

# Building Green Smart City Capability in South Sumatra, Indonesia

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Article

# Building Green Smart City Capability in South Sumatra, Indonesia

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**Abstract:** Information and communication technology is currently developing rapidly. It has created a great of opportunities for governments worldwide to meet the demands of the public in providing services including environmentally friendly public services for the community and citizen. This study aims to present a case study on public services of South Sumatra Government programs in order to develop a green smart city concept by combining the smart city and green IT concepts which aim to align and incorporate green IT components including pollution prevention, product stewardship and clean technology into conceptual variants, essential elements, and strategic principles. Smart City is an innovative and modern concept utilising technology to facilitate and provide public information and to improve environmentally friendly public services through smart applications. South Sumatera is one of the provinces in Indonesia that has been implementing a smart city to provide environmentally friendly public services through the command centre. It is used to monitor entire government agency activities and communicates with the public. To fulfill the aims of the study, this study identifies the comprehensive environmentally friendly public services through Natural Resource-Based View Theory perspectives. In addition, this study deploys in-depth interviews with sources or informants as a form of data search and direct observation. The number of informants used as research respondents consisted of several elements of the government, including the executive, legislative, and implementing agencies. The study reveals that the South Sumatera Government has several environmentally friendly public services that could be deployed to prevent pollution and reduce the emission in their activities. Further, the government in South Sumatra has product and service stewardships and invest clean technology to minimise the adverse impacts of their activities on the environment.

**Keywords:** Smart City; Natural Resources-Based View Theory; South Sumatra, Ecological, Green IT.)

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## 1. Introduction

In this era of industry 4.0 and globalisation, there is a rapid growth of interest of the public, companies, and government agencies in using Information Technology (IT) through the information system. This trend occurs because IT can process, store, and convert data into information needed by those parties [1]. In the governmental sphere, authorities must meet the demands of the public in providing services that are beneficial to the wider community in all regions; trusted and dependable; and accessible and interactive [2]. Information systems implementation is successful when users utilise the systems and such application eventually support organisations in achieving their goals. For

governments to implement information systems effectively and efficiently for public services, they must develop and build a management system such as a smart city strategy.

Indonesia Smart (Smart Nation) will only materialise when it has implemented the stages and development of a smart city at the city, district, and provincial levels. Smart Province itself is the concept of implementing governance at the provincial level based on digital/electronic where cities/regencies under the province have implemented Smart City and even Smart Village in its public services. This shows that Smart Province eventuates when all components in it, starting from the city/district levels to the village/complex areas, can collaborate. For this reason, proper communication planning and strategy is needed so that the implementation can perform optimally.

Responding to these challenges, the South Sumatra Provincial Government in November 2017 has provided a legitimation in the form of Governor Regulation No. 47 of 2017 concerning the implementation of the South Sumatra Smart Province. This policy is an effort to utilise technology and IT that can support the Smart Indonesia strategy in the digital era 4.0. The scope of this strategy includes planning, implementation, maintenance and development, as well as monitoring of the South Sumatra Smart Province which harmonises and integrates the implementation of the South Sumatra Smart Province in each Regional Government Organisation (RGO) of the regency/city and provincial government with the central government information system. In terms of planning, as stipulated in the Governor Regulation No. 47 of 2017, this refers to the strategy of accelerating the use of information and technology through the implementation of the South Sumatra Smart Province service and the development of infrastructure and applications. The South Sumatra Provincial Government has appointed the South Sumatra Province Communication and Information Office as the service provider/project leader, and the manager of infrastructure and applications.

In developing a smart city, provincial, city, and district governments can implement distinct methods and approaches depending on their vision and mission. Preliminary research of Mora, Deakin [3] used the information, communication, and technology (ICT) innovation for sustainability approach to encourage environmentally friendly waste management and reduction with a mobile-based e-waste information system development strategy. In another study, Duan, Nasiri [4] employed a people, society, and technology approach. Evans, Karvonen [5] utilised a green information technology approach to developing an environmentally friendly-based smart city strategy. Xie, Tang [6] have successfully used the features of blockchain to improve smart city services and promote smart city development. The latter research also examined how blockchain technology is applied to smart cities in the world. This study will apply a green IT and environmentally friendly approach to developing a smart city in the province of South Sumatra.

Like many other developing countries, the government of Indonesia acknowledges the importance of green smart city in making public services more environmentally friendly to the public. Larasati, Handyaningsih [7] develop the green smart city concept based on the governance, branding, economy, living, society and environment perspectives in Yogyakarta. Effendi, Syukri [8] develop nusantara sustainable smart city concept that consists of academician, business, community, government and media. Tan and Taeihagh [9] reveal that the green smart city in developing countries including Indonesia can only realised when the aconcurrent socioeconomic, human, legal and regulatory reforms instituted. Sutriadi [10] states that green smart city can be determined by community integrity, history and cultures, economic sectors, technology readiness and impacts, technical and political processes, and stakeholders. All these studies shows that the development of green smart city in different perspectives in Indonesia. Despite the rapid development of green smart city in Indonesia, the identification of IT capabilities in smart city to provide environmentally sustainability services of government still receives less attention. Therefore, there is a need to develop the green smart city based on the IT capability to help the South Sumatra Government to identify their IT resources that can be used to control and reduce emmision and wasted pollution during their activities.

