,244	880,234	1,015,776	4.00	4.36	3.97	3.68	3.43	1.54	1.43
Sabah	929,299	1,734,685	2,468,246	3,120,040	7.07	9.88	11.12	11.32	5.67	3.92	2.34
Sarawak	1,235,553	1,642,771	2,009,893	2.420,009	9.41	9.35	9.05	8.78	2.59	2.24	1.86
W.P. Labuan	26,413	54,241	70,871	85,272	0.20	0.31	0.32	0.31	6.54	2.97	1.85

Town and country planning in Malaysia have started as early as 1801 when the establishment of the Committee of Assessors in Penang. Early contribution of this committee in the planning area is the construction of roads and drains in Georgetown. Town Planning Department was established in 1921 after the appointment of Charles C. Reade as the first Town Planning Officer. In 1923, he has introduced legislation for town planning [28, 29]. At present, urban planning is under the responsibility of the Town and Country Planning Department (JPBD), Ministry of Housing and Local Government. To ensure effective planning in terms of the use, conservation and land development, JPBD play a role through the three levels which are federal, state and local governments. There are three main parts of JPBD which includes a) Development Plan covering the National Physical Plan Division, Regional Planning Division and Development Planning Division; b) Management consisting of Division of Management Services, Corporate Division, Internal Audit Unit, Law Unit and Town and Country Planning Department of State c) Research and Development that control Research and Development Division, Legal and Planning Regulatory Division and Division of National Land Use Information [30].

Town planning task involved the integration of geographic information. Duty to prepare and analyze the information can be accelerated and made easier with Geographical Information System (GIS) due to high capacity to manage spatial data, spatial analysis and visualization [31]. GIS in the field of town planning has produced many applications such as Penang GIS (PEGIS), GIS Application for Lembah Klang (AGISwlk), DBKL Development Control System and Putrajaya Urban Development Management System. GIS can help the state planning authority in connection with database development, analysis, storage of geospatial data, storing coordinates for the map location and area features [32, 33].

3. METHODOLOGY OF STUDY

This paper describe about the methodology that supposed to be related in this study. GIS has proven to be invaluable tool for evaluating alternative solutions to town planning problems especially in environmental issues. Thus, GIS technology has long been applied in planning and monitoring activities, which essentially include plans formulation as well as development control [7]. Methodology of study is describing the whole flow of research from start until the end. Figure 2 shows the flowchart of GIS application in town planning.

