GEOSPATIAL TECHNOLOGY AND INNOVATION ENABLEMENT FOR PHYSICAL PLANNING

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Abstract

The needs of geospatial technology and Innovation are crucially recently, especially in managing urban planning issues. The challenges of urban and rural development become more increased, and the need a big data analysis are vital, to ensure wise and correct decision can be made for the sustainability. This paper purposely to review the robustness of the development and challenges on the geospatial technologies and innovation enablement for continuous planning, monitoring handling urban planning issues. The ultimate finding shows that the scientific world has made commendable progress by providing geospatial data at various spatial, spectral, radiometric, and temporal resolutions enabling usage of the data for various urban applications. Finally, conclude that enablement progress is the best promising for future sustainability and resiliency.

Keywords: Geospatial, Remote Sensing, GIS, GNSS and urban planning

1. Introduction

Rapid urban development recently required digital data has increasingly become the basis on which governments, organizations and businesses alike base their decisions. Today, the volume, size, speed, diversity and complexity in which geospatial data was generated requires change: to the processes currently used by governments and businesses across the world, and to workforces that are capable of searching, analyzing and merging these massive amounts of data. Geospatial data has become a ubiquitous part of everyday services and is central to the business models of many of the digital disruptors that have become prominent in the 2020s. The rise of smartphones, tablets, and other mobile devices has contributed significantly to people's expectation of the use of geospatial applications. User demand for increasing accuracy, currency, and

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detail is growing and will require more automated data capture and feature extraction to keep pace with those requirements.

Physical planning is a design exercise that uses the land use plan as a framework to propose the optimal physical infrastructure for a settlement or area, including infrastructure for public services, transport, economic activities, recreation, and environmental protection. The physical plan was prepared for an urban area or rural area developments. A physical plan for an urban region can have both rural and urban components, although the latter usually predominates. A physical plan at a regional scale can also deal with the provision of specific regional infrastructures, such as a regional road or a bulk water supply system. The world's population is expected to reach double as it making the 21st-century transformative trends. Therefore, the study on the urban comprises of the multidisciplinary field including climate change, urban green space, urban areas, urban forest, urban landscape, urban growth, and more that related to the urbanization process of city planning (Shekhar and Aryal 2019). This field has been extensively studied with the aid of geospatial technology that can help to map, combine, analyze, modeling, visualization, and significantly able to spatial decision making (Avtar et al. 2020; Ismail, Muhamad Ludin, and Hosni 2020; Huneter et al. 2012).

The United Nations has highlighted issues of data quality and data collection abilities to optimally measure various indicators and has emphasized the need for a Data Revolution to enhance the data quality (Kharas et al., 2013). The United Nations has highlighted issues of data quality and data collection abilities to optimally measure various indicators and has emphasized the need for a data revolution to enhance the data quality (Kharas et al., 2013). The capability of geospatial technology to provide accurate information of land use land cover (LULC) in monitoring, interpreting, and projecting future changes in LULC become a greater help to the professional, research communities and policymaker in tackling the problem that arises ((Ismail, Muhamad Ludin, and Hosni 2020; Noor et al. 2020). Remote sensing and GIS is one of the geospatial technology that is widely used in governance and planning at national, regional, and local scales (Shekhar and Aryal 2019; Dangermond and Goodchild 2020). Rapid urbanization in cities and village can cause high demand for resources, and it leads to the overpower of the sparse resources and impact to unmanaged an unsustainable development situation (Adzandeh, Alaigba, and Nkemasong 2020). Thus, it tends to provide space for illegal agriculture or development, and the encroachment of land becomes more aggressively uncontrollable.

The risk of a natural disaster such as floods or landslides is higher when there is no proper land use planning, and this could affect the loss of life and property.

Therefore, geospatial technology such as satellite, drones, Wireless sensor of network and Internet of Things (IoT) are important to manage and control minimal impact from natural disaster. Additional, the preparedness process in terms of disaster management and planning will be effective (Lwin et al. 2019) (Noor et al. 2019). Hence, geospatial technology can provide a solution and guide in controlling the development in that manner, which further contributes to the sustainable ecology and environment. This study attempts to review the robustness of the development and challenges on the geospatial technologies and innovation enablement for continuous planning, monitoring handling urban planning issues. This section explains the paramount of geospatial technologies in urban planning while the second section describes the variety of geospatial databases. The third section discusses the correlation of geospatial technology towards sustainability in a measure of the SDGs and its challenges. The last section identifies future research priorities.