Knowledge of these different methods and approaches is consequential when initiating to implement the competence of green information technology (Green IT) to create environmentally friendly cities. Green IT in a smart city is potential to make infrastructure services more efficient and reactive to user behaviour, minimise resource consumption, improve environmental quality, and reduce CO2 carbon emissions. It is this convergence of 'Smart City' with urban sustainability that is the starting point for these issues.

While the emergence of a green smart city approach puts digital innovation, digital economy, and urban growth at the centre of efforts to create sustainable cities [11], how effective the use of IT capabilities has been for providing environmental sustainability services of government is unclear.

This study observes and identifies research gaps in the current smart city literature in Indonesia. Considering the lacunae, this study will develop a green smart city concept by combining the smart city and green IT concepts which aim to align and incorporate green IT components into conceptual variants, essential elements, and strategic principles. Therefore, this research ensures that social interests and environmental concerns have a special place in the smart city strategy. This green smart city initiative is used as a descriptive case study and chosen because of its ability to utilise ICT solutions to support the Indonesian government in fulfilling the transformative commitments that have recently been established in increasing public service innovations that have a characteristic concern for environmental damages.

## 2. Literature Review

### 2.1. Smart City Concept

Along with the development of information technology and the various types of services that governments can provide, the implementation of e-government is often associated with the development of urban communities to create a technology-based city, known as the smart city concept [12]. In general, e-government is defined as the use of ICT by government agencies in conducting their duties to manage administration and provide public services [13]. Through ICT, the government can improve performance, bureaucratic efficiency, and quality of public services.

Regarding the smart city, it predominantly refers to city management using ICT to improve the economy, quality of life, and natural resource management through good and participatory governance [14]. The smart city concept is not only the ability to automate activities such as in public services or traffic systems, but also the ability to monitor, understand, analyse, and design a city management system to improve efficiency, social equality, and quality of people's lives in real-time [15]. To achieve this, smart cities apply and utilise ICT in various sectors in urban areas such as health services, energy, water, transportation, and waste management. According to Caragliu, Del Bo [16], there are several characteristics of a smart city that distinguishing it from its conventional counterparts. They are development based on economic growth; utilisation of technology infrastructure and computer networks; increased the role of the technology industry and creative industry in development; community participation in the implementation of development and public services; sustainable natural resource and environmental management. In other words, smart city concepts are focusing on improving the quality of public services.

There are many studies on investigating the smart city in difference perspectives to improve the public service performance including Technology, knowledge, and economic development. In term of ICT infrastructure, many prior studies focus on the application of a wide range of electronic and digital technologies infrastructure to build smart city. For example, Anttiroiko and Komminos [17] identify the use of ICT infrastructure to adjust how the citizen life and work. Additionally, Ismagilova, Hughes [18] study the role of

ICT infrastructure and citizen in order to create innovative and smart city. Yaqoob, Hashem [19] investigate how the citizen could communicate and interact with government through embedding information technology in smart city. Similarly, Anttiroiko and Komninos [17] concern to develop ecosystem applications for public services as strategic tool service transformation of government to meet the needs of citizens.

In term of economic development, it has been associated with the existence of industries in the field of ICT or employing ICT in production processes. Moreover, the economic approach also could attract creative citizen or people and encourage a city to be an economic hub through exploring the potential resources to improve the quality of living. For example, building high-quality and more efficient public transport that is used to connect labor with employment is considered aspect for city growth. Thus, numerous cities in Southeast Asia attempt to develop and design a smart city project to promote economic growth through smart city. In Singapore, this project is called intelligent island with information technology transforming work, life, and play. Other city like Taiwan, building e-taoyuan and u-taoyuan for improving quality of living and creating e-governance and ubiquitous possibilities.

Focusing on knowledge, knowledge city widely adopted as smart city concept to nurture and empower citizens to deal with technologies. Winters [20] clarifies that a smart city is a centre of higher education, better-educated individuals, and skilled workforces. Smart cities act as magnets for creative people and workers, and this allows the creation of a virtuous circle making them smarter and smarter. Consequently, a smart city has multiple opportunities to exploit its human potential and promote a creative life [21]. Glaeser and Berry [22] showed that the most rapid urban growth rates have been achieved in cities where a high share of the educated labor force is available. The buzz concept of being clever, smart, skillful, creative, networked, connected, and competitive becomes a key ingredient of knowledge based urban development [3, 4]. possible confusion related to the technology perspective of a smart city comes from the top-down and company-driven actions taken for creating a smart city. However, it also comes from the confusion with other similar terms, such as digital, intelligent, virtual, or ubiquitous city. These terms refer to more specific and less inclusive levels of a city, so that the concepts of smart cities often include them [16, 23, 24]. For example, a digital city refers to “a connected community that combines broadband communications infrastructure to meet the needs of governments, citizens, and businesses” [25]. The final goal of a digital city is to create an environment for information sharing, collaboration, interoperability, and seamless experiences anywhere in the city.

