RESEARCH TRENDS OF SMART CITY IN INDONESIA: WHERE DO WE GO FROM HERE?

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ABSTRACT

The concept of the smart city is described as a solution of the urban problems. The Indonesian government has initiated to develop 100 smart cities by 2019, but there is still inadequate research about Indonesian case. Here, we have conducted a research to find current trends about smart city study in Indonesia. We identified the author background, the academic discipline of the author, the year, the research location, the most frequently-used words, and the most-cited technologies of Indonesian research about the smart city. We used content analysis and word frequency analysis to answer the questions. The government, academic, and business agency have joined the study, while other stakeholders may join too. There are varied academic disciplines which animate the examination. The year 2016 may be the opening of a positive trend, but there is still inadequate research locations covered. The noticeable most-frequently-used words are government, public, information, technology, and data. Then, the necessary technologies are the applications, infrastructure, Internet, e-government, and big data. Also, in the future, we need a research about a mobile-based smart city or social media monitoring and analytics.

Keywords: smart city, information and communication technologies, communities and state policy, word-frequency analysis, research trends.

INTRODUCTION

The lack of economic growth in rural places lures people to make a life in the city. The rapid urbanization growth has been a serious threat of governments in the world. When people keep coming to the city, the urban density will be quickly increased. Subsequently, the urban people will compete fiercely each other to gain an access for the basic needs. They need jobs, housing, foods, water, electricity, and other services. In the city, the people whose houses at slum area may face the unwanted disease. The governments must resolve the majority of the problem (United Nations, 2014).

The “smart city” concept is an urban phenomenon rated to be a solution to the urbanization threats. But, the smart city concept isn’t an easy one to be practically implemented by the government professionals. At least, there are three challenges of smart city implementation: technology, people, and government. To claim their regions as smart cities, the governments must build a decent infrastructure of information and communication technologies (ICT). That is an initiative from the government, as building a smart city needs a huge financial investment (Nam & Pardo, 2011).

The government also needs a collaborative atmosphere to deal with the urban issues. The supportive government and technology will be useless without smart people to interact with. The digital divide is well-known as an important issue of the smart city implementation. Not every people know how to adopt the technology, they need to be educated (Nam & Pardo, 2011). The lack of economic growth in rural places lures people to make a life in the city. The rapid urbanization growth has been a serious threat of governments in the world. When people keep coming to the city, the urban density will be quickly increased. Subsequently, the urban people will compete fiercely each other to gain an access for the basic needs. They need jobs, housing, foods, water, electricity, and other services. In the city, the people whose houses at slum area may face the unwanted disease. The governments must resolve the majority of the problem (United Nations, 2014).

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digital divide is well-known as an important issue of the smart city implementation. Not every people know how to adopt the technology, they need to be educated (Nam & Pardo, 2011).

SMART CITY: GLOBAL & NATIONAL CASES

Despite the difficulty, there are notable successful smart cities in the world. The notable smart cities are Singapore, La Grange, New York, Riverside, Columbus (United States), Gangnam, Suwon, Seoul (South Korea), Montreal, Waterloo, Calgary, Toronto (Canada), Glasgow (Scotland), Mitaka (Japan), Taipei, Taichung (Taiwan), Stockholm (Sweden), Eindhoven (Netherlands). The list refers to smarter cities than other cities in the world, there are numerous soon-to-be smart cities (Intelligent Community Forum, 2017).

Although the smart city concept uses word “city”, the concept may be implemented in the city-state like Singapore, the small town like La Grange, or the province like Eindhoven. The smart city concept can be changed to the smart community (Intelligent Community Forum, 2017).

In Indonesia, the smart city projects have been initiated by 22 local governments. The local governments are Aceh, Denpasar, Tangerang, Jakarta, Bandung, Depok, Bogor, Bekasi, Semarang, Banyuwangi, Surabaya, Pontianak, Samarinda, Balikpapan, Lombok, Pekanbaru, Makassar, Manado, Padang, Palembang, Medan, and Yogyakarta. Outside of the list, other local governments in Indonesia also keen to implement the smart city (IISMEX, 2017).

In South Tangerang, May 2017, Ministry of Communication and Information Technology made an assessment of the national smart city movement. By making collaborative research with other ministries, they chose 25 cities/regencies to be pilot projects of smart city movement. In the future, the Indonesian government will actualize 100 smart cities in 2019. They divide it into three-year progress: 25 cities in 2017, 50 cities in 2018, and 25 cities in 2019 (Ministry of Communication and Information Technology, 2017).

The first 25 cities are Badung, Bandung, Banyuasin, Banyuwangi, Bekasi, Bogor, Bojonegoro, Cirebon, Gresik, Jambi, Kutai Kartanegara, Makassar, Mimika, Pelalawan, Purwakarta, Samarinda, Semarang, Siak, Sidoarjo, Singkawang, Sleman, South Tangerang, Sukabumi, Tangerang, and Tomohon (Ministry of Communication and Information Technology, 2017).

