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Smart Sustainable City Application: Dimensions and Developments

Smart services for region of the foremost cultural centers of a developing country

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Abstract—Developing countries are the main state of the global urban population growth. The trend creates unprecedented technology challenges. In developing countries, technologies are enabling progress on urban functionality, productivity, and livability. In response to that need, the Working Group 5 in the International Telecommunication Union's - Telecommunication (ITU-T) that forms the Focus Group on Smart Sustainable Cities (FG-SSC) provides the specific dimension and develops technical reports, specifications, and others that make cities smart and sustainable.

Despite the wide range of literature that exists on the topic of global smart cities, there are differences that characterize the smart city application needs for each region, especially in a developing country. This paper defines dimensions of smart city application and how the development refers to be the better understanding of what constitutes a smart city is. This paper aims to provide the general foundation for further, more in-depth explorations of application development on a smart city.

Keywords—smart city; application development; ITU-T; developing country; information technology; e-Gov

I. INTRODUCTION

Smart city definition varies through which it is being conceptualized. The concept of a smart city has established to become a vision and mission that is applied in big cities all over the world that not only requires encouragement and participation of the community, but also adequate technology infrastructure. The technology infrastructure will become an automatic computing pillar in the field of smart city planning.

The smart city takes social, economic and environmental issues have become tightly interconnected. As urban populations continue to rise there will be a need for emerging the city to develops sustainability between governments, businesses and communities [1]. Smart City definition can be defined as The British Standard Institute (BSI), "The effective integration of physical, digital and human systems

in the built environment to deliver sustainable prosperous and inclusive future for its citizens" [2].

The Smart Sustainable City (SSC) application must be planned and designed as well as possible because it is needed to ensure the availability of services on an ongoing basis. It becomes the outcome of creative thinking, innovation of modern technologies, entrepreneurial spirit [3] and ecologically sustainable transformation including exploration of socio-economic development in the Smart Sustainable City. Therefore, recommendations for implementing smart services must be prepared based on the appropriate functional and implementation priorities. To achieve this, this paper refers to the Smart City Information and Communications Technology (ICT) infrastructure work standards that are applied internationally.

ITU-T forms various Focus Groups based on ITU-T Recommendations A.7. The Study Group 5 in ITU-T formed a Focus Group on Smart Sustainable Cities (FG-SSC) at its meeting in February 2013. The work of the Focus Group can be in the form of technical reports, specifications, and others. It aims to provide consideration by the parent group in standardization activities [4].

Yogyakarta is a region in Indonesia that is known as a city of culture, city of education and city of tourism based on a dominating sector of industries. The city is targeting the accomplishment of e-Government as a means of Yogyakarta city management information system that is reliable in supporting effective, efficient, transparent, accountable and participatory public services. The function of the City of Yogyakarta as the center of activity and the center of the administration of the Special Region of Yogyakarta made the population density in this city quite high [5]. Thus, ICT is the key to the conceptualized as well as the development of smart services [6].

More deeply, a Smart Sustainable City is built by a system that has many subsystems in it and can be viewed from various perspectives. In Asian countries, there have

been concerted efforts to drive smart city. Each country has a different focus in initiate smart city dimensions. The challenge that will be faced by the city is how to determine the planning of application development for each dimension of a smart city in a homogeneous architecture environment. In terms of functional services and priority of smart city implementation in a city based on culture, tourism, and education, this paper provides insights regarding the dimensions of a smart city and application development as a solution to overcome city challenges. The current needs of the Smart Sustainable Cities related to sustainable urbanization and ICT that take forward the research outline.

II. CITY DIMENSIONS

The city dimensions are highly specific context to discuss some key about the nature of the Smart Sustainable City in the developing country. In the future, it concludes by underlining the role of Information and Communications Technology (ICT) mainly focuses on applying the next-generation information technology to all walks of life, embedding sensors and equipment to hospitals, power grids, railways, bridges, tunnels, roads, buildings, water systems, dams, oil and gas pipelines and other objects in every corner of the world [7].