Indonesia Smart (Smart Nation) will only materialise when it has implemented the stages and development of a smart city at the city, district, and provincial levels. Smart Province itself is the concept of implementing governance at the Provincial level based on digital/electronic where cities/regencies under the province have implemented Smart City and even Smart Village in its public services. This shows that Smart Province eventuates when all components in it, starting from the city/district levels to the village/complex areas, can collaborate. For this reason, proper communication planning and strategy is needed so that the implementation can perform optimally. Prof. Suhono Harso Supangkat in his paper titled “Smart Province” on 22 February 2018 described that the challenges faced in creating a smart province are: (a) equitable development; (b) human resource development to become smart people to play an active role in the provincial development process; (c) potential regional development; (d) the need for accurate and up-to-date information regarding regional conditions and development in all provinces (cities and districts); (e) participation of various stakeholders for the success of development; (f) the development of a digital government to assist in the process of data management and integration to support targeted policy-making and utilising ICT in potential development and governance in the province.

Although the numerous cities are planned around the concept of sustainable economic development, knowledge and ICT Infrastructure, these cities are promised to be

strongly grounded in economic issues. Several people look at this as an example of a free-economic high-tech market in an area connecting between developing and developed countries. However, most resources are consumed in cities worldwide, contributing to their economic importance, but also to their poor environmental performance. Cities consume between 60 percent and 80 percent of energy worldwide and are responsible for large shares of CO<sub>2</sub> emissions [26].

Thus, there is a need to develop a concept ecological sustainability smart city as a new approach related to the role of information technology as a solution to reduce the impact of smart city energy consumption. Table 1 shows the summary of literature review on smart city.

**Table 1.** Summary of literature on smart city.

Authors	Pollution prevention	Product stewardship	Clean technology	Economic development	Infrastructure	Knowledge city
Mahizhnan [27]				✓	✓	
Eger [28]				✓	✓	✓
Giffinger and Gudrun [29]				✓	✓	
Harrison, Eckman [30]					✓	✓
Thuzar [31]		✓		✓		
Barrionuevo, Berrone [32]			✓			
Bakıcı, Almirall [33]	✓					
Popa, Carutasu [34]		✓	✓			
Kumar and Dahiya [35]				✓		
Peng, Bohong [36]	✓				✓	
Mwaniki, Kinyanjui [37]				✓		
Li [38]					✓	
Serrano [39]					✓	
Jnr, Majid [40]		✓				
Fromhold-Eisebith and Eisebith [41]	✓			✓		
Kuecker and Hartley [42]						✓
D'Aniello, Gaeta [43]					✓	✓
Yigitcanlar, Kankanamge [44]					✓	

## 2.2. Green Smart City in Indonesia

Indonesia is a developing country which attempt to implement the green smart city for efficiently and effectively adopting latest technologies for improving the delivery of public services. This could be shown by several previous studies. For example, Mahesa, Yudoko [45] develop the platform ecosystems for Indonesia smart cities that will be used to increase collaboration among stakeholders and develop new opportunities for the development of circular economy to resolve the urbanization complexities. Larasati, Handyaningsih [7] identify dimensions of smart city application to better understanding what constitutes a smart city is and develop a concept to provide the general foundation for further a smart city development. The dimensions of smart city in this study are governance, branding, economy, living, society, and environment. Achmad, Nugroho [46] develop a conceptual framework of the green smart city based on synthesized and aggregated literature review. It shows that green smart city framework is about integrating existing government services and resources.

**Table 2.** Previous Studies on green smart city in Indonesia

No	Dimensions	References
1.	Governance, Branding, Economy, Living, Society, and Environment	Larasati, Handayaningsih [7]
2.	Tourism, health, Safety and Security, Government, Energy, Environmental, Circular Economy, and Education	Mahesa, Yudoko [45], Kurniawan, Dwiyanto [47]
3.	Services, Resources, Architecture, and Goals	Achmad, Nugroho [46]
4.	Academic, Business, Government, Community Partners, and Media	Effendi, Syukri [8]
5.	Environment Regulations, Availability of Green Spaces, Pollution, Investment, and Energy Efficiency	Afrianto and Tamnge [48]
6.	Human Resources Capability	Rachmawati [49]
7.	Social and Political Approach	Suartika and Cuthbert [50]
8.	Environment, Social, Culture, and Economic	Hayati, Utami [51]

