



Big Data Analysis on Urban Planning Governance: How is Big Data Used to Plan Urban Management?

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Abstract. Big data is a collection of structured and unstructured data in large volumes and stored in one unit from the internet of things (IoT). In the government planning sector, big data is a supportive instrument to find gaps and weaknesses in governance. This study aims to analyze the use of big data in urban governance planning. This research case was conducted on the Magelang city government in conducting urban planning using big data. This research analysis method uses an exploratory qualitative approach with web analytics as a research instrument. The results of this study show that; 1) The Magelang City government uses big data in providing public services to the community. 2) Magelang city big data is integrated into one reporting system and services integrated with the Magelang city government website; 3) Big data could be more optimal in building good governance in the city of Magelang. 4) The quality factor of Human Resources is one of the obstacles to the application of big data in urban governance management in Magelang City.

Keywords: Big Data Analytics; Urban Planning Governance; Urban Management

1 Introduction

This article analyzes the use of big data in urban planning and management. Big data is a collection of data with a large volume that is integrated with a single Internet of Things (IoT) unit [1]. The Internet of Things (IoT) is a collection of uniquely addressable heterogeneous electronic devices that collect and exchange information through multiple human connections [2]. The device is responsible for the production of billions of new facts every day around the world. It produces modern tools at various scales and instantly incorporates them into the form of software commands that city planners can connect [3].

The increasing complexity of universal cities in this digital age pushes traditional urban design and management practices closer to breaking point [4]. Historically, urban management has been able to rely on traditional approaches, which involved only a small number of people and stakeholders in making informed decisions [5]. As a result, urban planners need to make high-quality, evidence-based decisions that can be applied across multiple spatial scales. They can do this by leveraging the potential of emerging technologies such as Big Data Analysis (BDA) [3]. However, the main difficulty stems

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from the requirement of an adequate understanding of the data mining process and the processing, analysis, and utilization of these large data sets.

Big data technologies and related tools are compatible with smart cities and urban management techniques to improve urban sustainability [6], [7]. This is true both in terms of the approach and the technology. The practice of environmentally responsible urbanization is entering a new phase [8]. Data-driven smart cities can deliver sustainable urbanism, and there are currently concerted efforts underway to push sustainable cities worldwide to be more inventive [9]. It is possible to achieve urban sustainability by building and implementing data-driven technology systems to support and improve relevant processes, functions, facilities, structures, strategies, and policies relating to various urban patterns.

A large amount of data-driven approach has emerged as necessary for the operation of smart city affairs to achieve sustainability [10]. As a direct result, we will enter an age where instrumentation, data, and computing will systematically seep into the structural makeup of cities. To drive long-term, eco-friendly expansion, modern cities are using the Internet of Things (IoT) and Big Data Analytics (BDA) extensively [11].

One of the benefits of Big Data that has already been realized, particularly in the commercial realm, is the ability to determine how the public feels about a product by conducting sentiment analysis on social media [12]. Aside from assisting businesses in making decisions that are better informed and more accurate based on data [13], it also helps to improve the company's image in the eyes of customers; it is helpful for business planning by gaining an understanding of customer behavior (for example, in banking and telecommunications companies); it is also useful for gaining an understanding of market trends and consumer desires [14], [15]. The technology behind Big Data can be put to extensive use in the government, in addition to helping conduct analyses of businesses.

Big data presents the public sector with several options, including collecting feedback and public response through government service information systems and social media as a foundation for creating policy and enhancing public services [12], [16]. Finding solutions to existing problems based on data, such as by analyzing weather information and soil fertility levels, the government can determine or advise the types of crop varieties grown by farmers in certain areas and times; and assist in the management and supervision of state finances. Another example of this would be the government's ability to find a solution to an existing problem based on the data [17], [18].

When referring to the magnitude of the benefits that can be offered by trends in big data technology, particularly in the public sector, it is interesting to examine the extent to which big data technology has been utilized in several government institutions in Indonesia and what challenges arise in its application. This is because of the magnitude of the benefits that trends in big data technology can offer, particularly in the public sector [16]. The use of Big Data technology in an organization can be deduced from the functions already in the institution's information technology infrastructure. These functions allow the institution to carry out tasks associated with mobile, social, and Big Data-Analytics applications [19], [20].