2. Recent progress on geospatial technology and Innovation in urban planning

Since the introduction of geographic information systems (GIS) in the 1960s, it has evolved tremendously to the extent that it permeates our daily lives. Geographic information systems (GIS) and geospatial information science (GSIS) has grown and matured over the last decade (Malczewski 2006; Malczewski and Rinner 2015; Yuan 2017 (Mohd Noor et al. 2018; Mohd Noor, Abdullah, and Hashim 2018; Noor and Abdullah 2015)). Advances in remote sensing, information communication technology (ICT), big data, geolocation-based services, and geotagged social media have propelled GSIS into an influential field (Goodchild 2009, 2014; Li et al. 2013; Tao 2013). Geospatial information in urban planning has increasingly been applied in municipalities, land use planning, infrastructure planning and improvement of service delivery (Yeh 1999; Kohsaka 2000).

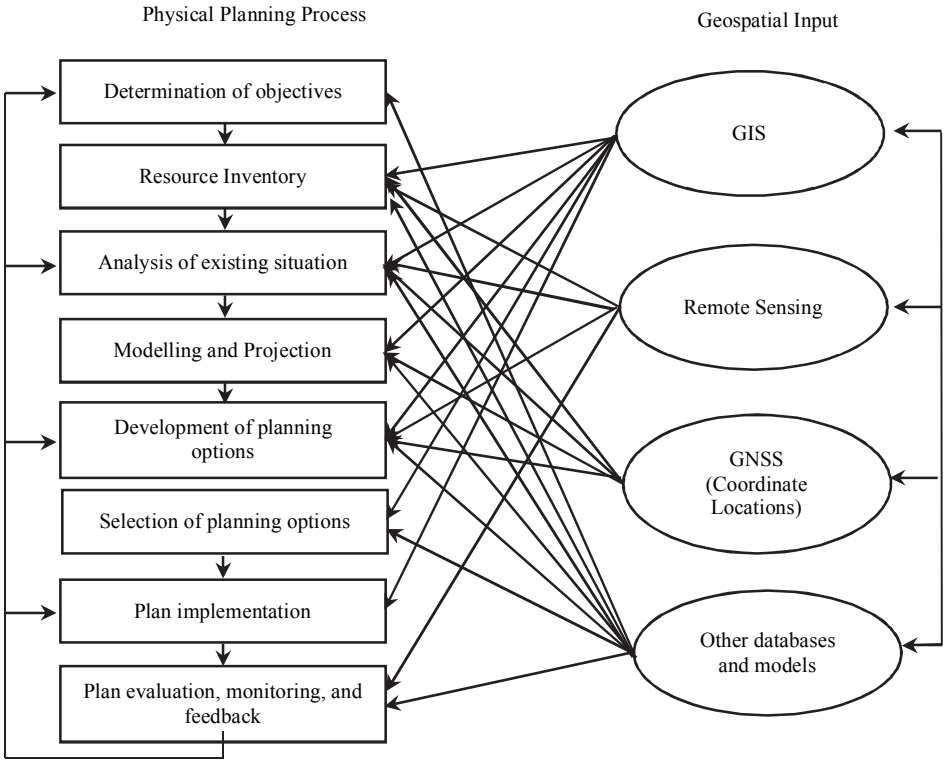

Figure 1: The integration of Geospatial databases in the urban Planning Process *(modified after (Rajaram 2015)*