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The previous research findings on the implementation of sustainable smart city focuses on governance, business, government, environment, energy, regulation, human resources, economic and social and political approach. There is few research of sustainable smart city, that is related to identify the use of information and communication technology in local government to reduce its impact to natural environment. This research reveals that ICT use enable the government to achieve the goals and maximizing the performance of Smart Sustainable City services. A city needs to choose its role based on how it can optimally promote the development into a smart city while ensuring good strategic flexibility going forward. Therefore, there is a need for Indonesian government especially South Sumatra government to identify their ICT resources and capabilities in order to develop and provide sustainable government services to entire citizen and community.

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### 2.3. Green Smart City Concept Development

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To develop a green smart city concept, this study adopts the Natural-Resources Based View (Natural-RBV) theory. The theory aims to add the natural environment as a unique resource or ability to the RBV to develop a theory [52]. Hart argues that private or government organisations need to develop critical competencies in their engagement with the natural environment. Such competencies can contribute to sustainable competitive advantage. Therefore, Natural-RBV is developed with the relationship between environmental challenges and the resources of government operationalised through environmental competence in the organisation.

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This study adopts Natural-RBV theory to identify green IT capabilities need to be studied and developed by the provincial government, especially the communications and information department in implementing green smart cities in South Sumatra. For example, when creating purchase, leasing or outsourcing decisions, many local governments now consider companies that have a good environmental track record [53, 54]. In addition, green IT functions are easily upgraded to meet business demands. It is also can educate employees and change their behaviour to reduce energy consumption. Therefore, green IT adoption is needed to help both private and government organisations build and improve their environmental competence.

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Natural-RBV theory reveals that organisations can attain environmental competence through three factors [52, 55]. The first factor is pollution prevention. This focuses on the control and reduction of emissions and wastes pollution during the activities of government organisations. An organisation can enhance pollution prevention through improved management, material replacement, reuse, recycling, or process innovation [52, 56]. Pollution prevention and waste management are accepted as one of the sustainability criteria of an organisation [57], provide several advantages especially for first-mover

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organisations (Nerht, 1996); and can reduce cycle times by simplifying or eliminating unnecessary stages in organisation activities to increase productivity and efficiency (Hart 1995). Therefore, essentially, this factor is a strategic proposition (Elliot, 2007). Since the generation of pollution is considered a sign of inefficiency (Porter & Van der Linde, 1995), preventing pollution can enable organisation including government to save control costs, input, and energy consumption, and reuse materials through recycling (Hart, 1997; Taylor, 1992). This eventually can increase the profitability of the organisation and its competitive position in the market (Hart 1995, 1997; Hart & Milstein, 2003; Molina-Azorin et al., 2009). Bakıcı, Almirall [33] reveal that electronic or digital service of government can eliminate the complicated procedures and reduce the energy consumption through connecting people, information and city elements using the new technologies.

The second factor is product stewardship. This refers to an organisation's ability to evaluate the environmental impact of its resources or infrastructure and services provided to partners or stakeholders. It requires environmental impacts to be considered throughout the entire lifecycle of the organisation, including the source of raw materials, product design, and the development process (Hart 1995, 1997). Product stewardship aims to reduce the overall lifecycle environmental costs of a product by disciplining the design and development process to achieve a system transformation from "cradle-to-grave" to "cradle-to-cradle" (Shrivastava et al. 1995). From a product design perspective, product stewardship can be considered a significant motivator for "green" application design that focuses on reducing energy over the full equipment cycle (Francis & Richardson, 2008). Product stewardship can also be enforced through laws and regulations. For example, smart city policy leads to sustainability of cities in the case of UK cities particularly to deal with their current and future development challenges and focus on city smartness and sustainability aspects [58].

The last one is clean technology. Such is an organisational strategy to invest in environmentally friendly technology to change organisational behaviour to be more sustainable (Hart 1995; Hart & Milstein 2003). It requires investment in future technology. Hart (1997) argues that organisations can reduce their unsustainable practices by planning, developing, and using clean technology. This is because many of the existing technology bases in many industries are non-environmentally friendly. At this stage, organisations need to use their sustainability vision to plan for new products and services they should develop or purchase, and the capabilities and competencies that will be required to use them for more sustainable options. Cleaner production used to achieve eco-sustainability especially in the production process can allow industrial production to enter into environmental sustainability vision Hart and Milstein's (2003) as they highlight the potential use of technology that saves materials, is energy-efficient, non-polluting and low waste (Hart, 1997; Geiser, 2001).

