Measuring Smart Mobility Readiness Index: A Bandung Perspective

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Abstract- The increasing number urban residents brings various challenges for city lifeness, one of which is transportation problems. In Indonesia, the problem is very serious in several cities, including in Bandung. There are a number of strategic issues related to transportation, including low performance (quality and quantity) of public transport services, low frequency of Trans Metro Bandung buses and school buses, lack of orderly pedestrian facilities, low level of community discipline in traffic and accident rates. In addition, transportation also causes high pollution due to vehicle exhaust emissions. In overcoming these problems, the city of Bandung tried to apply the concept of smart mobility as one dimension of smart city. In previous research, variables and indicators have been established which are parameters for measuring smart mobility. The variables that become parameters are location efficiency, reliable mobility, health and safety, environmental stewardship, social equity, robust economy and people. In this study aims to measure the index for each variable and indicator to produce a final index to measure smart mobility that has been applied in the city of Bandung. This research is a mix method research which is an experimental research in the form of data collection using analytical and descriptive data through data search to obtain an index. Descriptive data collection was done through searching for best practice data and secondary data which was confirmed through focus group discussions / interviews with the speakers. Resource persons are selected using the quadruple helix concept: government, business people, researchers in the field of smart mobility and users transportation services. This study found the readiness index of smart mobility in the city of Bandung is in number 61. The lowest smart mobility indicator application is Congestion Effects on Productivity with a value of 46.15, where the majority speakers agree that the level congestion in the city of Bandung is still high. While the highest indicator is Distribution Access and Mobility with a value of 68.71, where the majority speakers agree that public vehicle rates in the city of Bandung are still in the cheap price.

CCS Concepts: • **General and reference** → **Reliability**; *Performance*; • **Computer systems organization** → Maintainability and maintenance

Index Terms- Smart city, smart mobility, Bandung, Indonesia

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Ben Trovato, G.K.M. Tobin, Lars Thørväld, Lawrence P. Leipuner, Sean Fogarty, Charles Palmer, John Smith, and Julius P. Kumquat. 1997. SIG Paper in word Format. *ACM J. Comput. Cult. Herit*. 9, 4, Article 39 (March 2010),4 pages.

I. INTRODUCTION

Bandung as one of the largest cities in Indonesia with a population density of 15,713 people / square km has a role as a tourist destination city, a center business activities and an education city [1]. This makes Bandung a densely populated city and has a high level of mobility. The number vehicles driving in Bandung also experienced growth, which recorded an increase in vehicle volume of 11% from the previous year [2].

Bandung as one of the major cities in Indonesia, initiated the concept of smart cities management. There are ten priority areas that applied to the Smart City of Bandung: governance, education, transportation, energy, health, environment, security, society, finance, and trading [3]. Smart mobility is a dimension of smart city, which is described as a highly code, software-mediated, and data-driven transportation concept. With its role as one of the pillars of the city in having the ability of technology absorption to create sustainable development, smart mobility implementation must be fixed properly.

1.1 Smart Mobility in Bandung

Based on the performance report of Transportation Department Bandung in 2015, transportation is one of the strategic issues, including the low performance (quality and quantity) of public transport services, the low frequency of Trans Metro Bandung buses and school buses, lack of pedestrian facilities feet including connectivity between activity centers, low levels of community discipline in traffic, low facilities, services and vehicle parking policies and accident rates [4].

The air quality in the city of Bandung is currently very worrying where more than 70% of the air is polluted by industrial pollution, motor vehicle exhaust and so on. Where the environmental impact is the transportation sector contributes more than 66.34 percent of exhaust emissions in the city of Bandung, while the social impact is the number of traffic accidents that continue to increase to 22.37 percent per year [1].

The Bandung city government has made an effort to realize smart mobility, including the construction 10,000 points free wifi access and the construction Bandung Command Center which is the control center of the city of Bandung which is integrated with the CCTV system. As of September 2017, the Bandung city government has made 354 applications to facilitate the public service process and accelerate the performance of the civil servant [5].

II. RESEARCH OBJECTIVES AND QUESTIONS

Objective of this research is to measuring readiness index smart mobility in Bandung to support trasnportation management that have been implemented by city government and related institutions. The research questions of this study are as follows:

1. How does the secondary data from best practices related to variables and indicators to measure Bandung smart mobility readiness index?
2. How does the secondary data from Bandung related to variables and indicators to measure Bandung smart mobility readiness index?
3. In accordance to the experience, feeling, and insight of respondents, as well as based on secondary data of Bandung and best practices, how much are the values of variables and indicators to measure Bandung smart mobility readiness index?
4. Based on the index in point 3. how is the level of readiness of Bandung related implementation of smart mobility?
5. Based on the index ranks obtained, how the results of the comparison of analytic data with the assessment of smart mobility index?
6. What can be done by stakeholders of Bandung in order to implementing the city of Bandung as a smart city in terms of smart mobility variables?