The recent enablement of technology and innovations in urban planning can be understood as a general integration of geospatial databases in the urban planning process. Nowadays, there is an assortment of geospatial databases such as GIS, remote sensing, GNSS and other databases and models (Figure 1). These provide a privilege to the researcher communities to apply the geospatial database according to their research focus. Each of the databases has it is specialty and character that helps in the decision making support system. For instance, the application of remote sensing is prevalent as it provides leverage features and able to support the planning process. It can be summarised such as, synoptic view of areas that afford a general view of a whole especially in an inaccessible area, fast data acquisition, the capability of the spectral range that converting the information into visible representations, spatial-temporal and automatic or semi-automatic processing. Besides, GIS or Geographic Information System can depict differences, spatially coincident features that are similar to CAD. However, the power of a GIS lies in its ability to analyse relationships

between features and their associated data (Samson, 1995). This analytical ability results in the generation of new information, as patterns and spatial relationships are revealed. Meanwhile, GNSS or Global Navigation Satellite System is a global navigation system that provides location, velocity, and time synchronization. Previously, GNSS is a complex and refined technology, but as time evolved, the GNSS interface becomes more friendly and able to access to the non-technical user. The variance of GNSS units available from 10 to 20 meters and it can be obtained to centimetre-level accuracies depends on the pricing factor. GNSS technology act as an imperative tool for the management of urban planning issues.

3. Geospatial and Sustainability Challenges

The Sustainable Development Goals (SDGs) are a universal call for action to end poverty, hunger, protect the planet, and ensure that all people enjoy peace (United Nations, and Nations, U 2015). The success of the Millennium Development Goals (MDGs) has encouraged us to achieve 2030's Agenda for 17 SDGs which lead the world to prosperity and sustainability. The challenges in the twenty centuries are to provide and improve sustainable development for the long term health of human and ecological systems. To have a progressive action, the needs to support the delivery action must be supported by a suitable tool. Therefore, since 1992, the United Nations Conference on Environment and Development recommended GIS as an appropriate tool to achieve 17 SDGs (Nabiyeva and Wheeler, 2020;). Besides, Earth Observation (EO) is one of the promising geospatial data that undoubtedly play insightful roles in achieving SDGs (Cochran et al. 2020; Anderson et al. 2017). As mentioned by Avtar et al. (2020), geospatial data is one of the assuring data sources that can be applied for monitoring and achieving SDGs. Similar to Nagabhatla and Brahmbhatt (2020), geospatial tools can be integrated and combined with referenced data, ground knowledge and can be applied in the multidisciplinary field such as disease control management, land-use changes, poverty, education, policy, or other social issues that provide analytic ability to manage spatial and non-spatial information (Srivastava et al. 2009; Avtar et al. 2020)

As is well known, the 2030 Agenda of Sustainable development are consisting of 17 SDGs at its core. However, the frequency of a geospatial approach to support sustainable development is still less as discussed by Nabiyeya and Wheeler (2020) in their study by using database engines of Web of Science and Scopus. The result shows that only certain of SDGs, namely "Life On Land", "Sustainable Cities and Communities", "Climate Action" and "Quality Education" that have large numbers of scientific papers that applied GIS in their content. For instance,

most of the content related to GIS and SDG is the "Life on Land" goal, which provides the researches with the ability in decision making. GIS helps the authors to integrate the data for mapping, modeling, monitoring, and measurement, which explained the usage of the spatial analysis approach. Compared to other SDGs that have least frequently GIS in the context of SDGs. The authors synthesize that, GIS was limited in linking with SDGs due to unspecified issues or topics that can relate to the field of sustainable development GIS.

Moreover, some problems are not spatially orientated and tend to neglect the power of GIS; which can be used even it is less spatially oriented at the beginning. The challenges of GIS can be seen through the country that faced scarcity of data compared to the country with an abundance of data. Scott and Rajabifard (2017) discussed that due to the insufficiency of data, most of the nations will tend to be vulnerable and at the stake of risk or left out to achieve a sustainable development compared to those countries that have limitless of data. This is the gap that needs to tackle or it will become a vast digital divide. Now in its fifth year of global reporting, the challenges in able to bridge the digital divide must be solved progressively. Considering the broad range of SDGs' targets, geospatial information is one of the most important tools for monitoring their achievement. It will also pave the way for the successful accomplishment of SDGs. Achieving the SDGs undoubtedly demands massive global concerted efforts to efficiently make use of data sharing, processing, and aggregation in a highly multidisciplinary framework. National geospatial information agencies will need to collaborate closely with national statistical and earth observation professional communities to deliver consistent and reliable data to fit into the formulation of wide-ranging sustainable development policies.