The government uses big data to regulate, evaluate, plan, and manage government so that a good and ideal government can be formed [19], [21]. The rapid development

of technology makes big data an alternative to sustainable urban planning and governance [14]. This research focused on the Magelang City government as one of the cities that applies smart city principles in city planning and governance. The Magelang city government has implemented an integrated system through Magelang Cerdas with One Stop Public Service and Information Portal with One Touch. A one-stop portal for electronic-based Public and Public Information (Digital) services [22], [23].

In addition, the Magelang City government already has a Sectoral Data Portal, namely data. As an Integrated One Data Information System in Magelang City that accommodates sectoral data producers in the scope of OPD, Vertical Agencies, Private Institutions, and Educational Institutions [24], [25]. The data mechanism is driven online, integrated, and supported by the Bang Data virtual assistant connected to the Telegram application. Data is proven to be a Data System that impacts the effectiveness and efficiency of public services and plays a role in realizing evidence-based policy-making [24].

Some of the research that has been done is related to urban planning, urban management, smart cities, and Big Data Analytics. The research that has been done by [8], [10], [18], [26], [27] Focusing on the theoretical application of big data in governance and urban planning. In this study, the authors analyzed based on empirical data related to big data in urban planning and governance. This study aims to analyze the use of big data in Magelang city planning and management. The author identifies indicators in the use of big data in the integrated system that the City of Magelang has used and evaluates the use of the extensive data system in the planning and governance of the city of Magelang. This research uses an exploratory method approach with Web Analytics analysis instruments. This instrument was chosen to make it easier for the author to analyze the big data used in the DataGO integrated system.

2 Method

The research method used in this study is a qualitative method with an exploratory research approach. Exploratory qualitative methods are used in this study to explore research seen from various sources that are analyzed in detail [28], [29]. This study aims to analyze the use of Big Data in urban planning and governance. The focus of this research was conducted in Magelang City as a case study of the use of Big Data in City planning and governance. The Magelang City Government has integrated Big Data through one DataGO system included in Magelang Cerdas.

The source of this research data is primary data by conducting interviews from the Magelang City Informa, Communication, and Statistics Office as well as data on the data analyzed through the official website of the Magelang City government (<https://datago.magelangkota.go.id/>). In addition, this study also used data sourced from national journals and indexed international journals totaling 25 journal articles and national online news totaling 15 articles. This research period was conducted from July 2022 to October 2022. This data analysis technique uses Web Analytics instruments, namely RankWatch and Ubersuggest, to help analyze the DataGO website owned by the Magelang City government. Utilize web analytics tools to evaluate the

effectiveness of the website and enhance user experience [30], [31]. Web Analytics used as an analysis method to track key metrics and analyze visitor activity and traffic flow on the Magelang City Government's DataGO website.

3 Result and Discussion

Smart city exists as a smart governance concept that connects society by integrating the development of technology, information, and communication (ICT) [32] Smart city is a city that is built with the view of sustainable and integrated development so that it becomes a new solution to help change the function of the government as a social management innovation [33] One of the important dimensions in smart cities is that smart governance has a function in its implementation to regulate the performance of the government to carry out services to the community [34] Given the need for public service delivery, innovation, and good collaboration are indispensable in building a smart city. So smart governance is present as one of the dimensions of smart cities that have an important role in realizing smart city governance.

The idea of a smart city can be articulated by combining the advanced capabilities of the internet of things (IoT) and artificial intelligence (AI) technology in the context of the formation of a methodical system that makes use of big data ([35] Where the Internet of things has an important role in the implementation of management in the implementation of smart cities [36] The concept of smart city implementation is built by integrating information communication technology and various instruments, organizational structures with initiatives built online aimed at solving the main problems of a city [37], [38]. This can be achieved by implementing smart governance well, because smart governance as a social management innovation where all resources, society, and technological development can blend into one and can influence each other [39]. So, to realize a smart city, it is necessary to implement smart governance which has an important role in overcoming the problems of a city. Smart governance needs to involve the participation of its citizens[40] Thus, the governance process is based on citizen participation processed through an internet of things (IoT) and artificial intelligence (AI) system collected in a big data system [31].

