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Smart growth, smart city and density: in search of the appropriate indicator for residential density in Indonesia

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Abstract

Smart growth is one of the efforts of controlling the natural resources consumption. Smart City aims to create a high quality of life. The primary element of the city-forming is the built-space density. House grew sporadically, creating the land and building size characters. Similarly, the nature of resident's social, cultural and economic. A housing density indicator that comes from the physical and non-physical nature of residents is considered necessary. The indicators of residential density are compared. Then, it will set up indicators that best fits the character of housing in Indonesia to reach smart growth and smart city.

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1. Introduction

1.1. Definition of Smart Growth and Smart Cities

At this time, research on Smart Growth and Smart Cities increasingly arranged. At the same time as physical development in the world's cities, it's very important to find the solution of the problems in urban areas. In the beginning, this article delivered with understanding the basic of the Smart Growth and knowing when Smart Cities were beginning.

Base on fundamental nature, the city has been established by the building environment to make a solid (Kostof, 1991). The settlement and housing are the most significant in shaping the built environment in urban areas. The housing provides a huge part in forming the building density in urban areas. This time, the phenomenon in the field

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shows that residential use consumes land quickly and in a massive way. Afterward, the building densities become excessive. In urban areas, it has to be controlled so that the quality of life can maintain.

Based on this, it is very important to control housing density in a suitable way. Urban residential density has reached the final phase of overcrowding. Therefore, urban residential density needs to be controlled with some mechanisms that according to social and local economy indicator. The aim is to be there is no rejection from the people. Planning that comes from the unique indigenous or homegrown people is expected to give effectiveness and efficiency of better implementation. That planning is more compatible with the desires of the society itself. In the larger scope, the value of urban residential density, which is base on a unique local people, will strengthen sustainable development in urban areas.

Controlling the building density crowd is one of some approach to achieve sustainable development. On the beginning, urban development focused on physical, economic and social aspects. After that, the urban development also approaches on environmental and sustainable agendas. It is necessary that urban development has to address on smart growth. As a factual example, a house in urban areas with landed house type becomes such of problem and challenges to achieve smart growth. In a collective description, smart growth aims to make a compact city, not create a city development in a sprawl condition (Turner, 2007; Song, 2005).

Smart Growth is a healthy development in economic, environmental and social. The basic concept of the Smart Growth among others:

- There is mixed land use;
- A compact, effective and efficient building design in a city;
- The environmental facility can achieve by walking;
- Have a strong sense of place;
- Preservation of open spaces;
- Development by the needs of the society;
- Have some choices of transportation;
- The decision for development is fair, cost effective and can be measured;
- Development decision is based on the people agreement and other stakeholders.

There is a difference between smart growth and smart city. If smart growth plays a role as "pot" of physical nature of urban areas, the smart city play a part as "content" of urban areas. The idea of the smart city has arisen because of two dynamisms circumstance. The first is an enhancement of technology development and the second is drawing of people's needs. Urban issues resolved by an attainment of science and technology (Angelidou, 2015).

The concept of the smart city first used in the year 1994 by Dameri and Cocchia (Jucevicius et.al, 2014). Since the year 2010 number of publications that discuss smart city increased rapidly. This publication related to the arising smart city projects and support from the European Union. Refer to the opinion of some researchers city's information systems were affected city technology stage. The "digital" city that interconnected to society follows the well-informed people. Therefore, people can reach higher knowledge, and a positive condition for a smart city will realize (Jucevicius, et.al, 2014).

Based on research that prepared by Caragliu, Chiara del Bo and Peter Nijkamp (2009), the explanation of Smart City is a city that have a strong focus and purpose for every aspect in the social community upturn into public services. The technology used to encouragement to realize the smart city. So that, all social classes acquires a justice and the benefits of the urban fabric. The landscape of Smart City formed from several aspects; there are the local nature, priority of city development, the city requires and global market forces.

Until now, the term of a smart city is still not clear enough.

Smart cities – Preliminary Report 2014, ISO/IEC JTC 1 Information Technology books, state the description of smart cities. Smart City is a new concept and a new model, which applies the new generation of information technologies, such as the internet of things, cloud computing, integration of big data and space/geographical information, to facilitate the planning, construction, management and smart services of cities. Developing Smart Cities can benefit synchronized development, industrialization, informatization, urbanization and agricultural modernization and sustainability of cities development. Smart Cities is to pursue:

- Convenience of the public services;

- Delicacy of city management;
- Livability of living environment;
- Smartness of infrastructures;
- Long-term effectiveness of network security.

Smart Cities could therefore provide:

- Better and more convenient services for citizens;
- Better city governance;
- A better life environment;
- More modern industry that is greener and more people friendly
- Smarter and more intelligent infrastructure; and
- A dynamic and innovative economy.

