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Smart City: The main assist factor for smart cities Analysis: a systematic review

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ABSTRACT IN ENGLISH

Initially, A smart city was originally a solution used to deal with the environmental crisis that took place in the 20th century. Smart city concepts derive from the use of technology and knowledge to enhance society's efficiency and competitiveness. The indicators are needed that support the achievement of a smart city. We will analyze the indicators that can impact the smart city achievement in this article. The aim of this study is to identify the indicators that influence the process of developing a smart city in order to be able to help other cities to establish sustainable policies and work plans so that they can prepare themselves for a smart city consistently. From the results of content analysis and descriptions of literature reviews, it is concluded that the indicators most used in the assessment of smart cities are divided into eight groups of indicators, including governance, economy, living, mobility, environment, people, branding, and demography.

1. Introduction

The growing flow of urbanization poses new challenges for urban areas. It is starting with socio-economic initiatives, hygiene, education, waste management, and mobilization. On the other hand, there are a variety of demands in an increasingly modern and developed community, such as a comfortable living and working environment, decent public space, and ease of mobility[1]. In addition, efforts to develop urban infrastructure and services have begun to be pursued by major cities in the world over the last two decades, with the goal of creating improved environmental, social, and economic conditions. This initiative then contributed to the notion of a smart city that was later embraced around the world by developed cities[2]. Indeed, smart cities have been a worldwide trend, and Indonesia is no exception. It is not only the government's pride to have a nickname for a smart city, but a smart city is a big step in advancing cities in a nation that relies on information and communication technology. The rapid growth rate of ICT provides room for immense innovation and should be used as an impetus for the government to promote efficient, sustainable, and progressive urban development [3].

In the 1990s, the word "smart city" was first recognized. At that time, "smart city" concentrated on the creation of new infrastructure for information and communication technology (ICT)[4][5]. A smart city is literally defined as a smart city with a concept designed to benefit the community, especially to be efficient and effective in managing resources[2]. Based on terminology, a city is understood as a unique spatial dimension where it becomes a place of social and economic exchange, whereas intelligence is the ability to understand and solve important problems. Then a smart city is described as a space for human coexistence through the sustainable use of established resources and capabilities [6]. In urban planning and development, knowledge is defined as a philosophy for the government or public agencies to determine the direction of strategic policies. This is focused on the notion of a smart city as a city

with freedom of expression and access to public information services. In addition, smart is often understood as a service product capable of thinking on its own. This gives rise to the concept of a smart city as a city that can track infrastructure conditions by making preventive action plans to achieve maximum service for the community [7].
Although the word city has been used widely by different nations, there is no general understanding regarding the smart city that has been agreed to be used universally [3][4][5]. The word smart city is a definition consisting of multiple components or dimensions [3]. The integration of the city's dimensions, starting with transport, health care, electricity, education, utilities, food, buildings, water, and safety, would create a smart city [8][9]. Some researchers argue that all dimensions must work simultaneously, it cannot only include the smart city model into one dimension [10]. The smart city dimension is then separated into several domains and indexes according to the needs of urban development. Smart city measurement methods and indexes have been developed according to the needs and concepts of smart cities. The smart city maturity level rating system based on several indicators can improve the management and development of cities to become more targeted. Besides, by dividing the assessment of the maturity level of a smart city into several indicators, it can make it easier for policymakers to decide where the direction of urban development is.
Some studies have measured a region's smart city maturity level, but few have compared the measurement metrics that have a direct impact on a smart city's maturity level. Researchers want to find out what metrics are most commonly utilized and have a direct effect on the maturity level of smart cities by using the findings of previous studies on smart city maturity levels. In evaluating the maturity level of a smart city, this paper will perform a literature review on what evaluation measures are currently used in many countries to decide the degree of maturity in smart cities, by understanding the indicators used and seeing the effects of the assessment, it is hoped that we will be able to assess the determination of indicators that will be used in the future. Realizing the key indicators that can be used as indicators for the evaluation of smart cities, it is hoped that the maturity value of smart cities in the world, especially Indonesia, will increase. Researchers hope that the findings of this research can be used as a reference in determining the indicators for assessing smart cities according to regional needs. There are at least two research questions that will be responsible for this research, based on the problems described, namely what indicators are widely used in measuring a smart city's maturity level after the indicators used in calculating the maturity level will then be analyzed what indicators are most commonly used and has an influence on the calculation of the maturity level of the smart city. This study of literature consists of research methods, research questions, results, and discussion, and finally ends with a conclusion.