The availability of data is, of such subject, one of the most important factors to consider while doing Big Data analysis [41]. Access to new and old data can be a challenge for big data, particularly when it comes to older data that is kept in various formats and often even in physical form [42]. The requirement of licenses and licenses to access non-public data legally adds another layer of complexity to the process of gaining access to new data [8]. Especially if there is a sense of sectoral ego among the several entities that possess the data. The phase of data gathering is believed to be the most challenging for service and information providers in Indonesia who apply Big Data analytics, and this is because of how important it is [7]. Indonesia already has data for various purposes, and many of them; however, the sources are dispersed, and as a result, additional work is required to obtain integrated data on a national scale. The concept of data sharing, as well as open data, becomes necessary at this point.

The Magelang City Government already has a Sectoral Data Portal, DataGO, which is present as an Integrated One Data Information System for the City of Magelang that accommodates sectoral data producers in the scope of OPD, Vertical Agencies, Private Institutions, and Educational Institutions [24]. DataGO Information System is a web-site-based data management that aims to improve the quality of data management by forming a structured database that can present high-quality, updated, and representative data and statistics[22]. The DataGO mechanism is driven online, integrated, and supported by the Bang Data virtual assistant connected to the Telegram application. DataGo is proven to be a Data System that impacts the effectiveness and efficiency of public services and plays a role in realizing evidence-based policy making [25]. Fig. 1 shows the appearance of the main menu on the Magelang City Government DataGO website.

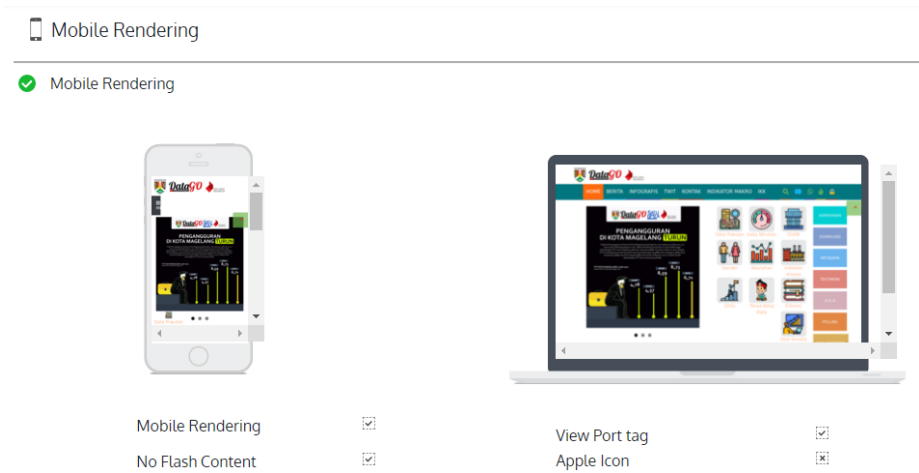


Fig. 1. Magelang City Government DataGO Website Display in 2022 [43]

Some of the features presented in the Magelang City government's DataGO service display service features and data presentation in an integrated manner. This is done to provide transparency or openness to data access owned by the Magelang City government. The Magelang City government presents data transparency and ease of accessing data through the DataGO website [44]. Some of the data published in DataGO is also published in the Magelang City Open Data portal based on CKAN (Comprehensive Knowledge Archive Network) with metadata under the required national structure. The establishment of the Magelang City open data portal is based on the concept of One Data Indonesia and the existence of a one-data portal managed by the Presidential Staff Office (data.go.id) which also has a CKAN platform.

This system is managed online by all SKPD and vertical agencies in Magelang City as a secondary data source. Each SKPD and the vertical agency has a Person in Charge called the DataGO Manager responsible for data validity and availability on certain variables. DataGO managers have the ability of dexterous personnel to update data and publish data accurately [22]. Each DataGO Manager has a user and password and is

required to input data online on DataGO under the periodization and data group is responsible [23]. As a legal, the existence of a DataGO Manager is determined in the membership of the technical team based on the Decree of the Mayor of Magelang [45]. Coordination between Administrators and DataGO Managers is carried out regularly each three-month with the focus of discussions related to the enrichment of variable substance, desk data, and confirmation of the validity of data to be published regularly [25].

