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Research Article

The Application of GIS Technology in the Management and Development of Ho Chi Minh City

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Abstract

Because of the fact that the population is constantly increasing year by year in Ho Chi Minh City, the population data management, technical infrastructure as well as urban planning and development are facing many difficult challenges due to the lack of technology, human resources, methods which are too outdated with paper documents or software that are no longer suitable. Around the world, in major developed countries, the application of GIS technology has gradually become an indispensable trend in the management, planning and development of urban areas into smart, modern cities because of its outstanding advantages compared to the previous methods. This article examines common features of the GIS information system, thereby proposing practical applications of this technology to assist in the management, planning and development of Ho Chi Minh City, take another leap to reach the finish line to become the smartest and most modern city in Vietnam in the near future.

Keywords: Development, GIS, modern, management, smart

1 INTRODUCTION

Vietnam from one of the poorest countries in the world suffered a lot of damage after many wars of invasion from the US and the West is now one of the most dynamic countries in the East Asia Pacific. GDP per capita increased 2.7 times, reaching over 2700 USD in 2019, with more than 45 million people out of poverty. The poverty rate fell sharply from more than 70% to less than 6% (according to statistics from the World Bank). The remarkable development of Vietnam over the past 30 years is due to the correct policies of the Party and the State on economics, politics, etc., especially for the two major pillar centers of the country are Ho Chi Minh City and Hanoi Capital. However, nowadays, Ho Chi Minh City is facing with the dilemmas of a large city whose population is growing too fast due to the flow of migration from rural areas to living and settling. Accompanying the rapid growth of the population is the challenge of demographic management, pressure in planning, urban technical infrastructure development and a great obstacle to advancement to a modern, smart city.

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The GIS is a tool that can assist in the management and analysis of an area based on geographic data. Up to now, GIS has been widely applied in urban planning and management worldwide and

gained many achievements. such as: In Japan, since the 1990s, the Government has turned to the National Spatial Data Infrastructure - NSDI (National Spatial Data Infrastructure) to serve many fields such as: management, planning, and response to natural disasters, etc.In the West, GIS has been developed in almost every field from agriculture, forestry and fishery to economic-related fields such as post office, real estate, etc. Besides, there are many big countries have successfully applied GIS such as Australia, China, etc. [1]

2 RESEARCH CONTENTS

2.1 Research history

GIS is being applied by many countries around the world in many industries because of its outstanding features. In Vietnam, many provinces across the country have initially researched on this technology. According to Hiep and his partners (2019), for a modern, civilized and intelligent tourist city, the leaders of Phan Rang - Thap Cham have asked to promote the construction of urban infrastructure works as well as applying information technology, especially GIS, in management and development to improve efficiency [1].

According to the research of Hien & Hung (2013), in Thai Nguyen city, urban construction planning and management still face many difficulties because mainly planning maps are simulated on paper documents. Other necessary data has not been fully agreed with the planning map to form a complete database system. GIS is the optimal and effective solution in management and planning issues such as technical infrastructure works, urban construction status [2]

In developed countries like Japan, there are many authors who have studied this technology. According to Kitsuregawa and associates (2010), GIS has become an indispensable solution to the problem of urban management globally, especially for developed countries. Currently, in Japan, one of the most commonly used GIS systems is the road navigation system in the car. In which including a number of prominent technologies such as VICS (Vehicle Information & Communication System). They show the traffic conditions of each road, nearby incidents and structures, the optimal routes for the driver's journey, etc. based on infrastructure data in the GIS. This system plays an important role in traffic regulation and efforts to reduce traffic congestion [3].

2.2 General information in GIS

In the early 60s (1963-1964), scientists in Canada gave birth to a geographic information system called GIS. GIS (short for the English phrase Geographic Information Systems is a collection of computer-based processes from which an area can be drawn up on a map and collected, stored, analyzed, managed, edited, manipulated and updated geographic information with spatial relations to solve a specific problem. The GIS geographic information system consists of four important parts: hardware, software, facilities GIS data and finally people, can be described as Figure 1 below. "People" here are not only experts in the GIS application itself, but also need experts in the field areas that GIS is aiming to collect, manage, and analyze (Figure 1).