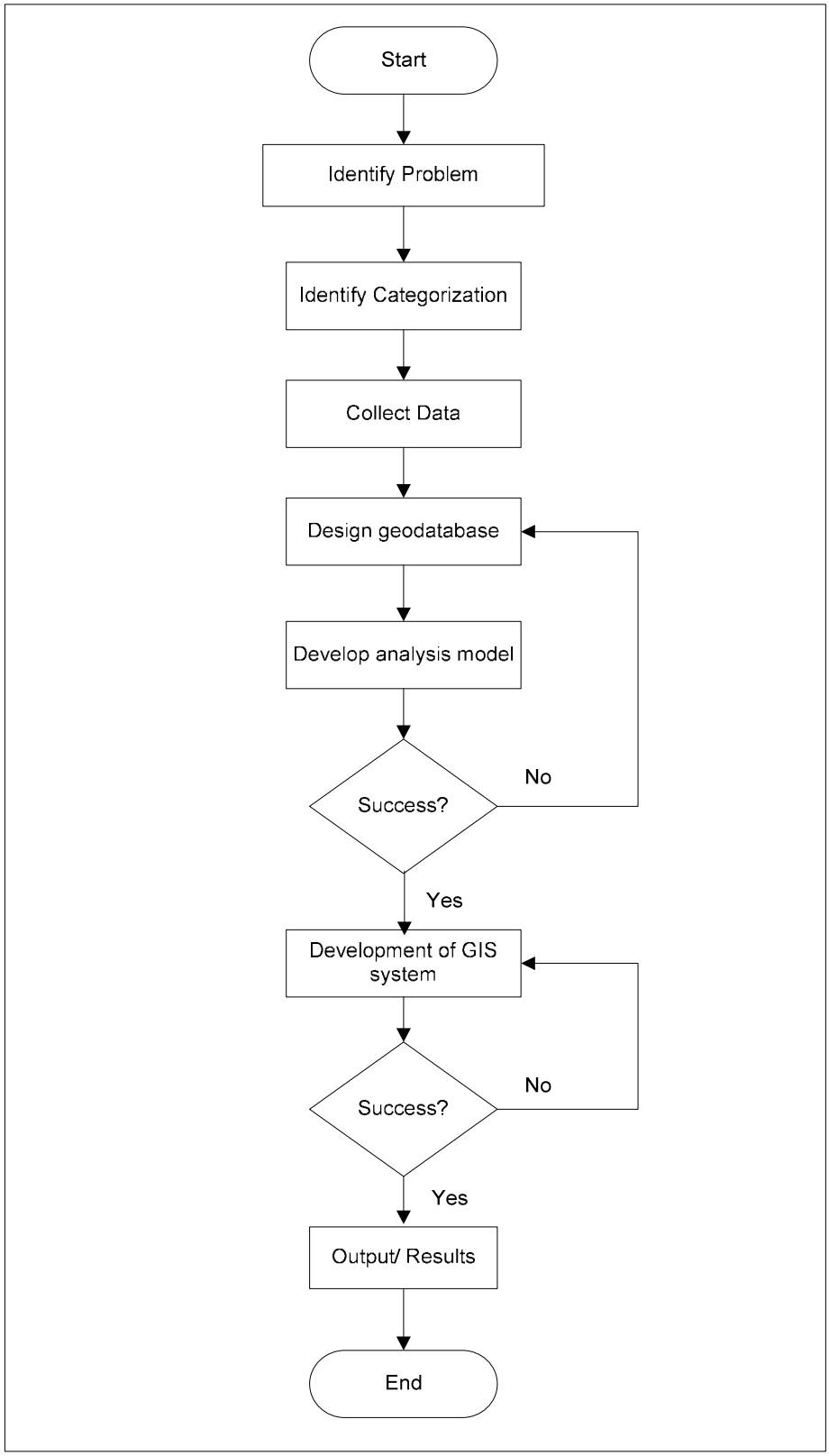

FIGURE 2: Flowchart of Study

In this paper, the problem will identify in the current situation. It aims to describe the issues and problems that related to the study. Problem in this research are the process of planning will took long time, difficult to monitor a lot of planning, no proper database, difficult to monitor security and crime rate, data collection and digitization of the same and repeated information and difficulties in coordinating the planning and development programs at district level. Based on problem that listed, the categorization will divided into two there are planning, monitoring and planning. The activities of planning and monitoring in town development are most important to ensure that the town development plan move in well [5, 6, 7, 50]. The monitoring system that has been developed for both the state and district levels make it possible to evaluate the success of plan implementation. Monitoring the implementation of development plans are crucial to ensure that activities are in line with the implementation schedule and whether the resources or implementation procedures are used effectively. Monitoring procedures enable timely action to be taken to correct the deficiencies detected. While the planning and management process involves many stages of decision-making and expertise from various fields and hence necessitates for collaboration among the parties involved. It is used to assist decision-making, taking into account among other things, the current scenarios of the proposed development, physical constraint and future impacts [8, 34, 49].

When the problem have recognize, data will collected. Data is depending on the situation of study. After collecting data, it will design database. This entire database can refer to Table 2 at feature column. Database will manipulate to describe the scenario of application town planning at state and domestic level. When database have been develop, analysis model will develop to analyze the result. Analysis GIS using spatial data and non spatial data to create analysis [60]. The main objective of creating model analysis is to answer what will happen to town planning in future and past few years [60]. With the result, we can conclude and predicting on what we should take to overcome town planning problem based on result GIS analysis. After analysis model was successfully, the application system will develop to support the result and to maintenance for future. The result will show data development, preparation spatial form statistics, preparation of reports, maps digital information searching and management of geographic information.

4. RELATED STUDY OF GIS APPLICATION IN TOWN PLANNING

This study proves GIS applications have been developed and implemented in the field of town planning in Malaysia. Results from studies performed on existing applications indicate the applications are suitable to use in town planning to address the problem occurred. Each development of Geographical Information System in town planning field in Malaysia has been studied comprehensively from the research carried. Table 2 shows the study of GIS applications in town planning in Malaysia. This table explains the categories and characteristics of GIS applications that have been developed and the results achieved after implementing the application.

TABLE 2: Existing of GIS Application in Town Planning

Researchers	Application	Category	Problems	Features	Results
[35, 36, 37, 38]	Development Control System, DBKL	Planning	• Planning process took too long • The difficulty to monitor a lot of planning	Model data: • Information Kiosk • Planning Authorization • Building Control • Documentation Processing • Enforcement • Geospatial and Planning Information • Meeting Presentation	• Save time for information processing
[39, 40]	Urban Development Management System, Putrajaya	Planning	• The difficulty to monitor a lot of planning	Model data: • Planning application subsystem that process applications from registration until approval • Applications can be submitted online	• Allow the public to submit applications through the website • The database is available for all areas
[41, 42, 43, 44]	*e-Rancang,* Kuantan	Planning	• The difficulty to monitor a lot of	Model data: • Registration	• Transparent and simple modular-