In case of green smart city, the clean technology can be used for tackling pollution, managing water efficiently, and supporting green buildings and alternative energy, cities can become cleaner, more pleasant places to live, while at the same time drastically reducing their energy bills [32]. For example, Government of Moncton, Canada, have showed a broad green city project, which has aim to promote greater use of public transport and bicycles, and more recycling. In addition, with ICT, the government has imposed tighter controls on irrigation water and launched tree-planting campaigns [32]. In the same way, Popa, Carutasu [34] state that by using ICT infrastructure including Internet of Things (IoT), governments are possible to optimise use of smart waste system to monitor and track waste collection in order to improve its productivity and collected waste storage capacity. Moreover, a cloud-based technology for data-driven water demand management. It utilises data analytic methodology to optimise water-use efficiency and improve financial forecasting accuracy through engaging citizens [59]. This technology can be used as software-as-a-service application that allows cities access both real-time and historical parking data and aims to make optimal and efficient use of parking resources.

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### 3. Research Methodology

This study employed a qualitative research and focus group method based on the philosophy of post-positivism, which was used to examine the natural conditions of the object, and the researchers were the principal instrument. The sampling of data sources was conducted purposively, the collection technique was managed by triangulation (combined), the data analysis was inductive, and the results emphasised meaning rather than generalisation.

**Table 2.** Research Informants

Informant	Total	Informant Status
Indonesian Ministry of Communication and Information	1	Researcher at the Indonesian Ministry of Communication and Information Research and Development Centre
Regional Secretariat of South Sumatra	2	Regional Secretary and Assistant III for Administration and General Affairs
Regional House of People's Representatives of South Sumatra	1	Chairman of Commission I
Department of Communication and Informatics of South Sumatra	7	Head of Service, Secretary, Head of PIP, Head of E-Gov, Head of ICT and Encoding, Head of Statistics and Head of Planning
<b>Total</b>	<b>11</b>	

The object of this research was the Communication and Informatics Office of South Sumatra Province, Related RGO, District/City Information and Communication Services, providers, universities relating to efforts in creating a green smart province. This study deployed in-depth interviews with sources or informants as a form of data search and direct observation. The number of informants used as research respondents consisted of several elements of the government, including the executive, legislative, and implementing agencies as shown in table 2. They will be selected for interview based on the role in their respective organization who involved in strategic planning process during building and implementing the smart city. The questions the researchers asked the informants varied according to the capacities of the informants. The interviews are exploratory in nature, consisting of open-ended questions that focused on participant perceptions of the processes and influential factors of Green IT in south sumatra government with respect to the three dimensions of natural RBV Theory. In Indonesian Ministry of Communication and Informatics cases, the interviews focused on their perceptions of these issues in IT projects implemented to reduce energy consumption in operational activities and clearly defined the roles, responsibilities, accountability and control for green smart city. Informant from departement of communication and infortics of South Sumatra is questioned the development of green IT standard across the government agency and offices and the extent to which South Sumatra government has a green business infrastructure (such as green rated buildings) and green power sources. Further more, in the case of Regional House of People's Representatives of South Sumatra is emphasized to allocation of budgetary and other resources for Green IT and the extent of policy in the house dedicated to e-government including green smart city.

In order for this research to be more objective and accurate, researchers also sought additional information by making field observations. Table 2 shows the details of the

informants in this study. Analysis of the data in this study was communication planning model based on Public Relations by Cultic and Centre to identify and analyse the communication strategies managed by the South Sumatra Province Communication and Information Office in realising South Sumatra as a Smart Province in implementing the Sumsel Command. 364  
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The second phase is focus group methodology. This method is well documented as a reliable and cost-effective method for qualitative data gathering in both public and private organisations. 15 participants in a focus group are involved in the process due to a shared government circumstance or condition. This method also has the strength of focus group in providing insights into a specific issue from a group of selected participants. As the focus group technique relies on effective interaction between the several participants. This is supported by the fact that well-designed focus groups provide the researcher with the ability to observe how theories emerge with regard to the viewpoint of the participants. In this respect, it is noted that the opportunity must be offered to all participants to express their thought. This study provides a deeper understanding on the three key dimensions and expected data outcomes from a focus group: 1) articulated data, where participants express thoughts from a direct question; 2) attributional data, where the moderator discreetly provokes discussion; and 3) emergent data which refers to normative understandings. 369  
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#### 4. Research Findings and Discussion 383

Based on the results of interview and previous studies, this study proposes a conceptual model consisting of three components corresponding to the three factors of IT use in smart cities as follows: pollution prevention, product stewardship, and clean technology. This study discussed each component in more detail. 384  
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The research results for the development of a smart green city are highly needed and is one of the considerations in planning the province of South Sumatra. Pre-development research is needed to determine the feasibility of the programme, whether it is effective, efficient, and trackable—meanwhile, the post-development research functions to determine whether the programme is acceptable. In the development and construction of Smart City in South Sumatra, the implementation of the Sumsel Command Centre was conducted by the South Sumatra Province Communication and Information Agency on 7 September 2018 as a strategy to improve cost efficiency and operational time for the South Sumatra Provincial government. To develop and build a strategy from implementing the South Sumatra Command Centre, this study employed three eco-sustainability strategies as follows: pollution prevention, product stewardship, and clean technology (Ijab, 2010). 388  
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##### 4.1. Pollution Prevention 399