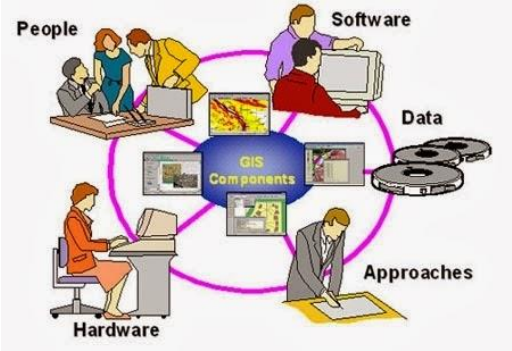

Figure 1. GIS's important components

GIS stores real world data through a set of thematic layers. These layers can be linked together thanks to their geographic features and according to this seemingly simple thing that is essential and very valuable in solving many practical problems such as choosing an optimal route for vehicles, application of planning or wastes management. The outstanding advantage of this solution compared to other types is the ability to combine many sets of data, information, including spatial factors. a combined database, for analysis and on-demand access. Besides, it also significantly changes the speed of updating, editing spatial information and increasing efficiency and accuracy in solving practical problems. Especially with the current scientific development, GIS can be combined with many other technologies (computer graphics, computer-assisted maps, remote sensing, etc.), is an effective tool in a wide variety of departments such as environmental resources, weather measurement and forecasting, etc.

2.3 The situation of applying GIS in Vietnam

A smart and modern city cannot become a reality without the help of technology, residential and housing databases and spatial data infrastructure (Infracstruture - SDI). Early realizing the great potential of technology application in the process of modernization and development of the country of Vietnam, GIS was introduced, piloted and applied very early by a number of specialized agencies and organizations to serving for professional work since the 90s of the twentieth century. Since 1995, a number of projects on geographic information systems have been established by the Ministry of Science and Technology. This pioneering step aims to give many organizations, companies and other agencies the opportunity to explore and approach this new type of managing technology. Not only that, every year, the Ministry of Science and Technology advocates to emphasize the importance of GIS technology, identifying this as one of the priority research content in the innovation and modernization of the state management process.

In the field of natural resources and environment, since the late 1980s, with the help of international friends, GIS and remote sensing have been quickly added to a number of environmental resource monitoring projects, including as Vietnam Electronic Atlas. In addition, GIS is also used in real-time traffic infrastructure management, transport vehicles, a typical example is Mapinfo software, Vietmap navigation and monitoring services. Over the past 10 years, GIS has been focused, invested and developed much more strongly by many departments in Vietnam to solve many problems of society such as agriculture as solid moisture monitoring Remote sensing (RS) is one of the PA technologies that allows growers to collect, visualize, and evaluate crop and soil health conditions at various stages of production in a convenient and cost-

effective manner [4] and tourism as conducting tourism information management; being able to produce a comprehensive thematic map. The paper analyzes the existing problems of GIS applications in tourism management [5], flood control.

In the field of urban planning and development, application of information technology and GIS, there have been great developments to change the traditional way of paper management in the past. Many studies as well as GIS pilot projects have been studied and implemented, but there are still shortcomings in realization. Therefore, urban information databases on planning on GIS have been strengthened in order to comply with Directive No.09/2008/CT-TTg dated February 29, 2008 [6]. This is one of the top priority tasks of the Ministry of Construction and related agencies across the country. Thanks to that, many research topics have been carried out and carefully surveyed, which can be mentioned as "GIS application in urban technical infrastructure management in Vietnam" of the Geo Viet Consulting company. In this report, the author introduced the results and experience in applying GIS in the management of urban technical infrastructure by the company cooperating and supporting with the Ministry of Construction to implemented in 7 cities (My Tho, Ben Tre, Tra Vinh, Ca Mau, Rach Gia, Tam Ky and Quang Ngai) as well as all urban systems (cities / towns / towns) of 4 provinces (Thai Nguyen, Phu Tho, Ha Nam and Nghe An) [6]. Another related research topic by Nguyen Thi Thuy Hien and Dinh Viet Hung in 2013 is "Research on the application of GIS technology in urban construction planning management". Through the research paper, the authors have studied the advantages and feasibility of GIS as well as contributed to building the structure of data groups and data layers in the GIS database to serve the work of urban construction planning and management [2]. Currently, in Vietnam, especially Ho Chi Minh City, competitions and seminars are held to find out and promote many new models and solutions of GIS products in urban planning management as well as discussing and reporting on the results of GIS application for further development.