	Municipal Council		planning • There is no database that can manage large amounts of data	• Electronic charting • Technical process • Meeting management • Report and searching • Status monitoring	based system • Facilitates the developer to submit application
[45, 46, 47, 48]	Safe City Monitoring System	Monitoring and Planning	• The difficulty to monitor security in the city • Growing crime rate	Model data: • Distribution and Crime Hotspot Analysis • Timeline Analysis • Repeat Location Finder Analysis • Aoristic Analysis Correlation Analysis of Population and Crime Density • Analysis of Safe City Program Effectiveness • Potential Crime Location Analysis.	• Monitor the effectiveness of the Safe City Program measures in addressing street crime • Identify areas of existing and potential hotspots, crime patterns and the location of frequent crime • Provide information for the enforcement of crime prevention measures
[49, 50, 51]	Penang Geographic Information System (PEGIS)	Planning	• Difficulties in managing the land • Difficulties in land usage planning	Model data: • Base Map • Development Planning • Services and facilities • Economic resources • Environment	• Assist in providing information for planning and implementation of development projects • Saves time and cost of the development process
[52]	Darul Ehsan Geographic Information System (DEGIS)	Monitoring and Planning	• Difficulties in monitoring or controlling the activities of planning • Long planning process • Data collection and digitization of the same and repeated information	Model data: • Base Map • Development Planning • Services and facilities • Economic resources • Environment	• Preparation of spatial statistic • Preparation of report • Digital map information searching • Management of geographic information • Mapping • Saves cost in collecting data • Standardization of GIS data
[53, 54, 55, 56]	Negeri Sembilan Geographic Information System (GIS9)	Monitoring and Planning	• Difficulties in coordinating the planning and development programs at district level	Model data: • Base Map • Land Usage • Physical • Environment • Transportation • Public Facilities • Land Information • Geopolitics	• Develop a database that can be integrated • Provides required planning information through ongoing data collection, update and storage

				• Population • Socio-economy	
[57, 58, 59]	Klang AgisWlk, Lembah Klang	Planning	• Difficulties in planning control • Traffic congestion • Provision of housing and amenities. • Declining environmental situation.	Model data: • Base map • Tourism • Utilities • Physical Characteristics • Public Facilities • Administrative Boundary • Land usage • Population and Socio-Economy • Green and Recreational Area • Traffic and Urban Transportation • Geohazard • Environment	• To facilitates query analysis • To facilitate in monitoring the development planning • As development tools to support planning and evaluation of development policies • To develop the application and analysis based on the new database

After the analysis of the use of Geographical Information Systems, found that the field of town planning have applied this system because of its ability to solve problems. The main problem to be solved by the researcher is the difficulty in controlling, monitoring or managing town planning in Malaysia. Another problem in town planning is the planning process took too long to complete. In addition, without using database the large data is difficult to control. While rapid urban development complicates safety monitoring. Therefore, too many town planning problems had made coordination of planning and development of district or state become difficult.

To resolve these problems, GIS applications have been developed such as Development Control System, DBKL, City Development Management System, Putrajaya and Safe City Monitoring System. Thus, the application development consists of monitoring or planning categories. Therefore, the features of applications developed to support the application have data elements such as base maps, planning and development, services and facilities, utilities and economic resources. The results showed that GIS is used to solve problems involving town planning. Other than to facilitate the process of updating and assessing information, this system can save cost and time in which there is no repetition of the process data. The use of GIS system allows the public to submit applications through the website. In addition, GIS application provides the database to control large data. GIS applications also help to monitor the effectiveness of the Safe City program to tackle crime. Therefore, GIS applications have been developed to identify the existing and potential hotspots, crime patterns and the frequent crime locations. The analysis done in GIS application is the preparation of spatial-formed statistics and reports, searching of map digital information and management of geographic information.

5. CONCLUSION

In conclusion, GIS has helped to solve the problems that exist in town planning in terms of data development, preparation spatial form statistics, preparation of reports, maps digital information searching and management of geographic information. Based on analysis that has studied, we can conclude that GIS town planning can divided into two categories which are planning and planning monitoring. In general, the problem that state in town planning usually are difficulty to monitor a lot of planning, no database that can manage large amounts of data and difficulties in planning control. To overcome this problems, features GIS is using for example base map, information kiosk, report and geospatial and planning information. Results from using GIS system are, save time for information processing, the development tools to support planning, and evaluation of development policies and to develop he application and analysis based on the new database.

But, this paper has research limitation on leaking GIS town planning system in Malaysia. This is because GIS in town planning is still new in Malaysia compare to other countries. For future work, the research need to list the details of the function GIS town panning system that have been develop to save cost management and operating costs because through the application of GIS software, town planning monitoring results can be standardized and more organized and effective.

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