City dimensions identification is also about understanding the city itself about the city identity, its stakeholders and their priorities as the uniqueness of each city while enhancing its overall living quality and sustainability with the support of ICT.

The Vision of Medium Term Regional Development Plan of Yogyakarta is one of the efforts to reaffirm the realization of the region as a comfortable city of habitation, a city of service centers with strong competitiveness, cities that are oriented towards community empowerment, and cities that are based on special region values. The vision is a reference to innovations in the field of information technology in order to provide benefits and convenience in service to the community as a smart city concept in the city. There are three overacting and closely interrelated dimensions at the core of a city [4]:

A. Environment and Sustainability

The amount of electricity during 2016 in Yogyakarta increased by around 10.08 percent compared to last year and reached 1,094.87 million KWH. The total energy used by households is around 40.35 percent, 38.76 percent by business units, 3.43 percent by industry, and the rest is absorbed by social, government and other customers [8].

Cities represent 75% of energy consumption and 80% of CO₂ emissions on a global basis, and represent the largest of any environmental policy challenge. Therefore, sustainability and the environment are the most critical components in the functioning of any city [4].

Multiple studies conducted in this field suggest that each of these attributes encompasses a series of more granular categories and components [4] [9]:

TABLE I. CATEGORIES AND COMPONENT OF THE ENVIRONMENT AND SUSTAINABILITY DIMENSION OF YOGYAKARTA

City Infrastructure and Governance		
Policy and Management		Infrastructure
<ul style="list-style-type: none"> • Integrated environmental management strategy • Municipal administration 	<ul style="list-style-type: none"> • Urban planning • Buildings and physical infrastructure • Mobility, transportation and traffic • Public safety 	
Energy and Climate Change		
CO ₂ Emission		Energy
<ul style="list-style-type: none"> • CO₂ from energy production • Emissions per capita 		<ul style="list-style-type: none"> • Energy performance
Pollution and Waste		
Waste		Air
<ul style="list-style-type: none"> • Waste management • Waste water treatment 		<ul style="list-style-type: none"> • Urban particulates and air quality • Indoor air pollution • Local ozone
Water		Noise
<ul style="list-style-type: none"> • Drinking water • Water quality index • Water management 		<ul style="list-style-type: none"> • Noise pollution
Social, economy and health		
<ul style="list-style-type: none"> • Social services • Citizen satisfaction • Tourism • Education • Culture/heritage • Demographics 	<ul style="list-style-type: none"> • Gross Domestic Product • Employment • Financial Resilience 	<ul style="list-style-type: none"> • Adequate sanitation • Disease control and mitigation • Citizen health service • Citizen health socialization

B. City Level Services

The development of Smart Sustainable City is supported by innovation in the field of functional urban environment that suggested for this dimension:

TABLE II. CATEGORIES AND COMPONENT OF THE ENVIRONMENT AND SUSTAINABILITY DIMENSION OF YOGYAKARTA

Technology and Infrastructure	Environment
<ul style="list-style-type: none"> • Transportation • Building • Fire and emergency response • Healthcare • Urban planning • Safety and security • Education • Tourism 	<ul style="list-style-type: none"> • Environmental and natural hazard • Water • CO₂ • Air quality • Waste • Energy
Governance	Economy
<ul style="list-style-type: none"> • Organization • Law adjjustice • Resilience • Leadership • Commitment • Regulation 	<ul style="list-style-type: none"> • Economic strength • Human capital • Institutional effectiveness • Financial maturity • Financial capital • Creative products

C. Quality of Life

The population of Yogyakarta City in 2016 according to the population projection of the Central Statistics Agency was 417,744 people, with details of 203,845 male residents and 213,899 female residents. With an area of 32.50 km², the population density of Yogyakarta City is 12,854 people per km² [8].