2.4 Main functions of GIS

2.4.1 Displaying detailed and accuracy datas of a huge area

In order for a complete geographic information system to be displayed exactly what in reality, it is indispensable to use a database system as a foundation for solving specific problems. Data from ancient times has been exchanged through forms such as writing, drawings, and the problem of collecting them is also very important in society. However, the need to exchange information is increasingly higher, especially information in a large space, people need a new method of representation compared to the past because of the form of writing, text Writing has revealed many limitations and weaknesses. And the mapping tool was born as a solution to these requirements, bringing many fields of science and technology to new heights, especially military sciences.

Along with the movement of the times, thematic maps were born to represent information and data according to a certain subject of use. In the 20th century, the explosion of technology increased the demand for thematic maps of large areas and higher accuracy. That is when computers are integrated with the software to synthesize a lot of data and detailed information in a wide area into the base system, making it easier to analyze, manage and solve problems.

Data can be obtained from a variety of sources such as measurement datas from the real field and remote sensing, statistical data on quantities or data from previously available types of conveyor maps. Then will enter data into the database system by many methods such as manual entry,

digitizing thanks to the digitizer (Digitizer) or a method of digitizing through a scanner (Scanner). Then through many stages and manipulation of those geographic data to standardize them, the end result will be best displayed in the form of a map or chart. Accurately displaying geographic data on maps plays an important role in storing, exchanging and processing them. Besides, we can export attribute data to excel tables, create statistical reports, create 3D models based on many tools in them.

2.4.2 Analyzing geographical databases

Analysis of spatial databases and parallel properties on digitized maps is an important function of GIS to assist people in solving practical problems of users. It is also a key difference from the previous data management software, mapping software and engineering drawing software. Analyzing spatial data is no different than arranging GIS map layers on top of each other. During the analysis process, GIS provides a set of tools or computer programs that allow users to perform a series of processing actions on digital map and attribute data, providing efficiency and high convenience. The spatial data analysis tools in GIS can be divided into the following basic groups: (1) query, classify and measure, (2) stack maps logically and visually, (3) algebraic computation.

In that set there are 2 important tools: the superposition analysis and the adjacency analysis. In superposition analysis, 2 map layers will be stacked together to create a new map layer, from which two databases are combined for analysis and review, usually consisting of 3 different types: Point-in-polygon (point in region), Line-in-polygon (line in region), Polygon-in-polygon (region in region). Adjacent analysis is a search based on measuring the distance around or between connected objects. Depending on each case, different types of tools are applied to suit and shorten the time to resolve.

2.5 Research methodology

The research paper is formed based on many reference sources, learn about the GIS geographic information system, about the application of GIS in a number of industries. In addition, there is support and cooperation from students, people who are living and working in Ho Chi Minh City during the survey to get opinions on the urban situation of Ho Chi Minh City.

2.6 Research results

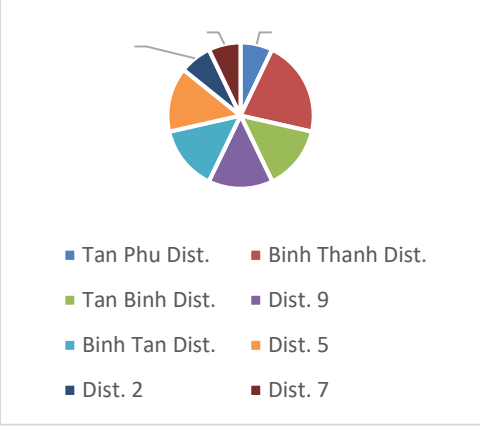

Figure 2. Distribution of survey participants

From the chart above, we can see a fairly even distribution of population in different areas, with 7.1% of the respondents currently living in the district. 7, District 2 and Tan Phu District; 14.3% are in Tan Binh district, district 9 and district 5; 21.4% is Binh Thanh district. This shows that Ho Chi Minh City is a very densely populated place. Not only that, during the survey, 50% of the respondents said that themselves and their family were born and raised righteously in this city, but the remaining 50% went to other provinces to go to Saigon to study, work. That shows that Ho Chi Minh City is a promising land for all people across the country, this is also an indispensable core force contributing to the construction of a smart, modern city. Future. That is why city management must be improved more and more (Figure 2).