There are two digital things that can accelerate a city become a smart city. The first is the digital-city strategy and the second is digital initiative comes from the community.

Digital-city strategy offers new ways for government and developers to build infrastructure and services more efficient. Digital-city strategy, for example, IP network infrastructure, e-government services, digitalization process, and planning system in urban areas, transportation, healthiness, education, utilities, and buildings.

The second is the digital community initiative. This initiative can stimulate self-reliance on in the community, strengthen social capital, and bring digital inclusion.

Population growth and urbanization increase rapidly necessitate to cities grow more economical, more social, and retain environmental sustainability. It can transform cities and offer possible solutions through a digital-city platform. The collaboration needed between the government, industry, cities, and citizens to share ideas and to use an urban-digital platform as solutions to these urban problems (Hodgkinson, 2011). An issue among some various challenges of a smart city is that virtual world is not a purely public space because not all those people who have the same access to do. People will not automatically have access to digital recourses. So that, the opportunity to participate also not the same (Angelidou, 2014).

1.2. How with Residential Density?

Major elements to shape an urban were a highly intensity housing. The highly market-driven land price enforce the housing land use becomes efficiently. This condition pushed housing function to create the most densely populated area. Numbers of houses per square kilometers become enormous, so than the density housing ratio follow that condition. These housing buildings density must control. Although the housing developed in an intensive way, housing must direct to be a smart urban housing.

Cheng cited in Ng (2010) said that the density physical size is a concentration individual or physical structure in one unit geographic. Plot ratio is the ratio of the amount of the floor to a parcel. The density of residential buildings in an area indicated the intensity of land use level. Udy (2004) shows land use intensity is an indication of land ratio with:

- floor area (developed /permitted built space),
- population (number of dweller / occupant in the area),
- the amount of residential unit and the number of rooms/space

To determine ideal density ratio of residential buildings in urban areas must be constructed from the result of an analysis design that respond to the issues from dweller. It is not an approach that comes from a rigid conditions design (Clarke in Thomas, 2003). Also, not only the density in physical form but density also can be measured by feelings or man assumptions. Each has perceptions about numbers of people can carry in an area and wide of space to accommodate properly.

Perception of a density influenced by spatial arrangement characteristics, the interaction between individuals with their surroundings, cognitive nature of the individual and social, cultural norms values.

1.3. Why indicators of smart residential density are needed?

The residential density comes from a composition of a house building and the open spaces. The circumstance of residential density is very close to the dirty environment, slum and unhealthy maintained. The various residential causes different density that has established. Be very important to make the ratio of urban residential density as a tool to bring prosperity to the community. These leading indicators must be ordered to provide guidance on how to create a smart residential density.

Here can analogize that broad ownership over plots and house building reflects an occupant's social and financial character. This is like that said by Rapoport (1990) that preferences of the occupant is the result of interaction and understanding the meaning of environment day-to-day, which is manifest in the built environment. Nevertheless, according to Rapoport (1969), a house is the result interaction between man and nature, his wishes, social groups, the way of life, the need social and psychological, individual and his group needs, economic resources, his attitude toward nature, personality and lifestyle. The buildings as a manifestation are the result interaction between man and his needs, possibilities of technology, and physical aspect (climate, sites, materials, visual landscape, legal and others).

Every occupants/dweller has a distinctively different character. So that this influencing, not only in a process to create a residence, but also in a residential density. Size over plots and the difference in residential density resulting heterogeneous figure ground (Zahnd, 1999). Then, the solid shape that comes from the Building Coverage and the Green Coverage becomes very varied. As it was raised by Rapoport (1969), these entities have been formed naturally in line with the characteristics of its human resources. It can emphasize that in this case, there is an urban residential density that formed naturally derived from the society characteristic. Housing urban areas have a contribution to change un-built becomes built environment. To keep under control the buildings residential density by the government city/region that is determined by top down it is difficult to implement. The cause of its difficulties because there is an occupant character has formed the buildings residential density naturally. Since, it needs to find smart residential indicators by the unique occupant characteristic.

2. Methods

Preparing this article is started from the urban development problems that directed to the smart growth. The Urban residential building is playing a large part in developing the city. The city becomes growing increasingly with its population density and crowd. After that, the development of information technology turns into the alternative solution for the problems of urban areas. The result of empiric and theoretical research publications sidelined help these leading to draw up a smart growth and smart city indicators.

Qualitative evidence presented in smart growth and smart city discussion then continued to study the urban residential density. Smart growth and smart city indicators then focused only related to urban residential areas. The "smart" indicators for urban residential density areas are then discussed to promote sustainable development.