In this strategy, several the data and information researchers requested informants included: the number of users of government public service applications, pollution and waste management, procedures for reuse, recycling, or the innovative process of using IT implemented by Smart Province. According to the researcher, data is needed to take the appropriate steps in determining the strategy to be implemented by the governmental agencies. Moreover, this programme will have a significant impact on making South Sumatra as a smart and environmentally friendly province. This smart solution is obtained from comprehensive data and information through the use of ICT. This will help to develop the efficiency of government services to the community appropriately and quickly. 400  
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At the beginning of 2019, the research process began at the Human Resources Development and Research Centre (BPSDMP) in Jakarta by the HR Research and Development Agency of the Ministry of Communication and Informatics with the title: "Smart Province Readiness Study in South Sumatra Province". This research will continue this year by conducting a focus group discussion (FGD) on the concept of the ideal smart 410  
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province and the readiness of the smart province. According to the head of the Human Resources Research and Development Agency of the Ministry of Communication and Information Technology of the Republic of Indonesia when contacted by telephone (10/2), the results of the FGD conducted and attended by all discussion participants (all representatives of districts/cities in South Sumatra) were that the government must implement a strategy that takes into account the main potential of the region, as well as procedures for preparing technology (infrastructure, applications) to create a smart area, and prepare governance (legal basis, policies, SOP), sources of human resources and budget that will support South Sumatra as a smart province. Apart from that, the informant also mentioned that there is a need to build a relationship between the South Sumatra government and the Regional House of People's Representatives of South Sumatra (DPRD), which has substantial political influence in implementing environmental-based smart provinces. One example is the implementation of this command centre to support the 2018 Asian Games international event held in Palembang, South Sumatra.

Chairman of Commission I in DPRD confirms that *"as we know, the DPRD has several functions and tasks, one of them is the budget work, where the DPRD functions to discuss the draft regional regulation on the provincial APBD (regional budget). The DPRD also has a supervisory function, in this case the supervision of the regional government and also the supervision of the provincial APBD funds. It means if South Sumatra government implement something; the provincial government must have a good communication and relationship with the DPRD to implement green smart city"*.

Departement of communication and informatics of south sumatra also states that *"many IT human resurces would disregard organisational objectives for eco-sustainability if they were not measured on this performance. Both the provincial and local government indicated that they had clearly defined sustainability vision, associated policy and governance mechanisms that facilitate the development of Green IT policies"*

The results from this study are consistent with several prior studies. Tolbert, Mossberger [60] state that the Legislature has an important factor in determining whether provinces will innovate in digital government. This is because that presence of legislative committees in the House dedicated to e-government is critical in explaining the extent of policy innovation of digital government. Many contries with the advanced IT infrastructure and legislative policy making capacity have more extensive implementation of e-government over time. Pang [61] in his study titled the moderating effect of IT governance on the relationship between IT investments and government performance shows the local government requires IT budget approval from Legislature as part of IT governance in the public sector organizations.

In addition, the South Sumatra Government has to redesign their IT infrastruture ecosystem to reduce energy consumption. This finding is supported by [62, 63] studies, that reveal that redesign IT infrastructure is required to meet environmental change through innovating business processes of e-government. For example, the implementation of e-mail, digital signature and virtual technologies can help institutions to promote their green government initiatives. Similarly, Antoni, Jie [64] discover that redesigning the IT infrastructure in business process can be emphasized on reducing operational cost in organization. For example, the use of video conferences in command centre such as zoom, google meet and other applications can improve efficiency of transpotation cost, and might drive the government to turn to enviromentally friendly office. In addition, the IT infrastructure ecosystems have to accommodate stakeholders of government demands to perform environmentally friendly activities. It might be used as strategy of South Sumatra Government to encourage internal and external stakeholders to adopt green behaviour in their activities, such as replacing the paper-based documents with digital documents. Furthermore, the IT infrastructure might reduce the digital divide and enhance the citizen participation in e-government implementation [65]. It means that the people with low-income households, people living in informal settlements and people

with lower levels of electronic literacy are able to access the smart city apps and also communicate with local government through the provided IT infrastructure channels including website, mobile apps and kiosk [66]. Accordingly, it can be concluded that South Sumatra Province has had several strategies to support the implementation of an environmentally friendly Smart City, either that has been done or for the future.