The author analyzes the quality of the IT system and infrastructure supporting the integrated Big Data system to analyze the used of Dig Data in Urban Planning and Management Governance. The author analyzed the DataGO website with a URL address <https://datago.magelangkota.go.id/> with a web analytics instrument. This analysis was carried out to see the quality of the integrated Big Data system used by the Magelang City government in providing data information. It can be used in sustainable City planning and City Governance. The results of the website analysis can be shown in Fig. 2.

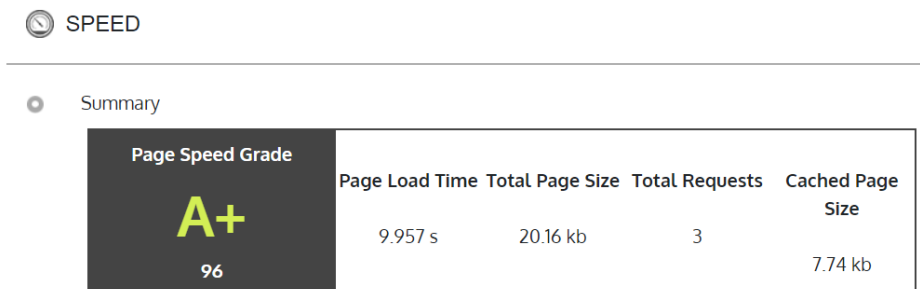


Fig. 2. Website Speed Quality [43]

Fig. 2 shows Magelang City Government DataGO website speed quality with Grade A+ based on website analysis through RankWatch. This shows that the Magelang City government is ready for IT infrastructure networks' availability in using Big Data. Because big data management requires a complex system that includes large amounts of data, Data refers to technologies and initiatives involving data that is so diverse, rapidly changing, or so large that it is too difficult to effectively address by effective conventional technology, expertise, or infrastructure [26], [46]. In other words, Big Data has a size (volume), velocity (velocity), or diversity (variety) that is too extreme to manage with conventional techniques. Big Data involves a process of data generation, storage, information retrieval, and analysis that stands out in terms of volume, speed, and variety [11], [18], [21]. The DataGO system used by the Magelang City government can be seen in Fig. 3.

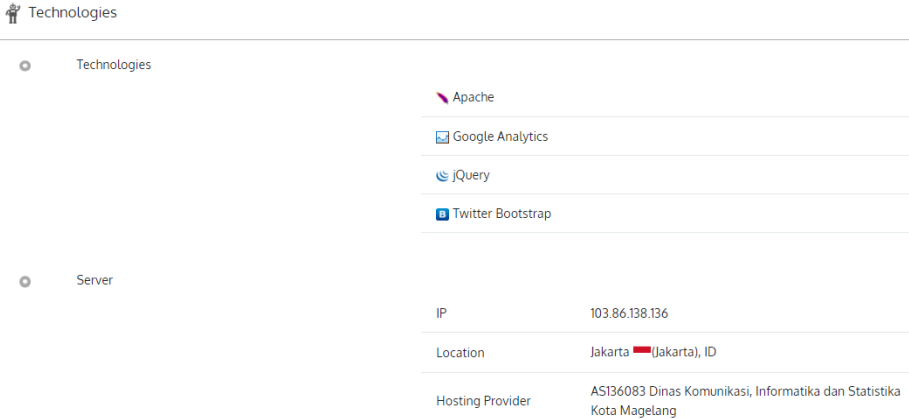


Fig. 3. Technologies Used by DataGO [43]

Fig. 3 shows the technology system used to develop DataGO to accommodate data and analytics. The technologies used in DataGO developed by the Magelang City Government include Apache, Google Analytics, JQuery, and Twitter Bootstrap. The technology used in the DataGO website supports data analytics and accommodates large amounts of data related to Magelang city public services. In addition, the use of this technology serves to analyze the community’s response to the quality of public services carried out by the Magelang City government. Fig. 4 shows the number of visitors to the DataGO website from July 2022 to October 2022, showing a significant increase.