3. Results and Discussion

3.1. Relevant Theory Supporting Smart Residential Density

Smart Growth is one of the various ways to promote sustainable development. To reduce its dependency on cars, effective use of land, to keep water supply and other natural resources save and an inclined well-living environment. One realistic kind of the smart growth among other is to control city growth and control the urban residential.

This densely solid growth must be able to smart growth density which the man-scale smart growth density and by social, cultural and economic community natural character. The relationship of residential and its occupants is closely (Johnson,1993; Ozdemirb, 2007). These entities form of the house, as the structure and layout, not only about economy functional consideration but also culture and occupant's non-physical life. A family and household not only as a being present structure and "natural conditions" membership or "universal", but a family is unique because the characteristics can be different from the times to time. Spatially changes of the house are closely related to the change of these spaces inside; that represents needs of the occupants that also change from time to time.

For example, in the region with the difference extreme climate, urban buildings residential density character should respond to climate nature (Nesslein, 2003). In the region with a dry and hot, it needs the high density and the high building. High density and high building meant to be able to form a shadow untroubled for users so that they can do their activity such among these buildings. In the region, with a hot and humid, what is needed is design

to minimize the effect of the storm and flood disaster. It is done by increasing rain absorption on the land, reduce run-off, provides natural drainage works between the low, collect run-off in reservoir cities such as a small lake, and provide buildings ventilation that is good and enough with various engineering design. In the region, with a cold weather, suggested the building better in high density with various functions. For example, shelter, retail, commercial sector, offices, and so on. The high density and multi-function are to reduce the use of land and reduce outdoor activities, reducing the transportation and difficulties to getting such a place.

Urban residential density can regulate by the point of observers from outside. The point like a people physiology mechanism, including inside is the ability to feel the comfort of a place based on the amount of time, the pleasure tendency and observer's customs (Spreiregen, 1965). Based on publications results of research, it is apparent that it is still not clear to differentiate between the definition of digital city and smart city. The libraries critical analysis helps us to clarify the role-dimensional digital in a smart city.

Table 1. Variable Relevant to Residential Density

No	Year/Source	Research Type	Variable Relevant to Residential Density
1	1998/Altas & Ozsoy	Empirical	Three groups of variables for residential satisfaction on dwelling space: user characteristics, physical attribute of a space, and beliefs and perception of the user about experienced space.
2	2008/Smith et.al	Theory	Eco-homes category method for landscape assessment: energy, transport, pollution, materials, water, ecology and land use, health and well being.
3	2010/Heng & Malone-Lee	Theory	Density delivers environmental benefit with mixed land and building uses. Mixed-use areas is expected to be able to: <ol style="list-style-type: none"> 1. allow parking and transport infrastructure to be used more efficiently; lower household expenditure on transport; 2. increase the viability of local shops and facilities; 3. encourage walking and cycling, bringing health benefits; 4. reduce the need to own a car, thus reducing emissions; 5. enhance social equity; 6. increase personal safety; 7. offer people convenience, choices and opportunity that lead to a sense of personal well-being.
4	2005/Porta & Renne	Empirical	Urban fabric indicators for measure the scale of the district or the neighborhood. the development of these indicators is the assumption that 'traditionally' designed town centers or suburbs are more sustainable in respect to social equity, economic stability and the protection/enhancement of the environment, compared to 'conventionally' designed places. Eight urban fabric indicators: accessibility, land use diversity, public/private realm, natural surveillance (fronts and backs), permeability/ street connectivity, employment density, number of buildings, and number of lots.
5	2015/ ISO/IEC JTC 1, Information technology, Global City Indicators	Theory	Education, fire and emergency response, health, recreation, safety, solid waste, transportation, waste water, water, energy, finance, governance, urban planning, civic engagement, culture, economy, environment, shelter, social equity, technology and innovation
6	2015/ ISO/IEC JTC 1, The Green City Index	Theory	CO ₂ , energy, buildings, transport, waste and land use, water, air quality, environmental governance.
7	2015/ ISO/IEC JTC 1, Smart City realized by ICT (proposed by Fujitsu)	Empirical	Service, environmental impact, energy, biodiversity, water
8	2015/ ISO/IEC JTC 1, Key performance indicator from ITU-T FG SSC	Empirical	Network facilities, information facilities, environment, building, energy and natural resources, innovation, knowledge economy, governance, transportation, security and safety, sanitation, healthcare, education and training, openness, participation in public life, convenience and comfort,
9	Nam & Pardo	Theory	Conceptual Relatives to Smart City : Dimensions : Technology, People, Community Concepts : <ul style="list-style-type: none"> - Technology (digital city, intelligent city, ubiquitous city, wired city, hybrid city, information city). - People (creative city, learning city, humane city, knowledge city) - Community (smart community)