If we mix the list from IISMAX and the Ministry of Communication and Information Technology, there are about 39 smart cities in Indonesia. The known smart cities are Aceh, Badung, Balikpapan, Bandung, Banyuasin, Banyuwangi, Bekasi, Bogor, Bojonegoro, Cirebon, Depok, Denpasar, Gresik, Jakarta, Jambi, Kutai Kartanegara, Lombok, Makassar, Manado, Medan, Mimika, Padang, Palembang, Pekanbaru, Pelalawan, Pontianak, Purwakarta, Samarinda, Semarang, Siak, Sidoarjo, Singkawang, Sleman, South Tangerang, Sukabumi, Surabaya, Tangerang, Tomohon, and Yogyakarta (IISMAX, 2017; Ministry of Communication and Information Technology, 2017).

There are numerous studies about the smart city, but there is only a little body of academic research discussing the research trends itself. Here, we want to identify the trend of smart city studies exclusively in Indonesia. Effendi and his colleagues coined a “Smart City Nusantara” concept, they argued that Indonesian government need a special research base. The smart city implementation needs a consideration to the local wisdom of the cities and also the countries. So, a body of research which is located in Indonesia is needed for fostering smart city implementation (Effendi et al, 2016).

We compose six questions that will be answered in this research. The first question is what are the author backgrounds of the studies in Indonesia. The second question is what are the academic disciplines of the authors in Indonesia. The third question is which year is the most active year for smart city investigations in Indonesia.

The fourth question is which locations are the most cited in the research. The fifth question is which words are contained in the top-ten list of the most frequently-used words about smart city studies in Indonesia. The sixth question is which technologies are contained in the top-ten list of the most technologies cited in smart city inquiries in Indonesia.

MATERIALS & METHODS

We used the strategy of Bohman (2014) to conduct our research. We searched scholarly articles about an issue. Then, we used a word frequency analysis to find the most frequently-used words in the bibliographic database. We searched the scholarly articles from scholar.google.com using keywords: “Smart City” “Indonesia”. We also used keywords: “Kota Pintar” “Indonesia”. Then, we saved all of the articles in our computer database.

Afterward, we compiled the articles by the language (English and Bahasa Indonesia). We discarded the articles without “Smart City” or “Kota Pintar” keywords. Also, we dismissed the

articles which contained more than 20 pages, like thesis or dissertation. We only let the journals or proceedings in because we wanted to count the words from the abstract to the end of articles. If we involved the thesis, we couldn't calculate the word frequency.

To learn the trends, we identified the author background, the academic discipline, the year, the research location, the most frequently-used words, and the most frequently-cited technologies. We created the descriptive statistics of the data. We created tables but divided the tables by its language: Bahasa Indonesia and English. By examining the language, we argued that the research has different readers, local and international. We limited the duration of research since the year 2014 to 2017 (until May 2017). We acquired 17 journals (Bahasa Indonesia), a journal (English), and 4 proceedings (English).

To answer the first to the fourth questions, we just manually checked the articles using content analysis. Then, we made a table and manually count the frequency of our case. To answer the fifth and sixth questions, we used the different method. We saved the raw text from the journals into two documents, separated by its language.

We processed the corpus using TextSTAT, a word frequency analysis software. We counted the word frequency and delivered it into two tables of the top ten of the most frequently-used words. We ignored the words without meanings like the stop words. Exclusively for the sixth question, we used the concordance facility of TextSTAT. By using the concordance, we could find phrases like "big data". If we used the normal method, we had only found "data".

RESULTS AND DISCUSSION

To answer the first question, we checked the author background of the research. The authors of the Indonesian-language research are the governmental agencies (3) and the universities (22). The authors of the English-language research are the business agencies (12) and the universities (6).

The government tends to do research with Indonesian audience. Meanwhile, the business tends to do research with international audience. The business joins a research by attending the conference. The university covers both kinds of research, strengthening the role of the academic sector in the research development.

According to Effendi et al (2016), the government, the business, and the academic sector have a role in developing the smart city. By examining 22 research articles, the three sectors involved in the development of the smart city. There are other sectors in smart city development, the media, and the community. Instead of doing research, the media and the community may collaborate with the different role.

To answer the second question, we checked the academic discipline of the authors. By learning the discipline of the authors, we understand the scope of the recent studies. Table 1 shows the majority of the authors of Indonesian-language research are electrical engineering (5), communication sciences (4), information technology (4), and urban & regional planning (3). The smart city has been successful to lure the researchers from the varied disciplines, from the engineering, social, computer, economics, to agriculture.