III. RESEARCH METHODOLOGY

Research method that being used in this research is a mix method, an explorative research through data retrieval using descriptive research and data analytic in finding data related to readiness index. The explorative research on this project is aim to compare between selected data based on interview result and widely captured data based on data analytic. Big data being retrieved through crawling data from social media twitter related to the concept of smart mobiltiy in general and indicators those have the highest and lowest value based on readiness index.

In descriptive research, the first step is to review the variables and indicators based on research conducted by [6]. The second phase is the search for best practice data of smart mobility application, followed by searching data about the application of smart mobility in Bandung. The fourth stage is to conduct structured interviews to the respondents that were selected from quadruple helix dimensions, where this approach involves four parties, namely: government, business player, researcher or expertise in smart mobility and citizen [7]. The respondents are directly involved in the implementation of smart mobility in Bandung, and can provide the desired information. The fifth stage, is measuring index of readiness from the value of indicators that have been obtained in the previous stage. Stages of this research can be illustrated as shown in Fig. 1.

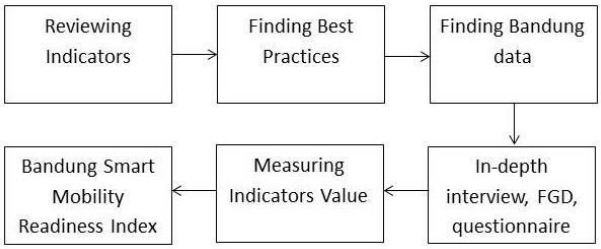

Fig. 1. Research stages.

Meanwhile, the respondents of this research are shown in Table 1.

Table 1. Lists of respondents

No	Category	Respondent	QTY
1	Government	Department of Transportation Bandung, Department of Communication and Informatics Bandung, Department of Environment Bandung, Department of Spatial Planning Bandung	6
2	Business Player	Q-Free Indonesia, Telkom Smart City, Indosat Smart City, Lintas Arta Smart City	6
3	Expert / Researcher	Expert from consultant, lecturer from Telkom University and Bandung Institute of Technology	6
4	Citizen	College student, employee and housewife	6

IV. SMART MOBILITY MODEL

Smart mobility is defined by innovative ways and technology integration in the process community mobility. This is certainly related to the transportation system. Based on previous research that was conducted by, smart mobility model can be summarized as shown in Fig. 2.

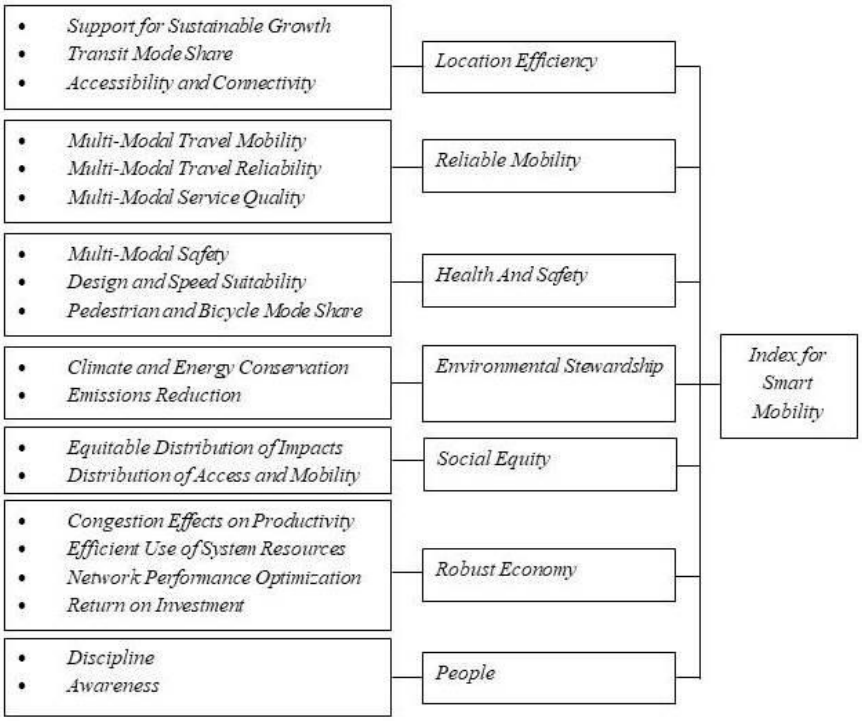

Fig. 2. Smart Mobility proposed model.