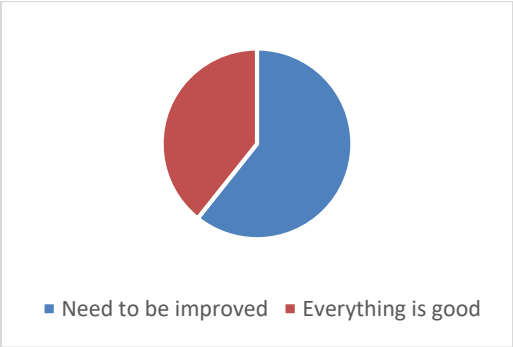

Figure 3. Survey of participants' commute to school/ work

Next is the opinions related to the road landscape in Ho Chi Minh City, especially on the familiar roads that have to go to school / work every day. The vast majority of respondents (about 60.7%) think that the road system and their landscape need to be further improved. Only 39.3% of respondents feel that the landscape and road system is quite good, suitable for urban beauty. This shows that the management of roads and traffic equipment is still limited. Specifically, there are still rubbish, plastic bottles, etc. on the road surface and on the sidewalk, green trees, not only that, not all traffic lights and lights are working well. Some things are completely damaged, there is a flickering light again, causing a great impact on people's travel. In addition, the bus waiting stations still have many shortcomings such as lack of roof, no clear notification system for trips and arrivals, etc. (Figure 3).

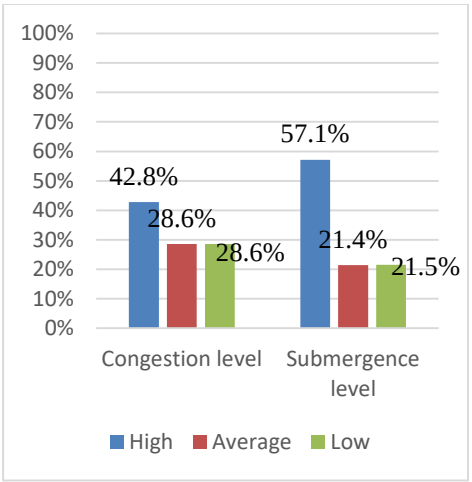

Figure 4. Congestion / Submergence level of going to school / work roads

The data in chart 3 shows that most of the traffic congestion is concentrated at medium and heavy levels, namely 42.8% and 28.6%. Only a few 28.6% have mild or completely absent congestion. As for the level of road flooding when it rains, there is a big difference compared to the traffic congestion when the total is 78.5% (57.1% in heavy and 21.4% in moderate). The remaining 21.5% are the number of people experiencing only mild or completely absent inundation. This shows that the current urban planning still faces many difficulties. Regarding traffic congestion, the main reason is due to the high population density. In many areas of the city there are schools or factories located on the main road, resulting in a dramatic increase in the number of people entering and exiting in the early morning or after evening, leading to traffic overload. As for the road flooding, the main reason is due to the speed of urbanization and concreting too quickly, and there is no specific strategy in the past, leading to an overloaded current sewer system. In addition, the green area, the surface permeability that is still or is ignored has not been taken into account, or is superficially allowed to pass. It is really a painful problem that needs to be resolved as soon as possible. good towards a modern, civilized city in the future (Figure 4).

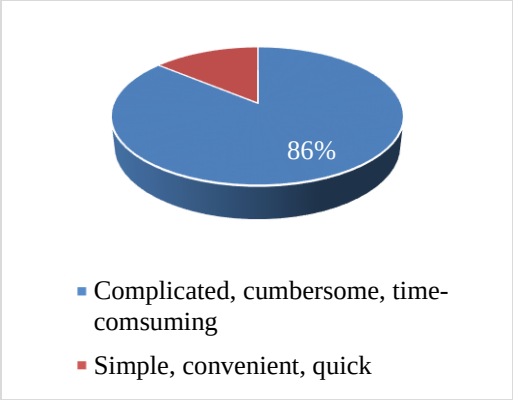

Figure 5. Surveying the paperwork and handling related to residential data

Finally, it is about paper administration, handling issues related to residential data. According to data from chart 4, up to 86% of people think that the administrative handling is too complicated, cumbersome and time consuming; only 14% of the administrative work has been simple and quick. This shows that the management of population data in a large area (specifically here is 1 district, 1 ward) has gradually appeared certain limitations and shortcomings due to the past. The work is mainly based on papers and books. So as population density is increasing, more and more data becomes more difficult and time-consuming for both implementers and requesters. There are areas that have started to apply technology but only support a small part of their work but are not ready to change completely. It is from these outstanding problems that the application of GIS in urban planning and management is more and more urgent than ever (Figure 5).