#### 4.2. Product Stewardship

In terms of product stewardship, the Head of the Research and Development Agency for Human Resources of the Ministry of Communication and Information Technology of the Republic of Indonesia emphasised on equitable development strategies, developing human resources whose the ability to use environmentally friendly technology, such as teleconferencing or video conference technology found in the command centre, used as a means of interaction and virtual meetings with regional heads of all regencies and cities in South Sumatra and can also monitor all activities of all regional organisations. He also added that the ability to use technology is insufficient. It must be accompanied by the ability to manage infrastructure and redesign service procedures for the community to minimise natural damage caused by service activities. Based on the Strategic Plan of the South Sumatra Province Communication and Informatics Office for 2018-2023, it is stated that the authority of the South Sumatra Province Communication and Information Office is in the communication and informatics sector, as well as the encoding and statistics in processing its authority emphasising the dissemination of information throughout South Sumatra through use of existing ICT infrastructures. This is in line with the implementation of a command centre which aims to create an environmentally friendly South Sumatra Smart Province through the use of ICT infrastructure and data management and applications that make it more straightforward for users and the public. South Sumatra Province Communication and Information Office makes this point clear:

*“Substituting travel and physical meetings with building command centre including videoconferencing and collaboration tools, eliminating paper-based workflows and reporting, and conducting government services through integrated electronic-based government systems including applications. In addition to these applications, other studies describe the indirect positive impact of using IS for reporting and measurement of environmental government services or collaborating on environmental initiatives.”*

Based on the results of interviews with informants, this study found at least six green products or services from the South Sumatra Communication and Information Office. First, the implementation of the command centre as a central facility for controlling and monitoring the components of the South Sumatra Smart Province in the form of applications, data, and information owned by RGOs throughout South Sumatra. Currently, this space is connected to various web-based applications such as the official portal of South Sumatra go.id, Sumsel smart digitalisation, Indonesian Disaster Rapid Assessment, and Integrated Media Management.

This finding is consistent with Huang [67] study finding that the role of command centre as a nerve center to efficiently and effectively mobilize resources, coordinate human resources and provide advice guidelines during covid-19 period. This current finding also agrees with Lacity and Willcocks [68] study findings that is a centralized command center establishes standards and best practice and tracks the business performance of service automation which can reduce human intervention a minimum and leading to enhanced information efficiency.

Second, the South Sumatra communication and informatics office is building data integration and applications from either RGO or cities and regencies in South Sumatra. This will transform the command centre into a data and information centre for RGO, cities, and regencies in South Sumatra. This finding is consistent with Molla [69] study finding that advanced data centre provides services on how to position IT as an enabler

of green initiatives. In additional, the finding of this study also is similar with Hashem, Chang [70] study finding that integrated data promises flexibility and low costs to reduce the technical barriers of addressing the data. For example, integrated data which collected from multiple sources, such as citizen and government organisations are stored in a database. The data are able to be utilized by the business intelligence and data analytics model to predict future behavior with increasing precision, decision automation, data driven business, and performance management to establish government administration simple. Thus, the green smart city infrastructures could be designed as platform that suitable for government and citizen to improve capacity and engage public participation[65, 71].

Third, the implementation of closed-circuit television (CCTV) used as a support public service. The command centre operator ensures that the CCTV at a certain point is on and monitors the state of the area. The results subsequently will be analysed in more detail so that notifications appear as needed. This finding is consistent with Chung [72] research finding that CCTV is combined with intelligent technology and the Internet that automatically detects and identifies specific objects such as people and objects. The implementation of the intelligent CCTV in the government office will be made mutually integrated with the employee access system. The data obtained by data centre will be more detailed in monitoring employees while carrying out their work activities. Thus, using an intelligent CCTV, the employee performance can be efficiently and effectively measured. As well as in this system there is also information that can be used as an indicator of performance measurement when making a decision immediately.

#### 4.3. Clean Technology

The last strategy is to create environmentally friendly products or services by using clean technology. The Communication and Informatics Office of the Province of South Sumatra must continue to research to support the ideal smart province strategy and for the success of the environmental-based smart province. This can be achieved through the online media approach that people need for communication (e.g., what information is needed, whether entertainment, opinions or news). Further, existing data can be used to analyse communication components, starting from sources, messages, channels or media, recipients, and feedback from the public. In addition to conducting research, the South Sumatra Province Communication and Informatics Office can optimise the role of the Information and Documentation Management Officer (IDMO) Assistant of the South Sumatra Province Information and Information Technology Office in collecting public information related to the field of information and communication technology. In the future strategy to implement clean technology, governments in South Sumatra, especially the Communication and Information Technology Office, will invest in building services and products that are environmentally friendly, including building a data centre that provides data and information of policies for public services, provision of information on local government administration. Departement of communication and informatics of south sumatra make point clear:

*“...the data center is a collection of data and information obtained through entire government services in the South Sumatra government, which will be used to improve the quality of existing services and be used to predict future sustainable services of government”.*

*“...we might employ our official website as a sustainability strategy to place all our Green smart city policies including general sustainability policy and the environmental management system is all seen in there too...”*

This environmentally friendly strategy shows how the government efforts to invest data centre to meet stakeholder requirements to provide green products and services and build green brand image that influence mindset of stakeholders [55].