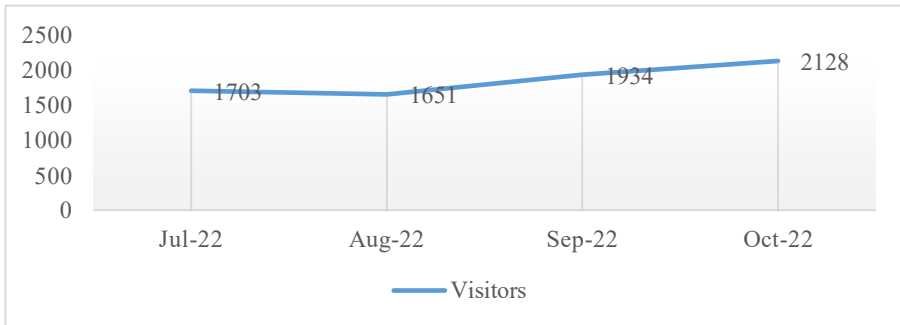


Fig. 4. DataGO Vistiors on July-Oct 2022 [43]

The increase in the number of visitors to the Magelang City government's DataGo website indicates the application of Big Data in providing open access and data transparency to the public. This shows that the public's interest in the openness of data provided by the Magelang City government. The increasing number of DataGO website visits shows the feasibility of the availability of data provided by the Magelang City government can provide benefits. Fig. 5 shows the traffic overview on the Magelang City government's DataGo website with organic keywords indicators.

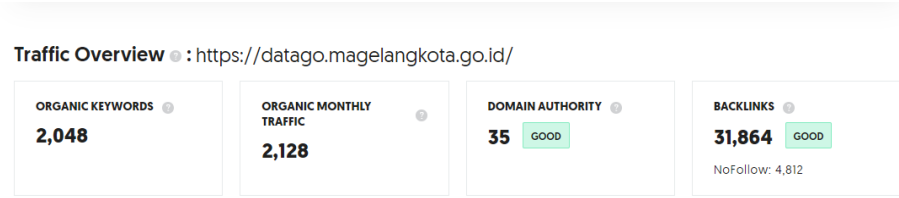


Fig. 5. Traffic Overview Website [47]

The use of organic keywords is an organic keyword that exists in content to help search engines understand terse-but content [48]. Based on Fig. 5, shows that the number of keyword organics on the DataGO website is 2,048 keyword organics during 2022. Based on the results of organic keywords analysis or keywords that visitors often search can be seen in Fig. 6.

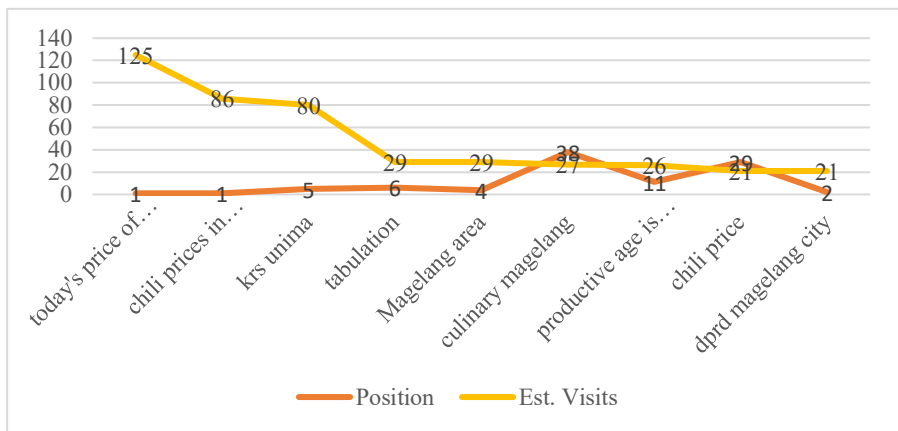


Fig. 6. Top Visited Keywords [47]

Fig. 6 shows the number of organic keywords most often used in search engines on the Magelang City government's DataGO website. The first position from July 2022-October 2022 is the price of chili in Muntilan and Magelang. The second is related to the Magelang City DPRD, and Magelang culinary occupies the fourth position as a keyword that visitors often use in searching through the Magelang City government's DataGO website.