The data tells that people are constantly striving to better themselves across many facets of their lives. The trend of rapid urbanization is reflected here because of the migration to urban areas in search of better employment and hopefully improved living conditions. Quality of life is a recurrent theme in understanding the nature and operation of a city and a key dimension since it reflects how citizens or inhabitants of a city perceive their own sense of general well-being of individuals and societies, negative and positive features of life [4].

Local government needs to determine the direction of regional development policies that are relevant to future conditions both in terms of trends in changes in cities/regions, behavior and expectations of the community and other stakeholders, development of other cities and city / regional strategies in the competitive arena or global cooperation with cities abroad.

III. THE ROLE OF ICT IN SMART SUSTAINABLE CITY DEVELOPMENT

In the future Smart Sustainable City, ICT is more than just the technology use, but also the strategy used in its implementation in order to provide solutions in the present and meet future needs. Applications has an important role in ICT because it acts as a platform that gathers information and data to help enable increased understanding of how the city functions in terms of resource consumption, services, and lifestyle. Generally, the construction of Smart Sustainable City applications can be divided into three levels, including the construction of public infrastructure, construction of public platform for SSC, the construction of application systems. In this three-level, the construction of application systems is particularly important, and has earned great concern across the country [7].

TABLE III. HOW ICT ENABLES THE PERFORMANCE OF SSC

Information and knowledge sharing	With immediate and accurate information, cities can gain an insight on the problem and take action before it escalates
Forecasts	ICT provides and manages this information more efficiently, so that the city can improve its preparedness and response capability
Integration	Access to timely and relevant information (e.g. ICT-based early warning systems) need to be ensured in order to better understand the city's vulnerabilities and strengths

The Smart Sustainable City application focuses on the following reclassification that have been identified for region of the foremost cultural centers along with key attributes [4].



Figure 1. Smart Sustainable City Pillars

ICT plays crucial role for future Smart Sustainable City applications development. More specifically, it has been depicted that ICT contributes to all the smart city dimensions (people, living, government, mobility, economy and environment), which is translated that the alternative ICT solutions [10]. A Smart Sustainable City ICT has to comply with the particular requirements of all forms of cities and plays major role in SSC development.

The provision of IT-based services must involve various sectors as well coordination of academic, business, community, government and media to be in harmony and there is no overlapping of sectoral interests [5].

ICTs also enable the following keys to achieving the goals and maximizing the performance of Smart Sustainable City services [4]. 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 [11].

For the best result, ICT in Smart Sustainable City required to be used in the most effective way. ICT in Smart Sustainable City is being a great extend for contributing the overall conditions of the region.

The smart city of Yogyakarta is a form of efforts to realize the development of the region by using information technology that is carried out in the framework of public information to improve information disclosure and public communication. Through this openness of information and communication, the population in the city of Yogyakarta is expected to facilitate information and facilitate the community in development.

Governments are using technological innovations to make a paradigm-shift to tackle the above challenges in urban environments. Another related term, ICT is sometimes used in preference to information technology, particularly in the fields of education and governance. In common usage, ICT encompasses any medium to record information, technology for broadcasting information and technology to communicating through voice and/or images [12]. ICT devices and services are only an enabler or purveyor which allows the "smartness" to percolate throughout a system [4].

ICT has made many fantasies about the lifestyle and quality of life in the future becomes reality. An ICT system is much more sophisticated and complex; there must be integration of data from different sources, and the cities must have the ability to respond "smart" for different requirements of daily living [13]. However, the more recent interest in smart cities can be attributed to the strong concern for sustainability, and to the rise of new technologies, such as mobile devices (e.g. smart phones), the semantic web, cloud computing, and the Internet of Things (IoT) promoting real world user interfaces [14].

In daily life activities, newer applications as the part of smart services are being developed which increase people interaction with and dependence on ICT-enabled devices [12]. The proper controlling and monitoring environment would provide an automation level which would require less human interaction. On the other hand the smart environment used to attract the users by giving them more control and property resources management [15].