2. Research Methods

A literature review, quest, and analysis of literature related to smart cities and the evaluation indicators used is the research tool used in this research. The researcher adopts a method for performing a systematic review by kitchen ham in the conduct of a thorough review method. The approach of a systematic review can be used to classify a particular domain issue and extract information from the analysis.[11]. A systematic review can be used as a research method as well as the process of identifying and critically assessing relevant research. Besides, a systematic review can also be used to collect and analyze data from these studies[12]. To make it easier for readers, the researcher puts the systematic review process into fig. 1.
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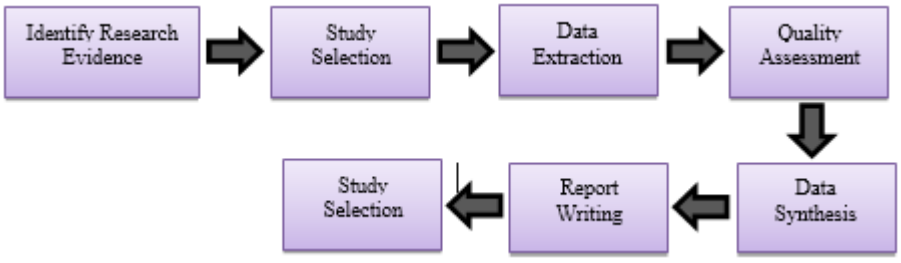

Fig. 1 - Systematic Review Process

Based on Fig. 1, each part will be divided into sub-sections as below;

- Identify Research

The predetermined problem topics can be developed into a research question to focus on the search journals that will be conducted. The subject posed in this systematic analysis lies in the use of which indicators are calculated to identify the level of maturity of smart cities in order to compare the most frequently used indicators that help the achievement of a better level of maturity of smart cities. These findings are supposed to promote the formulation of strategic work plans in a sustainable manner for the growth and development of smart cities. Based on the selected topics, the research questions from the systematic literature review are:

RQ1: What are the domains measured in the assessment and maturity level determination of smart cities?
RQ2: What domains most influence the maturity level of the smart city? as well as the causes behind the domain influence?

- Study Selection

After determining the research question, the researcher determines the type of data that will be used to conduct a systematic review. Researchers used a journal/paper conference with a time span of 2015-2020 as review material. Search for journals was carried out in 3 main databases, namely IEEE, Scopus, and Science Direct. The researcher determined the keywords to be used in the journal search process. The keywords used are keywords related to the subject of research being raised, such as smart cities, smart city, smart, sustainable cities, smart people, urban indicators, smart city indicators, sustainable city, urban development, smart city maturity level, smart domain city, and smart governance.

- Quality Assessment

In classifying papers, researchers use many criteria. Titles, abstracts, and journal content are among the parameters used in the journal classification process. The criteria for determining the content of journals that are used include:

Table 1 - List of Quality Assessment

	Quality Assessment	Answer
QA1	Are papers/journals published in the period 2015-2020?	Yes, in the paper/journal, it is written that the paper/journal was published in the 2015-2020 timeframe
QA2	Does the paper/journal use a specific framework in determining assessment indicators?	No, only some journals write down the framework used.

3. Result Data

The search for journals that have been carried out is based on the keywords previously determined in the research method, all keywords are used on the three portals that have been selected by the researcher. From the thousands of journals available, the researcher chooses several journals that are by the quality assessment that has been determined in the research method. The results based on keywords on the three journal portals are as follows:

Table 2 - List of Search Result

Portal	Result based on keywords	Selected Journal
IEEE	2329	7
Scopus	32.069	3
Science Direct	16.636	11

The journal/paper is extracted again produce the following journals on the basis of the quality evaluation defined in the research method :

Table 3 - Reviewed Literature

No	Author	Journal	References	Domain
1	Jally Sahoo; Mamata Rath 2017	Study and Analysis of Smart Applications in Smart City Context	[13]	Smart Living Smart Mobility
2	Grzegorz Masika , Iwona Sagana , James W. Scotta 2021	Smart City strategies and new urban development policies in the Polish context	[14][14][14]	E-governance Social Area Education People
3	Michael Strasser; Nico Weiner; Sahin Albayrak 2016	A maturity framework to evaluate smart city service solutions	[15]	Domain Mobility Economy
4	Aisyah Nuraeni, Hendra Sandhi Firmansyah, Ganjar Setya Pribadi, Ahmad	Smart City Evaluation Model in Bandung, West Java, Indonesia	[16]	Smart Living Smart Economy Smart Branding Smart Governance