Based on the organic keyword analysis seen in figure 6, it can be used as material for evaluation, planning, and governance of the city of Magelang. For example, with a keyword that is often visited, related to Magelang City Culinary, meaning that Magelang city culinary is a form of public attraction. Thus, the Magelang City government can use the results of this Big data analysis to build a centralized culinary tourism innovation in the city of Magelang, or it can even be material for making policies that support the development of culinary businesses in the city of Magelang.

Another example based on figure 6, related to the results of Big data analysis through the DataGO website, shows that chili prices are the top most visited keywords. This shows that the price of chili is the community's main attraction in the July-October 2022 period. So that this can be a reference to policy responses related to cherish chili. However, even though Big data analysis offers an excellent opportunity to base decisions accurately on data, there are times when using Big data analysis involves the risk of drawing the wrong conclusions [49]. For example, making assumptions about the causes of violence based on public data sets that do not apply to a specific location.

Using big data analysis risks drawing the wrong conclusions. Big data analysis alone cannot replicate a complex picture of possible relationships between different areas of policy, such as crime and socioeconomic groupings in a particular environment [50], [51]. Academics are skeptical about universal urban experiences and instead emphasize the importance of contextual specificity and local experiences within specific locations [52]. Consequently, the conclusions obtained in areas with high crime rates only immediately apply to locations with comparable statistics but different local contexts. However, as data utilization continues to evolve, the challenge is finding the right balance between automated analysis and interpretation based on context.

As municipalities become more data-driven in their policymaking, stakeholders must find practical ways to build mutual trust. The development of data-driven innovation needs to be translated into practicable urban policy making [53]. It needs to demonstrate how collaboration between different actors can be facilitated in the first place to prevent inefficient technological and policy design. Policy governance needs to be developed to make better decisions regarding which policies to adopt and when to exercise caution when implementing data-driven procedures [54], [55]. Research analysis results of big data analytics in the context of planning and governance can be used well in supporting the creation of sustainable smart city governance. However, its application to the planning and governance of the city of Magelang has yet to be carried out optimally.

The Magelang City government has created an integrated system integrated with Big Data through DataGO. However, implementing the data provided by the Magelang City government only functions as a form of data openness or data transparency sourced from regional apparatus organizations (OPD). The data presented is still being prepared to be the material for evaluation, planning, and management governance of the City of Magelang.

The results of the interview conducted with the Magelang City Information, Communication, and Statistics Office said that the readiness of human resources could have been better. This is shown based on the ability to provide data on each OPD. In addition, the interpretation of the resulting data still needs to be ready to be an evaluation material for planning and governance due to the lack of support for data analytics capabilities. The government is the leading actor in urban sector development planning. They do not use big data as a medium for evaluating urban development. The lack of mastery of Human Resources towards technology is also a significant factor. On the other hand, they only take advantage of collaborations, work visits, and acquisitions if they implement them correctly. In this condition, the weakness of this case gives a warning sign

for them to pay more attention to urban management planning to compete at the national and global levels.

4 Conclusion

When using big data analysis, there is a possibility of reaching incorrect results. Finding a common ground between completely automated analysis and interpretation based on the surrounding environment is a difficult task. The examination of large amounts of data cannot, on its own, recreate a comprehensive picture of the probable linkages between many areas of policy, such as crime and socioeconomic groupings in a certain setting. The innovation that is driven by data needs to be turned into urban policymaking that is practical. The governance of policies needs to be improved so that decisions regarding which policies to adopt can be made more effectively.

The city government of Magelang has properly presented open data through DataGO. However, the application of big data in urban planning governance and management has yet to be optimally implemented. Despite the availability of network systems and good infrastructure quality, human resources are not yet ready to utilize big data in urban planning and governance processes.

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