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Big Data in Smart Cities: Usage in *Kota Jababeka* for Customer Satisfaction

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ABSTRACT
Data continues to grow in importance in today's digital world, and when collected and combined in large quantities and various formats, it becomes what is known as "big data." In the industrial world, big data can be used for various things and in various ways; one of them is in managing a smart city. In the concept of the smart city, the city is integrated across people, information technology, and communication. Using big data in a smart city, area managers can find hidden patterns and discover the various tastes of consumers in the region, as well as other valuable information. In the Cikarang area of Bekasi, West Java, in Indonesia, an integrated industrial area known as Kota Jababeka is developing the smart city concept using big data. In an area of 5,600 hectares, there are 1,800 industrial tenants, 12,000 residents, and 5,000 commercial businesses. This study describes how the use of big data in Kota Jababeka is beneficial for city managers in satisfying the various needs of their constituents. We use descriptive, qualitative research methods, namely, interviews and studies of secondary data, as inputs. We conclude that the use of big data in Kota Jababeka makes it easier for city managers to provide services to their constituents and that the services can be provided in real time. However, sufficient funding is needed to develop big data, particularly for a smart city built by the private sector, such as Kota Jababeka. Therefore, any services that need to be improved for constituents from the big data findings need to be prioritized on the basis of available funds.

Keywords: *Big Data, Smart City, Service, City, Customer*

1. INTRODUCTION

Data is extremely important in today's digital era, driving progress in various fields. On the basis of historical textual research, Rosenberg (2013) states that the word "data" in English originated in the 17th century. The word "data" is the plural form of the word "datum," which is individual and separate but similar to other datum in the same set. In the 19th century, data creation and uses exploded along with rationalization and industrialization. Since then, data has continued to grow across most aspects of society. In the mid-20th century, with the computer revolution and the invention of supercomputers, data began to provide new objectivity that was based on extremely fast calculations. Data can also be used as inputs and as evidence in decision making. To that end, it must first be processed, i.e., data must be collected, compiled, and interpreted on the basis of some type of analysis. The more the data collected, the clearer the conclusions that can be drawn (Frith, 2017).

The data available in today's digital era is abundant and heterogeneous, both structured and unstructured. On a combined basis, the amount of data is thousands of times greater than the entire amount of printed material in the United States library (Mayer-Schonberger & Cukier, 2013). Because of the large amount of data that has been accumulated, the current era is described by Anderson (2008) as the "Petabyte Age" or "Zettabyte Age." This abundance of data has been described as big data (Ding & Ishwar, 2016). Big data can be interpreted as a very large amount of data that is fast-growing, that is in diverse formats, and that has value when the source of that data is accurate. The amount of data that defines the big data concept is at least 10.000. Algorithms allow big data to be processed and interpreted automatically. McKinsey defines big data as a data collection the size of which is greater than the ability of database software to capture, store, manage, and analyze. (Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., 2011)

Khan et al. (2014), state that big data can be characterized by three properties: (1) large quantities, (2) an inability to be categorized in a standard relational database, and (3) the ability to be generated, captured, and processed quickly. According to Boyd and Crawford (2012), big data is related to, and interacts with the following: (1) technology, in terms of maximizing computational power and accuracy of algorithms used to collect, analyze, connect, and compare the data, (2) analysis, i.e., using a large dataset to identify patterns that are useful in economic, social, technical, and legal decision making, (3) mythology, namely, the belief that big data offers more intelligence, knowledge, and insight than would be available without it, as well as offering objectivity and accuracy.

As mentioned in Taylor-sakyi (2016), based on the views of IBM scientists, big data has four dimensions: volume, velocity, variety, and veracity. Volume refers to the fact that the amount of data continues to grow as the number of mobile devices and social media users increases, and that many companies use large volumes of data to improve their decision making. At present, companies measure the volume of data they collect in terabytes, petabytes, and zettabytes, and there are estimates that as many as 2.5 quintillion bytes of data are created per day (Walker, 2015).