4. Recommendation and Future Outlooks

The study has attempted to highlight the ability of geospatial technology for physical planning. Geospatial technology is a technology relating to the collection and processing of data associated with the location. It is an emerging study field that includes GIS, remote sensing, and Global Navigation Satellite System (GNSS). Nowadays, numbers of the new geospatial portal are created to solve various dimensions of development for local, and national level such as Google Maps, Open Street Map, and Nasa Earth Observation. Apart from this, the demand for information is high and it needs effective public participation. The engagement of public involvement is necessary (Choi et al. 2016; Bugs et al. 2010) to provide useful data and exchange ideas to help to characterize the local space. The need for collaboration between public participation and geospatial will help to measure the SDGs. Besides, it helps to form and implement a successful

practice of policy that considers public perception. Thus, the high commitment of professionals and research communities is vital to facilitate the integration of multidisciplinary experts and mobilizing the resources and support to enable technology evolution with more interactive methods (Chen et al. 2020).

Geospatial technologies are known for the richness of data; however, the gap of the digital divide need to solve to prevent those countries that have limited access to the technology. Towards Agenda 2030, this matter should raise attention to have a comprehensive implementation of SGDs. Digital transformation is required to make sure the availability of data to all countries. Steiniger and Hunter (2012) suggested that free and open source and access notably support the documentation, publication, sharing models, algorithm, and tools for analysis and visualization regardless of the purpose; educational, or business purposes. Giuliani et al. (2020) also agreed that the low entry barrier for the providers and resources to reduce waiting for time or loss of interest to the user. Therefore, by 2020, geospatial technologies must able to increase the availability of high-quality, timely, and reliable national data. In some ways, it shows that the advancement of geospatial technology has been driven more interest to the user and consumer as it a response to multidisciplinary developments and breakthroughs. Big data, cloud computing, unmanned aerial system, mobile devices, and location-based services are some of the evidence that ensured the people to appreciate the need for geospatial information. Thus, the future outlook and trends of geospatial enablement can be outlined as following potentials:

- Earth observation technology such as satellites, high altitude or vehicle-based sensors are providing a greater variety and volume of data about the urban to higher resolution and temporal frequency for lower costs;
- Provision of web service infrastructures enters the mainstream, making it easier to create new technology-based products quickly and more cheaply than before and to outsource costs;
- Applications of sensors, robotics, cameras, encryption, cloud computing and other software, and hardware intelligence are converging, enabling new ways for organizations and their equipment to perceive and capture reality;
- Artificial Intelligence-driven solutions and machine learning will drive cost efficiency, accuracy and speed in GNSS and Positioning, spatial analytics and Earth observation; and,
- Satellites, unmanned aerial vehicles (UAVs), and sensor technology are being invested in by leading tech giants, existing providers of sensed imagery and governments.

Technological developments, the nature of machine-led decision-making in autonomous mobility, and other applications that require multi-stakeholder partnerships are creating new challenges in a world that will increasingly virtually. In the context of trends, cybersecurity, data privacy, ethics, trust and licensing will increase in relevance as interdisciplinary collaborations and are now at the forefront. Government-led geospatial infrastructures will need to take account of and consider responses to these emerging legal and policy top trends.

5. Conclusion

This paper addresses the importance and roles of geospatial technology and innovation for physical urban planning. Physical planning acts as an indicator to measure and monitor the progress of the city. Hence, the enablement of geospatial technology has acknowledged Agenda 2030, which is to measure sustainable development comprehensively. It is not only capable in produce maps, combine and analyze the data, but it is sophisticated proven in support of geographically decision-making support systems. The ability to add location to almost all existing planning information, unlocks the wealth of existing knowledge about physical, social, economic and environmental matters, playing a vital role in understanding and addressing the many challenges we face nowadays.The potential and advancement of geospatial technology with the existence of new technology enablers indicates that it has reached the level of maturity that allows this information as a core contributor to provide information to a multidisciplinary field to achieve SDGs.

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