Secondly, the South Sumatra Government has green initiative to develop and upgrade infrastructure to increase the accessibility of information and ICT resources for public. This government's initiative can empower the stakeholders to access whole e-government channels from any location. Therefore, the stakeholder no need to go to government office to get a public service and then reduce the transportation cost. Thirdly, Province of South Sumatra Government optimises the implementation of the Electronic-Based Government Administration System (EGAS) to provide environmentally friendly services. This program encourages the government to improve operational efficiency and paperless office [73]. This is also comply requirements and targets of paperless initiatives in the Indonesian public sector services.

Implementation of public information disclosure of EGAS in accordance with the mandate of Law No. 14 of 2008 and its implementing regulations. This finding is supported by Dawes, Vidiyasova [74] research finding that through implementation of regulation, the government has a guidance to keep on track to develop IT infrastructure and government itself receives benefits in terms of progress toward political and strategic goals for transparency, public service, and good management along with improvements in stewardship and agency mission accomplishment. Furthermore, the management systems standards and standardisation of IT equipment can assist South Sumatra Government as guidelines in minimising the environmental impacts of their public services. These also help the local government to select suppliers, raw material and products that can be used as green smart city infrastructure. Monitoring results and evaluation and inventory of ministries about the implementation of government affairs in the field of ICT of South Sumatra for a period of two years, the existence of the main tasks and functions of ICT affairs are still scattered in various regional apparatus (agency authority has not been optimally implemented). Table 3 shows there are the strategies of the South Sumatra Provincial Government in realising an environmentally friendly smart city.

**Table 3.** Ecological Smart City

No	Ecological Sustainability	Public services of smart city
1.	Pollution Prevention	SOP for infrastructure and applications ICT ecosystems Local regulation Human Resources capabilities IT Infrastructure Budget
2.	Product Stewardship	Sumsel Command Centre Virtual meeting Monitoring RGO activities Disseminating information through social media and websites E-sumsel (integrated budget Application) Data and application integration CCTV implementation
3.	Clean Technology	Data centre for public services Accessibility of information for each city district Optimisation of Electronic-Based Government Administration Systems Local government electronic data and information management services Increasing literacy in the use of digital startups by businesses/MSMEs in South Sumatra

## 5. Conclusion and Limitations

This paper attempts to identify the concept of ecological smart city that is getting increasingly popular in Indonesia. An in-depth analysis of interview and focus group reveals that the ecological smart city can be investigated from several perspectives including pollution prevention, product stewardship, and clean technology. These three dimensions should be the guidance of the South Sumatra Government to identify the green smart city implementation. Based on the results of the analyses, the pollution prevention is determined by public services of smart city, regional resources potential, technology preparation procedure for infrastructure and applications, ICT ecosystems, local regulations, improvement of human resource capabilities, coordination both vertically and horizontally in data/information management activities and IT infrastructure budget. Moreover, this research also shows that product stewardship consists of Sumsel Commad Centre, Virtual meeting infrastructure, Monitoring RGo activities, SOP of green design, Disseminating information through social media and websites, E-sumsel as a budget integrated systems, one data and application integration, and CCTV implementation. In clean technology approach, the study reveals South Sumatra Province has several IT strategies and use environmentally friendly IT resources in order to build image of green smart city in Indonesia. These technologies include Data centre, accessibility of information for each city district, Optimisation of Electronic-Based Government Administration Systems, Local government electronic data and information management services, Increasing literacy in the use of digital startups by businesses/MSMEs in South Sumatra, Application of encryption for information security, Implementation of public information disclosure and Results of monitoring and evaluation of environmentally friendly IT infrastructure policies.

In closing, it is important to acknowledge several limitations in this study and suggest possible paths for further research. First, the ability to generalize from the results of this study is limited by the small number of cases and interviews conducted. Secondly, this research only focuses on the development of green smart city of south Sumatra province. Thirdly, the current research has provided the viewpoints of both ecological and smart city. Fourth, arguably research has identified three dimensions and 23 public services of green smart city based on the ecological model developed by Hart [52]. While acknowledging this limitation, more work will require to be carried out to develop a green smart city for other cities in Indonesia or other developing countries from different perspectives and approach. For example, COVID-19 Pademic which has driven more government public services move from offline to online, has provided new opportunities for implementing green smart city concept in other provinces of Indonesia and other developing countries. Future research should also investigate a broader range of issues and approaches and more provinces involved to get more understanding how green smart city implemented, and might investigate the extent to which green smart city can implemented in South Sumatra Province or others in providing excellent service to citizen

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