The Smart Sustainable City transformation integrates technology and business / operational processes to improve the lives of its people. Smart Sustainable City concept in Yogyakarta includes elements namely smart governance, smart branding, smart economy, smart society, smart living and smart environment [17].

IV. DISCUSSION

Smart Sustainable City applications development is based on the city needs. The needs of the region of the foremost cultural centers of a developing country can be extremely complex with compounded issues in regard to services such as public services and environmental management, because it becomes a tourism and educational destination as well.

Based on the above identification, Smart Sustainable City application development of the city needs to acknowledge to some of the considerations below:

TABLE IV. COMPONENTS OF THE SSC APPLICATION

Dimensions	Components of Application
Governance	<ul style="list-style-type: none"> E-Government (public services, bureaucracy, public policy) Networked sensors and cloud computing Data interoperability
Branding	<ul style="list-style-type: none"> Accessing world class digital content online using collaborative technologies
Economy	<ul style="list-style-type: none"> Factories and small and medium enterprises of the future Welfare
Living	<ul style="list-style-type: none"> Smart hospitals Traffic management: Monitoring and routing Real-time linkage to emissions, traffic patterns, reduced fuel consumption
Society	<ul style="list-style-type: none"> Video surveillance and video analytics Seamless communication during natural and man-made disasters Flexible learning in an interactive learning environment Massive open online course (MOOC)
Environment	<ul style="list-style-type: none"> Generation/distribution/measurement of the energy Wireless communications Analytics and policies Load balancing, decentralization and co-generation Sustainable production and zero emissions Water information systems (WIS) Integrated water, waste and energy savings optimization schema Sensor networks for water and air systems

Each component of the Smart Sustainable City dimensions may be used to meet the city subsystems demand to achieve holistic analyses and the bridging of a diversity of services in a typical Smart Sustainable City initiative. The components of Smart Sustainable City applications as the modern technology challenges the status quo in municipal management strategies [18] and integrates the city's governance, branding, economy, living, society and

environmental dimensions in order to maximize resource management efficiency.

The components of the city's dimensions needs can be used as a foundation of the Smart Sustainable City applications development to bring city's resource effectiveness into reality, enable agility within the scope of business and technical capabilities through the ICT adoption to support municipal effort for sustainability.

V. CONCLUSION

The city of Yogyakarta tries to make an urban transformation based on ICT to fulfill its governance, branding, economy, living, society, and environment sustainability objectives as outlined in the Medium Term Regional Development Plan and regulation of Mayor No. 15 of 2015. The various components of a smart sustainable city dimensions need to be identified and can be used as part of the metrics and reference points for defining the smartness and the sustainability of a city. This will help contribute to a better, more in-depth understanding of what constitutes a smart sustainable city [3].

The availability of up-to-date and open networks for energy and digital connectivity is the basic infrastructure of smart cities. Improved connectivity must prioritize security efforts on relevant systems and networks that hold data related to citizen security and data privacy. Smart Sustainable City have overwhelming benefits and it a win-win situation for both government and the citizens [16].

The Smart City applications must be planned and designed as well as possible because it is needed to ensure the availability of services on an ongoing basis. Therefore, recommendations for the implementation of 6 smart dimensions must be prepared based on the appropriate functional and implementation priorities. Each dimension of the Smart Sustainable City components are prepared to support the vision and mission of the Yogyakarta City Medium Term Regional Development Plan as a complementary entity. To achieve this, the Compilation Team refers to the Smart City Information and Communications Technology (ICT) infrastructure work.

In supporting the efforts to implement the services in Smart City, a cooperation of various stakeholders is needed, both from the government, community service providers, industry, and the people of Yogyakarta City. With strong support, the implementation of smart city services in the city of Yogyakarta can be done by aligning the programs in Medium Term Regional Development Plan with applications that will be planned to be implemented in the Smart Sustainable City of Yogyakarta City.

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