Velocity refers to the fact that data is always in motion. It can also mean the speed with which data is created, processed, and analyzed, reflecting the need for real-time decision making based on data collection (McAfee and Brynjolfsson, 2012). Variety means there are various sources of data, both raw and processed. Examples are data obtained from the web, email, photos, etc. Variety can also refer to the types of data available from many sources, for example from digital TV use, credit cards, bar codes, and medical devices, including structured, semi-structured, and unstructured data. (Minelli, Chambers, and Dhiraj, 2013). Veracity means the data is reliable, in other words there are no false or fake data elements (Taylor-sakyi, 2016).

Data collected for use as big data undergoes a series of processes, including collection, filtering, and classification, followed by data analysis, storage, sharing and publishing, retrieval and discovery. Data collection starts with raw data, for example data obtained from financial markets or scientific research. The raw data is then processed in the form of log files; data from cellular, satellite, laboratory, chat notes, microblog messages, or postings on internet forums may be added. With data classification, data may be sorted by various criteria, such as user habits and hobbies (Khan et al., 2014)

Big data is inevitable and is having a similar effect as the Industrial Revolution, as described in Anderson (2008), Manyika et al., (2011), and Mayer-Schonberger and Cukier (2013). Companies that do not use big data will be left behind (Manyika et al., 2011). Similarly, big cities can utilize big data effectively will be able to achieve more for their citizens (Dirks, Gurdgiev, and Keeling, 2010).

An example of using big data for self-development is smart city management. The seeds of the smart city concept can be found in discussions among academics and practitioners from the 1980s, regarding the city of the future. In his book, Phil Harris described a significant intervention carried out by Sheridan Tatsuno of NeoConcepts, a consultant associated with the Institute for Constructive Capitalism at the University of Texas at Austin, an institution founded by George Kosmetsky, an entrepreneur who became an academic. Tatsuno wrote about a place in the U.S. called Silicon Valley as an alternative example of the success of industrialization in the future. The place is a globally connected, networked city with economic nodes that are interactive, massive and connected by airports, highways, and communications networks. Furthermore, the city developed advanced communication technologies such as complex fiber optic and satellite cable systems. (Harris, 1992)

The smart city concept understands that cities are a key element of the future, because they play a major social and economic role throughout the world and have a major impact on the environment (Mori, 2012). A smart city is defined as a city that has instruments, is interconnected and intelligent, as defined below. Here, “instrument” refers to the ability to capture and integrate data directly through the use of sensors and personal equipment, “interconnection” means that data is integrated into a platform to enable communication of information between various municipal services, and “smart” or “intelligent” refers to the inclusion of various analytical services, including modeling, optimization, and visualization to make better operational decisions (Harrison et a., 2010).

Giffinger et al. (2007) stated that smart cities are the most successful in terms of mobility, human resources, quality of people's lives, economic success, and environment, so cities should be built intelligently. Meanwhile, Nam (2011) states that key elements of a smart city are the existence of technology, people, and institutions (governance and policy) that can make cities integrated in terms of their people, social capital, and information and communication technology, to trigger growth and sustain quality of life. Here, technology means a smart city is able to integrate its physical infrastructure with advanced digital technology, such as computer networks, apps, or mobile devices. “People” refers to a smart city’s ability to share knowledge, education, and human creativity among its residents. “Institutions” refers the need for support from the government, city managers, and policy makers in designing and implementing smart cities.

The smart city concept has been developed in several countries, including, Singapore and South Korea, where Songdo is a globally competitive, environmentally friendly and high-tech business city. Guangzhou, China, is designed as a city that attracts talent- and knowledge-based, skilled labor, and Masdar City in the United Arab Emirates is designed as a sustainable future oasis city, powered by renewable energy. (Kingsley, 2013)

In Indonesia, the smart city concept has been applied in several cities, including Jakarta, Bandung, Semarang, Yogyakarta, Surabaya, Denpasar, and Makassar. In addition to the city government, the private sector has helped to develop the smart city concept. For example, PT Jababeka developed an independent city, Kota Jababeka, with an area of 5,600 hectares. The residents and industrial tenants benefit from PT Jababeka's use of big data. It requires many steps to turn data collected in Kota Jababeka into big data, processing it so that it can provide useful information and facts that enhance comfort and security for the residents. How does Kota Jababeka use big data in developing a smart city?