3.2. Defining Smart Residential Density

Housing density urban (low, and was) has several implications (Edwards & Turen, 2005). The density housing, low (around ten houses per hectare or less) have more advantages green open spaces. Thus, drainage rain and waste water can be arranged with good. Green open spaces can food crops for the benefit used as well as another biodiversity. Its population density is low creating an environment in which more calm. The weakness of housing most densely populated area is low fees for networking infrastructure network, utilities and transportation to be more expensive. The density (around 30 houses per hectare) has advantages among others are still make it possible for the movement by using a bicycle, manage wastewater system, and community. Food crops are still possible planted in the location of the garden.

The weakness of housing with moderately populated area densely is public transportation remains to subsidized more, and functionally, the form opening the mass buildings is not good. Urban Housing with a high densely populated area (around 60 houses per hectare or more) has some advantages. In the compact form made energy use more efficient, supports the development mixed-use, many travel will be done by walking, biking or using any transportation, better existing public urban design and better setting a micro climate. However, the weakness is a potential a criminal case and vandalism, the spirit society is on anti-social, much more noise, and good design only in a part of the necessary, the price house is very high.

Every kind of building density requires intervention to create its sustainability by information technology (digital) as tools to achieve it. Thus, smart residential density is a crowded urban housing but by using the principles of the digital technology as a supporter solutions to these housing density problems and tool to achieve sustainable development.

Big cities usually have the high-density demography. The big cities and densely is easy to spread knowledge and ideas, in a manner: placing a significant number of people in a contact, facilitate social interaction and produce ideas and innovation. For example city with its population density demography will certainly try harder than else for developing local public transportation system. They have been in a more ready to launch initiatives digital technology in a profitable transportation. However, the density demography can lead to diseconomies. In fact, this dis-economy makes the dense cities less intelligent, but in the same way, they are potentially more interested in introducing the ICT-based initiative that aims to reduce traffic congestion problem that was caused by diseconomies. (Neirotti, et.al ., 2014).

The urban density needs to be viewed not as statistics but as experience. Those who live in high-density urban areas does not always experience a sensed density is equivalent to the people that is not live in urban areas.

The urban housing density must remain sustainable environmental, social and economic. Key points are (Forsyth, 2003):

- The density is the number of units (can be some people, the house, a building area) in a certain region.
- Population density varies depending on the region to behave in calculating the density. The density in a location is almost always higher than the crowded environment,
- The population density is depending on which they live and numbers of members of the household.
- The buildings intensity measured in physical indicators that related, such as how many rooms on a lot or parcel.

Table 2. Indicators for Smart Residential Density

No	Variables	Indicators
1	Built environment	<ul style="list-style-type: none"> • concentrate development in mixed use neighbourhoods • use terraced or flatted solutions • use development clusters related to public transport • integrate with cycle or walking routes • exploit solar layouts • provide shelter • ensure mixed use and mixed tenure • exploit aesthetic potential of high density • eco-homes category method for landscape assessment: energy, transport, pollution, materials, water, ecology and land use, health and well being
2	Unbuilt environment	accessibility (land use diversity, public/private realm, natural surveillance (fronts and

		backs), permeability/ street connectivity, employment density, number of buildings, and number of lots.
3	Infrastructure network	<ul style="list-style-type: none"> • integrate energy estate planning with safe streets policies • vehicle efficiency improvements • city traffic management • improved public transport • lower speed limits • encourage journeys on foot or cycle • remove company car incentives • site layout should reduce the demand for journeys by integrating land uses • site density should be such that journey lengths are reduced • a range of attractive movement modes are provided, with priority given to journeys on foot and cycle • safety should be a priority through the provision of pedestrian lighting, traffic calming and CCTV. • CO₂, energy, buildings, transport, waste and land use, water, air quality, environmental governance.

4. Conclusion

The message here would be that this is about perception and experience. Of Most residents always spend life in which they live. Research has shown that person feels closely related to the way in which the house structured in itself. This study found that in fact the density not correlated with levels of satisfaction population. In fact, at the highest level dissatisfaction is found in the most populous and also in the most relieved. This study showed that the density considered to offered advantages and disadvantages. Sense includes the diversity, housing availability, transportation and other facilities.

In spite of its population density, but urban problems can be reduced through solutions digital and increase the efficiency management urban areas to support its social, environmental and economic sustainable issues. Smart Residential density Indicators can develop through an innovative approach to promoting the development of an intelligent and shows its implications for managing urban service-oriented citizens to achieve higher standards of living.

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