Table 1 The academic disciplines of Indonesian-language research

No	Author's knowledge background	f
1	Electrical engineering	5
2	Communication sciences	4
3	Information technology	4
4	Urban and regional planning	3
5	Accountancy	1
6	Agribusiness	1
7	Computer engineering	1
8	Computer system	1
9	Environmental engineering	1
10	Informatics engineering	1
11	International relations	1
12	Public administration	1
13	Not mentioned	3

Table 2 shows the less-varied academic discipline of the author of the English-language research. The majority of the authors are business workers, not from the university. The authors have

a discipline of the communication sciences, the public administration, and the urban study. By adjusting the research of both languages, we argue that the communication sciences and the urban studies are the dedicated disciplines of smart city research in Indonesia.

Table 2 The academic discipline of English-language research

No	Author's knowledge background	f
1	Communication sciences	2
2	Public administration	2
3	Urban study	2
4	Not mentioned	12

To answer the third question, we checked the year of the research. The year 2016 was the important year for the smart city since there were 13 research articles about that issue. About 8 out of 13 research articles use Bahasa Indonesia, and the other five research articles use the English language. In 2014, 2015, and 2017 (ongoing), there were 3 research articles each year. We couldn't predict the year 2017 since the year hasn't ended while we were doing the research.

To answer the fourth question, we checked the locations of the research. Table 3 shows that Bandung is the most-cited locations of the smart city. Malang, Surabaya, and Serang are the other important locations in Indonesian-language research of the smart city. The top four cities are located in Java Island. The current research is too much centered in Java Island since about 8 out of 13 research articles are located in Java Island.

Table 3 The research locations of Indonesian-language research articles.

No	Research locations	Province	Region	f
1	Bandung	West Java	Java	4
2	Malang	East Java	Java	2
3	Surabaya	East Java	Java	2
4	Serang	Banten	Java	2
5	Balikpapan	East Borneo	Borneo	1
6	Banjarmasin	South Borneo	Borneo	1
7	Bogor	West Java	Java	1
8	Jakarta	Jakarta	Java	1
9	Makassar	South Sulawesi	Sulawesi	1
10	Manado	North Sulawesi	Sulawesi	1
11	Metro	Lampung	Sumatra	1
12	Pekalongan	Central Java	Java	1
13	Semarang	Central Java	Java	1

Table 4 shares the similar fact with the table 3, as Bandung has topped the most-cited research locations. For the international audience, the capital city Jakarta rank second. The current research is also too much centered in Java. About 7 out of 11 research articles are located in Java Island.

The government of Bandung has shown the efforts to develop the smart city. Even, the Mayor of Bandung Ridwan Kamil has received the honor for the initiative (Suhendra, 2017). Ridwan makes the jargon of smart city then increase the awareness of collaborative atmosphere to gain supports (Hidayatulloh, 2016). Also, mass media support Bandung smart city (along with Jakarta) by publicizing the news with a positive tone (Yuliarti et al, 2016).

Table 4 The research locations of English-language research articles.

No	Research locations	Province	Region	f
1	Bandung	West Java	Java	4
2	Jakarta	Jakarta	Java	3
3	Banda Aceh	Aceh	Sumatra	1
4	Banyuwangi	East Java	Java	1
5	Batam	Riau Islands	Sumatra	1
6	Bekasi	West Java	Java	1
7	Bogor	West Java	Java	1

8	Kutai	East Borneo	Borneo	1
9	Surabaya	East Java	Java	1
10	Tangerang	Banten	Java	1
11	Tanjung Selor	North Borneo	Borneo	1

If we compare the available research locations with known smart city projects, there are many unique facts. About 13 out of 39 locations (one-third ratio) has been examined by Indonesian authors. The covered locations are Aceh, Balikpapan, Bandung, Banyuwangi, Bekasi, Bogor, Jakarta, Kutai Kartanegara, Manado, Makassar, Semarang, Surabaya, and Tangerang. The uncovered locations are Badung, Banyuasin, Bojonegoro, Cirebon, Depok, Denpasar, Gresik, Jambi, Lombok, Medan, Mimika, Padang, Palembang, Pekanbaru, Pelalawan, Pontianak, Purwakarta, Samarinda, Siak, Sidoarjo, Singkawang, Sleman, South Tangerang, Sukabumi, Tomohon, and Yogyakarta (IISMEX, 2017; Ministry of Communication and Information Technology, 2017)..

Uniquely, there are locations which aren't included in our list, for example, Banjarmasin, Batam, Malang, Metro, Pekalongan, Serang, and Tanjung Selor. However, according to a research by Yuliarti and her colleagues (2016), the cities like Tanjung Selor and Batam have been publicized positively by Kompas, a national mass media, as the smart cities. By learning the research trends, we argue that there are many smart cities in Indonesia that haven't been the research locations. Many research articles somehow took many cities which weren't described as smart cities (IISMEX, 2017; Ministry of Communication and Information Technology, 2017).