2. METHODOLOGY

To answer that question, descriptive qualitative research was conducted. Creswell (2014) stated that qualitative research has a data-driven nature; the goal of qualitative research is not to test theory. One way to obtain data for qualitative research is through interviewing techniques that allow researchers to become active players in developing and understanding what is being studied. Holstein and Gubrium (1997) emphasize that the best results of research are achieved through a good collaboration between researchers and informants who are interviewed (Ritchie, Jane and Lewis, 2003).

In this case, the author interviewed the General Manager of PT Jababeka, the manager and developer of the smart city in the Kota Jababeka area. A study of secondary data was also carried out to clarify and complete the description of how big data is used by Kota Jababeka to develop as a smart city. In addition, the author conducted a crosscheck by interviewing two people who live in Kota Jababeka.

3. RESULT AND DISCUSSION

Kota Jababeka is an industrial, residential, and commercial area located 35 km east of Jakarta, in Cikarang, Bekasi, West Java, built in 1989 by PT Jababeka. The area occupies 5,600 hectares and has 1 million residents. There are various industries in this region, ranging from light to medium to heavy (such as automotive), including both Indonesian companies and multinational companies from at least 30 countries, such as Britain, the Netherlands, France, Germany, the U.S., Japan, Taiwan, China and Australia. Examples of industrial tenants in Kota Jababeka are Unilever (a food, beverage, cleaning products and body care company headquartered in the Netherlands and the United Kingdom), Samsung (the largest electronics company in Korea), and Mattel (the largest American toy company). There are at least 700,000 workers in this region along with 4,300 expatriates.

As an independent city developed using the concept of a smart city, Kota Jababeka has its own infrastructure, including clean water treatment, wastewater treatment, power plants, as well as dry ports and sea ports to facilitate export and import activities of its industrial tenants. To reach this area, other than by secondary roads, one can use three toll roads (KM 29, KM 31 Cikarang Barat, as well as KM 34.7 Cibatu). The city cooperates with Internet Service Providers such as Telkom, Biznet, Lintasarta, and Indosat to help them serve their customers' telecommunications needs. Beginning in 2014, 200 kilometers of fiber optics, the basic infrastructure of information technology, have been installed in Kota Jababeka. There are plans to connect to public transportation such as the Cikarang-Balaraja (Mass Rapid Transit) MRT and Jakarta-Cikarang LRT (Light Rail Transit).

Kota Jababeka began using big data in 2016. PT Jababeka, which manages Kota Jababeka, utilizes big data to provide satisfactory services to its customers, focusing on its 1,800 industrial tenants because they are large and have a significant impact on PT Jababeka and the environment. With big data, PT Jababeka can predict customers' needs or determine what management needs to do to prevent customer complaints.

The use of big data in Kota Jababeka involves a series of processes. Initially, management began to collect data that had been recorded since 1997. Examples include data from the records of the Customer Service Department in the form of data about complaints made by telephone, SMS, or email. The data was then manually rewritten to conform to modern digital era standards. The collected data is now tabulated and classified as needed, so that a PT Jababeka manager can determine the needs of Kota Jababeka customers that are the most urgent.

Figure 1 Courtesy of PT Jababeka

Today, Kota Jababeka uses big data. The use of big data in Kota Jababeka began with PT Jababeka's development of the JSMART (Jababeka System Management for Advance Report) in 2016. JSMART is a digital application or app available on the Google Play Store and can be used by Kota Jababeka's customers to submit complaints, or give input or suggestions related to their needs in terms of security, water distribution or water availability, environmental conditions, citizen relationships or relationships with other residents of Kota Jababeka, garden and cleaning, and the provision of cleanliness. JSMART continues to be developed and updated to integrate all of Kota Jababeka needs.

JSMART is an example of computer-mediated communication (CMC), where "computer" refers not only to desktop and laptop computers, but also to smartphones, tablets, and other mobile devices. Simply stated, CMC is communication that occurs between people using some type of computer, and research on CMC is increasing as more people use the internet and computers.