	Munandar, Leni Herdiani, Nurwathi 2019			Smart Environment Smart Society.
5	Muhammad Akmal Juniawan, Puspa Sandhyaduhita, Betty Purwandari, Satrio Baskoro Yudhoatmojo, Made Ayu Aristyana Dewi 2017	Smart government assessment using Scottish Smart City Maturity Model: A case study of Depok city	[17]	Strategic Intent Data Technology Governance and Service Delivery Models Stakeholder Engagement
6	Hendra Sandhi Firmanyah, Suhono H. Supangkat, Arry A. Arman, Ryan Adhitya 2017	Searching smart city in Indonesia through maturity model analysis: (Case study in 10 cities)	[18]	Economy Society Environment ICT Governance People
7	Deepti Prasad, Tooran Alizadeh 2020	What Makes Indian Cities Smart? A Policy Analysis of Smart Cities Mission	[19]	Smart Citizen Smart Economy Smart Environment Infrastructure Smart Governance
8	Nuno Vasco M.L., Shahid Farooq 2019	Smart City Governance Model for Pakistan	[20]	Citizen Governance
9	Mengmeng Wang, Tao Zhou, Di Wang 2020	Tracking the evolution processes of **smart cities** in China by assessing performance and efficiency	[21]	Input : Smart Infrastructure Human Social Capital Output : Economy Environment Society
10	Gokhan Ozkaya, Ceren Erdin 2020	Evaluation of smart and sustainable cities through a hybrid MCDM approach based on ANP and TOPSIS technique	[22]	Smart Living Smart Economy Smart Mobility Smart Governance Smart Environment Smart People
11	Ayyoob Sharifi 2020	A global dataset on tools, frameworks, and **indicator** sets for **smart city** assessmen t	[23]	Economy Culture Environment Society and Culture Technology Innovation Infrastructure Smart Service Mobility Governance Urban Planning Human Infrastructure Living Standard Service Delivery Healthcare
12	Aapo Huovila, Peter Bosch, Miimu Airaksinen	Comparative analysis of standardized indicators for Smart sustainable cities: What indicators and standards to use and	[24]	Input Indicators: Resources Process Indicators : Master Plan

		when?		Plan Activity output Indicators : Transportation Outcome Indicators : Quality Living Impact Indicators : Evaluation Natural Environment Built Environment Water & Waste Transport Energy Economy Education Culture ICT
13	Kamila Borsekovaa, Samuel Korónya, Anna Vaňováb, Katarína Vitálišováb 2018	Functionality between the size and indicators of smart cities: A research challenge with policy implications	[25]	Smart Economy Smart People Smart Governance Smart Mobility Smart Environment Smart Living
14	Atul Anand, D.Dsilva Winfred Rufuss, V.Rajkumar, L.Suganthi 2017	Evaluation of Sustainability Indicators in Smart Cities for India Using MCDM Approach	[26]	Input Criteria : Mobility (MO) Economy (EC) Environment (EV) Society (SO) Energy (EN) Output Criteria : Quality of Life (QL) Self-Sustenance (SS) Economic Prosperity
15	Julio Cesar Ferro De Guimaraes, Eliana Andrea Severo, Luiz Antonio Felix Júnior, Wenyka Preston Leite Batista Da Costa, Fernanda Tasso Salmoria 2020	Governance and quality of life in smart cities: Towards sustainable development goals	[27]	Governance Quality of Life
16	Alvaro Palomo-Navarro, Julio Navío-Marc 2018	Smart city networks' governance: The Spanish smart city network case study	[28]	Social Innovation Energy Environment Infrastructures and livability Urban Mobility Governance Economy and Business
17	Celso Machado Junior, Daielly Melina Nassif Mantovani Ribeiro, Raquel da Silva Pereira, Roberto Bazanini 2018	Do Brazilian cities want to become smart or sustainable?	[29]	Social (7) Economy(3) Fiscal(5) Digital Dimension(2). Divided into 3 categories: Small Cities Medium-sized Cities Big Cities
18	Pierpaolo Girardi, Andrea Temporelli 2017	Smartainability: a methodology for assessing the	[30]	Measures 3 main layers of technology infrastructure: Energy

		sustainability of the smart city		Telecommunications Mobility (sustainable vehicles)
19	Alexander Sokolov, Natalia Veselitskaya, Vicente Carabias, Onur Yildirim 2019	Scenario-based identification of key factors for smart cities development policies	[31]	with 4 analytical dimensions: Economy Energy Environment Living. Demography Economy Transport and Infrastructure Society Planning Sustainability and Resources Land use and Affordable housing Access to Information Technology Planning.
20	Shiyao Zhu, Dezhi Li, Haibo Feng 2019	Is **smart city** resilient? Evidence from China	[32]	Infrastructure Economic Social Environment

Based on Table 3 above, it is possible to use 20 journals and paper conferences to address research questions that indicate what metrics are required to determine the readiness level of a smart city. Journals are chosen by researchers usually use the same approach, which is to divide the study area into several parts. By taking into account, several factors, including geography, education, and population, the division of the territory takes place. Overall, of the 20 journals reviewed by researchers, it is found that the economic measure is the most commonly used. The indicators in Table 1 are categorized by researchers into eight key indicators. The investigator shows eight key indicators in Table 2 to make it simpler for readers:

Table 4 - List of Search Result

Group of Indicators	Indicators
Smart Governance	Public Service Management Efficiency Public Policy
Smart Economy	Industrial Public Welfare Financial transaction Innovation
Smart Living	Harmonization Health Security Education
Smart People	Communication Social Innovation Human Capital Access Information
Smart Environment	Energy Management Resource Protection
Smart Mobility	ICT Technology Innovation Techno Planning Digital Mobility
Smart Branding	Tourism Ecosystem City Face Styling
Demography	

The percentage results of the indicators used will be obtained based on the grouping of indicators into eight major groups of indicators. The percentage results will be figured in Fig.2.

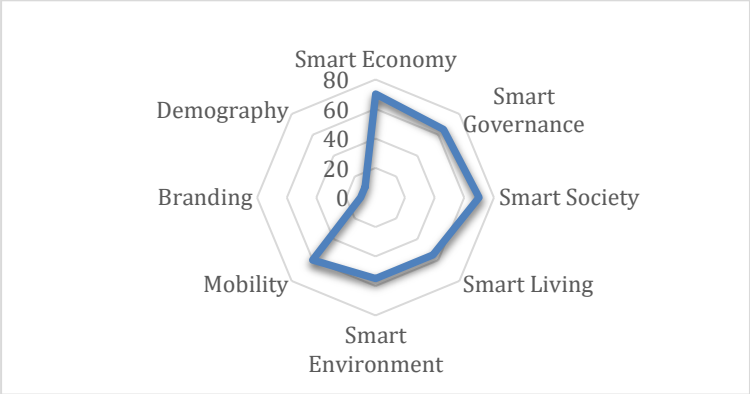

Fig. 2 - Chart of the indicator results obtained

From Fig. 2 that more than half of the researchers agree that economics and society are essential indicators of smart city growth. This is demonstrated by more than 80% of the research conveying that economic indicators have the highest importance for smart city readiness levels in the evaluation process. A strong city economy, which can help to increase the value of other indicators, will have an effect on smart living through the production of quality infrastructure and good health services, and a good economy will also have an impact on better governance [31]. Thus the economy would indirectly have an effect on three metrics at once: improving the quality of life (smart living), maximum governance and master plans (smart governance), and better access to knowledge and education (smart citizen).

The second position was accompanied by smart governance and smart mobility. As a measure of smart city readiness, as many as 65 percent of journals/papers include smart governance and smart mobility. This shows that the government, especially in decision-making and local governance which is then supported by the local community, has a strong enough power in a smart city [20]. Smart governance is an important input that will generate performance in the form of proper transportation (smart mobility) and life viability. Some researchers also claim (smart living). The presence of IoT technology is one of the attempts made to enhance the quality of the lives of people. This new technology is hoped to be able to change human life in all respects[33]. In safe city life, good policies will result.

At 55%, smart living is in third place, as an output of other indicators such as finance, governance, and society. Some journals/papers include smart living. The worth of life for the better would be improved by a strong economy, good government governance, and good education [26][28]. Also, the distance will decrease between big cities and small cities.

Branding and demographics are the indicators that are the least used to measure the readiness standard that only exceeds 20% of the overall journal. This is because some researchers agree that branding is an economic sub-indicator, but some researchers claim that branding is a separate indicator because entrepreneurship, the employment market, industrial economies, and financial transactions are the focus of the smart economy, while branding is a way of doing so. It has marketing areas such as tourism and culture [16].

Although smart society is one of the most widely used indicators of smart city measurement, smart society is one of the lowest score indicators with a value of <10%, especially in relation to education [25][26]. The social problem is a challenge in itself in the development of smart cities, in particular small towns, so that special attention is needed to enhance the importance of its feasibility [18][25][31].

4. Conclusion

After understanding and analyzing literature reviews related to what indicators are most widely used in supporting smart city development based on the journals that have been selected, the supporting indicators for smart cities are divided into eight main indicator groups, namely: Smart Governance, Smart Economy, Smart Living, Smart Environment, Smart mobility, Smart Citizen, Smart Branding, and Demography. This paper succeeds in proving that of the eight main indicators, governance and economy indicators almost dominate all journals with a total of 70%. In

governance indicators, sub-indicators of governance and services are the main concern, while economic indicators are the main key to the success of smart city development because a strong economy will create good infrastructure and quality of life. Good quality of life will provide an adequate education. A more in-depth study of the system to be used with the community, history, and needs of the relevant regions is required for further research so that a maximum evaluation is made..

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Disclaimer

The authors whose names are written certify that they have no conflict of interest.

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