2.7 Practical application of GIS in management and urban planning of Ho Chi Minh City

Because of the dilemmas remaining in Ho Chi Minh City today that have just been raised in the survey, the application of GIS in the management and urban planning in practice is a first task. First of all should be given priority. GIS will be an effective tool, a strong support in the process of solving social bottlenecks and difficulties. Specifically, in the residential administrative sector, we can integrate population data in a certain area into the GIS model, thereby making it easier to

manage human activities at birth location such as life, work, relationships, and other background information change over time. Thanks to that, the administrative processing time is also significantly reduced as well as information support for the work of protecting social security and safety.

Not only in the management of residents in a certain area, but also in public transport, GIS can be applied. Specifically here in the management of bus trips. Thanks to the integration of two GIS and GPS technologies, the Public Transport Management Center will make it easier to control trips as well as inform people of the route. GPS will be mounted on each bus to track the journey from the start to the end to see if it runs on the correct hourly chart, if you leave the station and run the correct route from there will be sent to the center to have timely response. And GIS will be applied to bus management, specifically in quantity, quality as well as on daily routes of each vehicle, thereby proposing innovation and development directions to improve the operational efficiency of the vehicle and the driver's service is more.

3 CONCLUSION

Along with the explosion of the technology industrial revolution 4.0, all industries and fields are starting to have a great reform, applying more and more technology than before in many different stages. Urban management, planning and development are not out of this technological trend. Therefore, the application of GIS is absolutely necessary and urgent to meet the urbanization process as well as the rapidly increasing density of the population. If we do not timely adapt to develop, surely the current stinging problems will become more serious and more difficult. GIS technology will be a tool, a powerful right hand to be able to manage and plan the urban area in a reasonable and effective manner, to satisfactorily solve the challenges facing now. Through this research paper, we have a comprehensive view of the problems facing Ho Chi Minh City as well as some solutions that GIS technology brings to solve those obstacles.

CONFLICT OF INTERESTS

None

REFERENCES

[1] Karikari, I., Stillwell, J., & Carver, S. (2005). The application of GIS in the lands sector of a developing country: Challenges facing land administrators in Ghana.

[2]

[3] Jovanović, V. (2016). The application of GIS and its components in tourism. *Yugoslav Journal of Operations Research*, *18*(2).

[4] Fletcher-Lartey, S. M., & Caprarelli, G. (2016). Application of GIS technology in public health: successes and challenges. *Parasitology*, *143*(4), 401.

[5] Fletcher-Lartey, S. M., & Caprarelli, G. (2016). Application of GIS technology in public health: successes and challenges. *Parasitology*, *143*(4), 401.

[6] Shyti, B., & Kushi, E. (2012). The impact of GIS application in the tourism development of Elbasan region. *The Romanian Economic Journal*, *15*(45), 189-210.

[7] Karikari, I., Stillwell, J., & Carver, S. (2005). The application of GIS in the lands sector of a developing country: Challenges facing land administrators in Ghana. *International Journal of Geographical Information Science*, *19*(3), 343-362.

[8] Li, H., Chen, Z., Yong, L., & Kong, S. C. (2005). Application of integrated GPS and GIS technology for reducing construction waste and improving construction efficiency. *Automation in Construction*, *14*(3), 323-331.

[9] Zagvozda, M., Dimter, S., Moser, V., & Barišić, I. (2019). Application of GIS technology in pavement management systems. *Građevinar*, *71*(04.), 297-304.

[10] Tan, H. H. (2021). Environmental education for the sustainable development of suburban communities in Ho Chi Minh City. In *E3S Web of Conferences* (Vol. 234). EDP Sciences.

[11] De-hui, L. I. U. (2008). The Application of GIS in Tourism: Discussion on Tourism GIS and Its Research Development and Prospect [J]. *Geomatics & Spatial Information Technology*, *1*.

[12] Kaiser, R., Spiegel, P. B., Henderson, A. K., & Gerber, M. L. (2003). The application of geographic information systems and global positioning systems in humanitarian emergencies: lessons learned, programme implications and future research. *Disasters*, *27*(2), 127-140.