The data obtained from JSMART is referred to by the PT Jababeka manager as "waiting" data. Data that is "self-seeking" or proactive is obtained from monitoring CCTVs (Closed Circuit Television) or closed television signals installed in Kota Jababeka as a surveillance system. This system offers various benefits. For example, city managers can determine the number of vehicles that come into and out of Kota Jababeka every day, along with details such as the number of small vehicles and large vehicles. Data obtained from the system can be used to calculate the age and condition of the road, notifying management if a vehicle has stopped too long on a road in the area, either because it is parked, broken down, or stalled, so the city manager can take actions to address the problem. Furthermore, in order to make residents and industrial tenants of Kota Jababeka feel satisfied that their needs are being met, city managers have established an SLA (Service Level Agreement) or SLG (Service Level Guarantee) for dealing with customers complaints. For example, when someone complains about a problem at a facility, the manager determines the deadline for the issued to be addressed, whether that is a matter of days, weeks or more. Handling complaints is related to the budget that a manager must take into account, so managers estimate permutations of possible customer complaints which are then included in the manager's annual maintenance budget. In addition, managers try to engage with other consumers and stakeholders to verify that the complaints are valid.

The method adopted by the Kota Jababeka managers to use big data in developing a smart city is known as Sensing-Understanding-Action. The goal of "sensing" is to capture data, via sensors in the CCTVs in the surveillance system installed in the region as well as from input and suggestions from residents through the JSMART app. "Understanding" refers to tabulating, processing and analyzing the data that is captured (in this case using popular statistical programming languages, namely R or Python), to produce an action or response from the managers to consumers. Managers can immediately know what problems residents are facing and the reasons for their complaints, thus facilitating communication between city managers and their customers.

The city manager of Kota Jababeka is currently developing a POC (Proof of Concept) for a system that will monitor water pressure through pipes in the region so that customers' water supply needs in terms of volume, pressure, and quality can be addressed in real time. That system is very important because the industrial tenants of Kota Jababeka depend heavily on water supply in their production processes. In the future, the manager plans to be able to distribute water and electricity for each area and every tenant efficiently with the ultimate goal of providing satisfaction to the residents and industrial tenants who are customers of Kota Jababeka.

The city manager is also conducting a customer satisfaction census using Survey Monkey, the results of which will be crossed with data obtained from the JSMART app. Thus, the data collected and processed by the manager is becoming more complete. The completeness of the data can improve customer satisfaction within the smart city of Kota Jababeka.

The challenge of Kota Jababeka in the future is to be able to achieve stability in managing the city that, incorporates information from apps, processes, infrastructure, and technology, so that "society 5.0" can be created as well as an ideal smart city. The concept of society 5.0, which refers to an information society centered on economic development, has been discussed by the Japanese government. Citizens of such a society can enjoy a high quality of life, be active, and feel secure because of the availability of various goods and services needed. (Fukuyama, 2018)

Another challenge is that, because Kota Jababeka is managed by the private sector, implementing smart city development takes place more slowly than the smart city managed by the government. Smart cities managed by the private sector need to seek investment first, which takes longer than funding for smart cities managed by the government.

From the description above, it can be seen that big data as used by Kota Jababeka can be one of the tools to determine the needs of city residents, just as big data makes it easier for businesses to determine the needs of their customers. The JSMART app made by Kota Jababeka, which contributes to big data, is a form of service communication. Media as communication is

progressing rapidly, and the JSMART app is one of example of that progress, along with the existence of the Internet of Things (IoT). Dohr (2010) states that IoT is a development of the previous concept, namely that computing is now everywhere. Sundmaeker, et al. (2010) argue that IoT allows people and things to connect anytime, anywhere, whatever they are doing. Ideally IoT can use any network and service. In Kota Jababeka, implementing IoT has been done in the form of CCTV services, record meters, and PJU (Public Street Lighting), all of which will support big data.