The level validity of proposed model then measured by using the Pearson Product Moment correlation formula. The test was conducted on 31 respondents within threshold = 0.355 that being retrieved from r table [8–9].. Results of validity can be illustrated as shown in Table 2.

Table 2. Validity test result

Variabel	Indicator	r Value	Validasi
Location Efficiency	Support for Sustainable Growth	0,653	Valid
Location Efficiency	Transit Mode Share	0,704	Valid
Location Efficiency	Accessibility and Connectivity	0,439	Valid
Reliable Mobility	Multi-Modal Travel Mobility	0,796	Valid
Reliable Mobility	Multi-Modal Travel Reliability	0,867	Valid

Reliable Mobility	Multi-Modal Service Quality	0,81	Valid
Health And Safety	Multi-Modal Safety	0,809	Valid
Health And Safety	Design and Speed Suitability	0,833	Valid
Health And Safety	Pedestrian and Bicycle Mode Share	0,782	Valid
Environmental Stewardship	Climate and Energy Conservation	0,735	Valid
Environmental Stewardship	Emissions Reduction	0,894	Valid
Social Equity	Equitable Distribution of Impacts	0,794	Valid
Social Equity	Distribution of Access and Mobility	0,582	Valid
Robust Economy	Congestion Effects on Productivity	0,847	Valid
Robust Economy	Efficient Use of System Resources	0,785	Valid
Robust Economy	Network Performance Optimization	0,897	Valid
Robust Economy	Return on Investment	0,713	Valid
People	Discipline	0,867	Valid
People	Awareness	0,814	Valid

From the calculation of the validity, it was found that all indicators were valid, so that all variables and indicators were included in the development of this model.

Reliability test is measured to determine the level of trust, reliability, consistency, or the stability of the result. Reliability is measured using the 0.05 significance level and the Cronbach Alpha technique. The alpha value obtained at 0.949 which can be concluded that the indicators and variables in this research is qualified. Results of realibility can be illustrated as shown in Table 3.

Table 3. Rebility test result

Case Processing Summary		N	%	Relibility Statistics	
Cases	Valid	31	100	Cronbach's Alpha	N of items
	Excluded	0	0	0.949	19

The quantitative validation process shows that all indicators are declared valid and qualified, so that the model that has been developed previously can be used as shown in Fig. 3. The model, then applied to measure readiness index of smart mibility implementation in Bandung through in-depth interview, FGD, and questionnaire distribution.

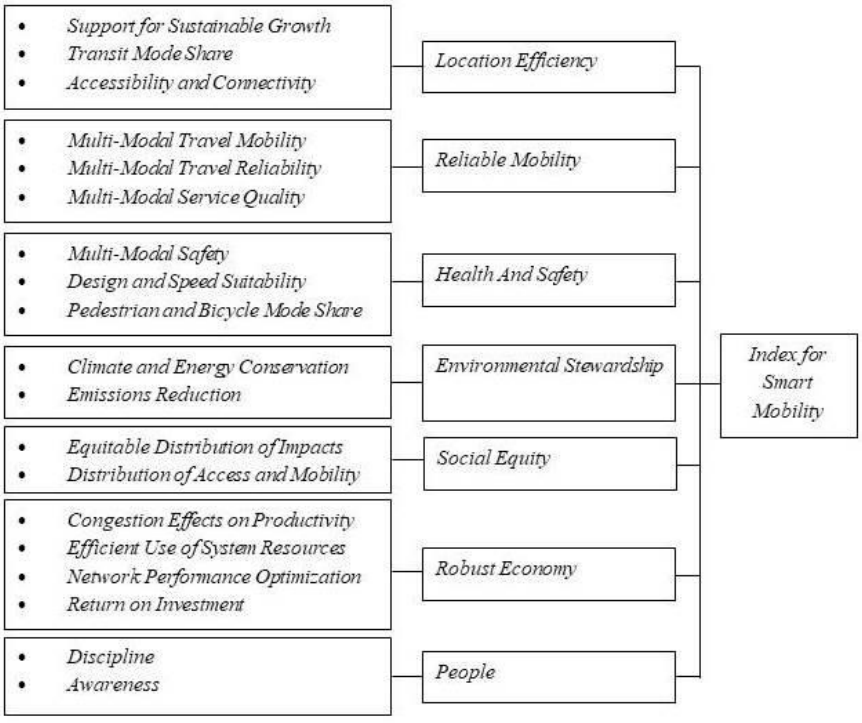

Fig. 3. Smart Mobility model.