The researchers must find the uniqueness about the cities, so they convincingly take those cities as the research locations. We can take Semarang as the example, besides of developing the smart city, the government also work for the resilient city (Sariffuddin, 2015). In the future, besides of increasing the research based in currently covered locations, other authors must explore the other locations in Indonesia as well (IISMEX, 2017; Ministry of Communication and Information Technology, 2017).

To answer the fifth question, we checked the most frequently-used words from the research articles. Table 5 shows that the similar words used by the research articles of both languages are city, smart, public, government, information, technology, and data. It is unsurprising if we find that city and smart are the top words. But, we rather focus on the government and the public, which belong to the important words. The smart city is described as a meeting point between top-bottom initiation (government) and bottom-top initiation (public) (Capdevila & Zarlenga, 2015).

The occurrence of words like information, technology, and data means that the three concepts are important to a smart city implementation. The smart city needs technology, that's the reason of this research. We explain the smart city technologies in the next paragraphs. Also, smart city implementation must consider how to manage information and data.

Table 5 The most frequently-used words of smart city research articles in Indonesia.

No	Indonesian-language Research	f	English-language Research	f
1	Kota (City)	1297	City	272
2	Smart	771	Smart	221
3	City	527	Government	187
4	Masyarakat (Public)	412	Data	156
5	Pemerintah (Government)	377	Media	109
6	Informasi (Information)	303	Public	106
7	Teknologi (Technology)	254	Social	82
8	Konsep (Concept)	247	Technology	72
9	Data	236	Bandung	68
10	Cerdas (Smart)	231	Information	64

To answer the sixth question, we checked the most frequently-used words about the technologies from the research articles. Table 6 shows that the similar words used by the research articles of both languages are applications, infrastructure, internet, e-government (electronic government), and big data.

The internet is the foundation of the smart city, indeed, decent internet connection requires decent infrastructure too. The infrastructure includes fiber optic channels, Wi-Fi, wireless hotspots,

and kiosks. The infrastructure is known as a barrier for the smart city implementation (Chourabi et al, 2012).

The smart city implementation will relate to the application development and e-government, to improve the public services. The government builds the application and considers the user-friendly approach. Then, the government pushes the citizens to download the application via their smartphones (Alawiah, 2017).

E-government is a concept which is used by the government to accomplish the good governance. The government uses the technology to escalate the performance. The government also promotes the accountability and transparency of the financial information (Widodo, 2016).

If the government develops the smart city, the system will receive huge amount of data. This is why a research about big data is important, the big data is useful for integrating, organizing, managing, analyzing, and presenting the data (Roessobiyatno et al, 2016).

The authors of Indonesian-language research tend to focus on website technology. The authors of English-language research tend to focus on mobile-based technology. M-government (mobile government) is an issue for international research since the local research is focused on e-government. In the future, when city people prefer the wireless technology, building a mobile-based smart city is a must (Nam & Pardo, 2011).

Also, the international research gives a clue about the social media monitoring and analytics. The government may use the big data and analyze it to gain a complete insight about the city. The government gets the social media data from the citizens to improve the public service (Roessobiyatno et al, 2016).

Table 6 The most frequently-used words of smart city technologies in Indonesian research articles.

No	Indonesian-language Research	f	English-language Research	f
1	Aplikasi (Apps)	153	Social Media	58
2	Infrastruktur (Infrastructure)	134	Big data	54
3	Internet	81	E-government	40
4	Situs (Website)	60	Qlue	32
5	Jaringan (Network)	59	Infrastructure	27
6	E-government	46	Internet	27
7	Mobile	35	Analytics	23
8	Sensor	33	Mobile app	20
9	Big data	32	M-government	16
10	Website	27	Monitoring	10

CONCLUSIONS AND FUTURE WORKS

From the discussion, it can be concluded that the current research articles about the smart city in Indonesia haven't been enough. By considering Indonesian government's vision of 2019 about the smart city, many researchers are invited to join the examination in the future. It is possible for smart city stakeholders, like government, university, business, media, community, or the others, to expand the research. Joining conferences is an option for the stakeholders to quicken the collaboration.

The smart city has lured the researchers from the varied disciplines. The smart city isn't a monopoly of one academic discipline. Many disciplines are required for the collaboration. The year 2016 is the opening of the smart city trends. Also, the cities used as a research location are still inadequate. By 2019, Indonesian governments are working into 100 smart cities, so the related researches are needed to be spread.

Discussing smart city will refer to the relationship of the government and the public. Also, the smart city is related to the technology, information, and the data. As the importance of technology, we must understand which technology is necessary. The applications, infrastructure, the Internet, e-government, and big data are the technology to deal with. The research about the mobile-based smart city or social media monitoring and analytics are noteworthy to be done.

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