The big data utilized by Kota Jababeka to provide satisfaction for its residents and industrial tenants can also be a form of service to increase customer loyalty. The Social Exchange Theory, initiated by Thibaut and Kelley (1959), states that individuals consider the economic context of their relationships. In this case, the individual calculates the sacrifice (cost) then compares it with the rewards obtained from maintaining a relationship. Costs are a negative value in a relationship, while rewards are positive. Relationships will continue to run when they have a net positive value, i.e., when the individual's reward is greater than his or her sacrifices. Conversely, the relationship will slacken or even end when it has a negative value, i.e., the sacrifice incurred by an individual is greater than the reward obtained (Griffin, 2012). With big data, Kota Jababeka residents will feel their relationship with the city has positive value, because the reward they receive will increase based on the fulfillment of their needs by the city management.

The satisfaction of the residents and industrial tenants can be seen from their comments, which state that Kota Jababeka is superior to other areas in Bekasi because the city planning is neat. Access to and from Kota Jababeka and other locations is easy and fast because the roads and transportation facilities are adequate. The internet service in Kota Jababeka is also good. Public facilities in that area are also complete.

The use of big data in Kota Jababeka also shows a form of stimulus and response; when residents provide a stimulus in the form of a complaint or give feedback through their apps, for example, city management will respond quickly with the help of big data and will take action to correct the problems.

According to the concept of Public Relations, the use of big data in Kota Jababeka will continue to succeed if it supports its enablers, in this case the infrastructure and technology such as big data analytics and Internet of Things (IoT), and those who run and supervise that technology. Smith (2013) defines enablers as those entities that serve as regulators by setting standards for organization, or in this case, the parties that make it possible for Kota Jababeka city management to communicate with the city's residents.

Engagement between city management and customers will continue because the management responds to complaints and customers feedback using technology and big data. However, city management must also pay attention to any limiters, i.e., parties who want to slow technological progress. For example, some people who feel threatened because their jobs are being replaced by technology or automation. If limiters are invited to communicate with city management, they will better understand and be willing to support the ideal smart city and the use of big data.

The use of big data in Kota Jababeka which was developed using the smart city concept can be analyzed from the perspective of the theory of the Social Construction of Technology, developed by Pinch and Bijker. According to this theory, a social structure can influence the development of technology (Pinch and Bijker, 1984). When there is a change in technology, there is also a change in society because between there is a relationship between a society and its technology. Therefore, since societies today commonly use smartphone, the internet, and apps, those tools must be understood by city managers so the city can use the technologies that are commonly used in the society. Kota Jababeka has already done that via JSMART, one of tools used to obtain data from Kota Jababeka's customers who commonly use smartphones and apps.

4. CONCLUSION

Big data is needed in today's digital era, especially in smart cities, because it can make it easier for city managers to register complaints or feedback from customers. Data that, in the past, needed to be collected manually can now be easily obtained digitally with the use of big data.

With big data, city managers can receive complaints or feedback from customers in real time, so that actions to deal with problems can be taken as soon as possible. However, to deal with or to improve on a situation, financing cannot be ignored. The speed of handling problems or providing services affects the city's budget. The bigger the budget, the faster the resident's needs will be made, and vice versa.

Technological advances in big data that are used by smart cities need to be balanced with advances in human skills and thinking; otherwise, technology's progress will be limited since technology still requires human intervention. In other words, technology is an extension of the human hand. In the past, humans communicated with each other using face to face or direct communication; now, with the help of technology, humans can communicate with one another through tools, with one of those tools being big data.

The use of big data in Kota Jababeka to develop that smart city will be more effective if city management

pays more attention to enablers and limiters there. In addition, the city can pay more attention to whether customers are aware of the use of big data in the smart city. More effective communication between the city managers, residents and industrial tenants is needed so that both customers and city managers are satisfied.

REFERENCES

[1] Anderson, C. (2008). The End of Theory: The Data Deluge Makes the Scientific Method Obsolete. *Journal of Business and Technical Communication*, *November 6* (WIRED)

[2] Boyd, D. (2012). Critical Questions for Big Data. *Information, Communication & Society*, *Vol 15*(5)

[3] Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Fourth Edition)*. Los Angeles-US: SAGE Publications, Inc

[4] Ding, W., & Ishwar, P. (2016). Big Social Data Analytics in Journalism and Mass Communication : Comparing Dictionary-Based Text Analysis and Unsupervised Topic Modeling

[5] Dirks, S., Gurdgiev, C., & Keeling, M. (2010). *Smarter Cities for Smarter Growth*.