5 SMART MOBILITY READINESS INDEX RESULT

To measure readiness index, secondary data from best practices and Bandung are prepared first. Secondary data is to used to provide information for respondents during the assessment process. Secondary data are taken from the results of literature reviews such as stakeholder service reports on the implementation of smart mobility in the city, newspapers, and information from the official website of the city government. Meanwhile, the selected city is a city that is included in the Global Cities Index 2018 released by A.T. Kearney. namely Singapore with consideration of ease in obtaining information, data availability, and data disclosure regarding the application of smart mobility in the city.

The City of Bandung data was taken from interviews with related agencies such as Department of Transportation Bandung, the Bandung City Communication and Information Office, and also visited the Trans Metro Bandung (TMB) Corridor, The Street Everybody Happy Bike Station (BOSEH), Leuwi Panjang Terminal and Terminan Cicaheum Terminal to see clearly related to the implementation implemented. Any changes and differences that occur, is updated according to the actual situation. Based on the result of interviews, FGD, and questionnaire distribution to 31 respondents, we found that the readiness index of smart mobility in Bandung is as shown in Table 4.

Table 4. Validity test result

Variabel	Indicator	Index	Category
Location Efficiency	Support for Sustainable Growth	68,15	Enough
Location Efficiency	Transit Mode Share	56,95	Bad
Location Efficiency	Accessibility and Connectivity	64	Enough
Reliable Mobility	Multi-Modal Travel Mobility	55,95	Bad
Reliable Mobility	Multi-Modal Travel Reliability	53,62	Bad
Reliable Mobility	Multi-Modal Service Quality	65,15	Enough
Health And Safety	Multi-Modal Safety	63,29	Enough
Health And Safety	Design and Speed Suitability	64,05	Enough
Health And Safety	Pedestrian and Bicycle Mode Share	63,43	Enough
Environmental Stewardship	Climate and Energy Conservation	46,47	Bad
Environmental Stewardship	Emissions Reduction	53,68	Bad
Social Equity	Equitable Distribution of Impacts	59	Bad
Social Equity	Distribution of Access and Mobility	68,71	Enough
Robust Economy	Congestion Effects on Productivity	46,15	Bad
Robust Economy	Efficient Use of System Resources	56,47	Bad
Robust Economy	Network Performance Optimization	57,95	Bad
Robust Economy	Return on Investment	58,6	Bad
People	Discipline	54,33	Bad
People	Awareness	62,14	Enough

The result shows that the smart mobility index of Bandung is 61 which indicates bad and still need much improvement. The lowest score is given to the indicator of "Congestion Effects on Productivity" with a value of 43.48, where majority respondents agree that congestion level is high. Meanwhile, the highest score is achieved by indicator of "Distribution of Access and Mobility" with a value of 68,71 that can be interpreted quite well. This indicator has a high value because majority respondents feel public transport rates are cheap.

Bandung Netizen has been active in social media to simplify the lines of communication with the community. Therefore, this research also performing Word cloud illustration to find out the public perception of Bandung City related to smart mobility with utilizing data on social media Twitter that can be seen in Fig. 4.

Fig. 4. Word Cloud Illustration

Gathering data is proceeded by crawling data with combinating mention and keyword on tweet that related to smart mobility such as @AtcsBandung, @BDG_CommandCtr, @HumasBdg, @PemkotBandung, smart mobility bandung, transportasi bandung, dishub bandung, trans metro bandung, tmb, damri bandung, boseh, bus sekolah bandung, mobilisasi bandung, jalanan bandung, jalan bandung, jln bandung, lalu lintas bandung, traffic bandung, trotoar bandung, pedestrian bandung, jalan kaki bandung, disabilitas bandung, sepeda bandung, parkir bandung and . Total tweets that succeeded to appear is 1697 with 6340 words which have a very random result and no one specifically discusses smart mobility. This is proving that the application of smart mobility in Bandung cannot be analyzed yet. Analytical data requires a very large amount of data and with sentiment analysis in order to be used optimally in decision making.

V. CONCLUSIONS

Both of readiness index and word cloud illustration indicate that improvements must be done continuously by stakeholders to optimized the smart mobility implementation. Every indicator has various weaknesses, strengths and problems. It is expected that smart mobility implementation in the future can be more targeted and can be implemented based on the priority level. So that the improvement and development of the transportation services produced can also be more efficient and in accordance with needs.

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