[6] Dohr, A., et al. (2010). The Internet of Things for Ambient Assisted Living. In *Seventh International Conference on Information Technology: New Generations, Conference Proceedings* (pp. 804–809)

[7] Frith, J. (2017). Big Data, Technical Communication, and the Smart City. *Journal of Business and Technical Communication*, *31*(2), pp. 168–187

[8] Fukuyama, M. (2018). Society 5.0: Aiming for a New Human-Centered Society. *Japan SPOTLIGHT*, *July-August*, pp. 47–50

[9] Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovi, N., & Meijers, E. (2007). Smart Cities: Ranking of European Medium-Sized Cities. Vienna, Austria: Centre of Regional Science (SRF). *Vienna University of Technology*

[10] Griffin, E. (2012). *A First Look At Communication Theory-Eight Edition*. New York: McGraw-Hill

[11] Harris, P. H. (1992). The Technopolis Phenomenon - Smart Cities, Fast Systems, Global Networks. *Behavioral Science*, *Vol 38:2*

[12] Harrison, B. Eckman, R. Hamilton, P. Hartswick, J. Kalagnanam, J. Paraszczak, and P. W. (2010). Foundations for Smarter Cities. *IBM Journal of Research and Development*, *Vol 54:4*, pp. 1–16

[13] Herring, Susan C. (2005). Computer-Mediated Communication on the Internet. *Annual Review of Information Science and Technology*. Feb 2005, pp. 109

[14] Khan, N., Yaqoob, I., Abaker, I., Hashem, T., Inayat, Z., Kamaleldin, W., Gani, A. (2014). Big Data: Survey, Technologies, Opportunities, and Challenges, *2014*

[15] Kingsley, P. (2013). Masdar: The Shifting Goalposts of Abu Dhabi's Ambitious Eco-City. *Wired UK, Technology*

[16] Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., et al. (2011). *Big Data: The Next Frontier for Innovation, Competition, and Productivity*. New York: McKinsey Global Institute

[17] Mayer-Schonberger, V., & & Cukier, K. (2013). *Big Data: A Revolution That Will Transform How We Live, Work, and Think*. New York, NY: Eamon Dolan/Houghton Mifflin Harcourt

[18] McAfee, A., & Brynjolfsson, E. (2012). Big Data: The Management Revolution. *Harvard Business Review*, pp. 61–68

[19] Minelli, M., Chambers, M., & Dhiraj, A. (2013). *Big Data, Big Analytics*. New Jersey: John Wiley & Sons

[20] Mori, and A. C. (2012). Review of Sustainability Indices and Indicators: Towards a New City Sustainability Index (CSI). *Environmental Impact Assessment Review*, *Vol 32:1*, pp. 94–106

[21] Nam, and T. A. P. (2011). Conceptualizing Smart City with Dimensions of Technology, People, and Institutions. In *Proc. 12th Conference on Digital Government Research*. M.D.: College Park

[22] Pinch, Trevor J. and Wiebe E. Bijker. The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science* 14 (August 1984), pp. 399–441

[23] Ritchie, Jane and Lewis, J. (2003). *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. London-Thousand Oaks-New Delhi: SAGE Publications

[24] Rosenberg, D. (2013). Data Before the Fact. *Raw Data Is an Oxymoron*, pp. 15–40

[25] Smith, Ronald D. (2013). *Strategic Planning for Public Relations*, 4th Edition. New York: Routledge-Taylor & Francis

[26] Sundmaeker, H., Guillemin, P., Friess, P. and Woelfflé, S. (Eds). (2010). Vision and Challenges for Realising the Internet of Things. *European*

Commission, Information Society and Media, Brussels

[27] Taylor-sakyi, K. (2016). *Big Data: Understanding Big Data*. January 2016.

[28] Walker, R. (2015). *From Big Data to Big Profits, Success with Data and Analytics.* New York: Oxford University Press