PAPER • OPEN ACCESS

Redefining smart city concept with resilience approach

To cite this article: Y Arafah and H Winarso 2017 *IOP Conf. Ser.: Earth Environ. Sci.* **70** 012065

View the article online for updates and enhancements.

You may also like

- Smart city planning and sustainable development
Ali Abdulsamea Hameed
- Information Construction Level of Smart City
Jiani Hong
- The Transformation of Smart City Concept in Urban Development (Case Study: Semarang City)
N O Fajriyah and A Djunaedi

This content was downloaded from IP address 2.81.214.90 on 24/01/2024 at 22:36

Redefining smart city concept with resilience approach

Y Arafah[1 2 3], **H Winarso**[1]

[1] Urban and Regional Planning, School of Architecture, Planning, and Policy Development, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung 40132, Indonesia.
[2]Architecture Department, Faculty of Engineering, Syiah Kuala University, Jl. T. Abdurrauf, No.7 Darussalam, Banda Aceh 23111, Indonesia.

yunitaarafah@s.itb.ac.id

Abstract. The smart city concept originally aimed at dealing with various urban problems, in particular, those related to the urban environment and infrastructure, such as modeling transport flow in a city. As it developed, the concept is now widely used to accelerate the process of urban management by using IT technology and by the availability of big data. However, the smart city discourses are still debated. There is a number of critical literature on the discourses; some are more concerned with the use and development of information communication technology (ICT). ICT and modern technology are considered the key aspect of the smart city concept. Meanwhile, others emphasize the importance of the people who operate the technology. Very few, if any, literature emphasizes the importance of resilience in the smart city discourse. The city as a complex system should have the ability to be resilient, especially when technology fails either due to technical/man-made or natural disasters. This paper aims to redefine the smart city concept in urban planning through a literature study in the context of planning using a resilience approach. This paper describes and defines what the smart city concept is, what it means, as well as explains the relation and linkage of the importance of using resilience approach in defining the smart city. Factors of resilience will lead to a soft infrastructure approach, such as enhancement in many aspects, e.g. community capacity, social and human capital, knowledge inclusion, participation, social innovation, and social equity. Discussion and analysis are conducted through a deep literature study using systematic literature review methodology.

1. Introduction

Cities continue to develop with various types of innovations and progress. According to the United Nation (UN), cities generate 75% of the global carbon emissions and consume two third of world energy. Moreover, due to urbanization and economic growth, energy consumption is expected to rise to three-fourth of the world energy consumption by 2030. Moreover, the UN estimates that 66% of the world population will reside in urban areas by 2050 [1]. This will certainly increase the amount of carbon dioxide, greenhouse emissions, congestion, and waste disposal that will affect public health. This will also create greater challenges in dealing with air pollution, population density, waste management and human health [2].

During the last years of the 20th century, two major phenomena emerged, namely urbanization and information technology [3]. In the 1990s the “smart growth” concept began to spread in an effort to seek solutions to problems such as population density, congestion, air pollution, open space running out, and

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

the soaring cost of public facilities [4]. The idea of the smart city evolved in an attempt to save the earth and human health. It is an idea or concept people had hoped would be able to solve urban problems while considering the environment [3]. Internationally, the smart city discourse developed as a way to meet the Kyoto Protocol's goals that call for reducing emission levels that had increased on an international scale. From there, the smart city concept is now widely used, supported and adopted by many institutions such as the European Commission Setis-EU, OECD, etc., along with a rapid increase in the number of research and publications that are conducted on the topic ([5] & [6]).

As the concept is more widely used, there is still unclarity in understanding its definition ([7]; [8]; [9]; [10]). Based on mutual understanding by the European Commission, the smart city is a concept that could achieve sustainability through using a wide range technology [11]. Therefore, the main objective of the smart city is to increase sustainability with the use of technology, hence, "smart sustainable cities" is seen as more suitable and accurate compared to the term smart cities [12]. In addition, terminology related to the smart city has developed in accordance with different definitions as well, such as the virtual city [13]; digital city [14]; knowledge city [15]; wired city [16]; ubiquitous city [17], and many more.

Currently, literature explaining smart city is plentiful and continues to expand; some of the most prominent focus is on the development of modern technology and information communication technology. Meanwhile definitions are not limited to only those, but in fact extend to other areas. This theory is supported by Caragliu et al., 2011 [18] who stated that a city is categorized as smart when it has invested in human capital, social capital, transportation, and modern ICT. It should also be capable of creating economically sustainable growth and a high quality of life with good management of its natural resources through participatory governance. Adding to that, Goldsmith and Crawford, 2014 [19], also discussed the importance of community involvement and good leadership to ensure proper implementation of the smart city concept. In addition, there is also need for community empowerment and related factors [20].

Various attempts are made at conceptualizing the smart city concept in planning, one of which is by developing several methods of benchmarking and indicators to evaluate and measure impacts. Benchmarking has the purpose of comparing smart cities based on various factors and ideas or concepts [21]. The benchmarking method is used to evaluate smart cities from different perspectives, e.g. its sustainability, global city performance, resilience, local government effectiveness, urban competitiveness, and good urban governance [21].

Benchmarking smart city planning now considers the perspective of resilience. Desouza and Flanery, 2013 [22], have even created an instrument or guideline in benchmarking of resilience based on an evaluation of the city's resilience, as well as a framework for its implementation. Their implementation framework is divided into two urban components, i.e. resources and process (physically) and communities, institutions, and activities (socially). Therefore, the factor of a resilience approach is needed in the development of smart city planning.

In the context of Indonesia, many cities, in particular, big cities such as Jakarta, Bogor, Bandung, and Surabaya, claim that their cities have implemented the smart city concept [23]. However, it is unconfirmed whether urban residents are 'smart' or intelligent enough or whether there is equality and fairness among all levels of society in both accessing and using ICT as well as in the modern technology provided? These sorts of factors have been a particular challenge in development and in implementing the smart city concept. The concept of resilience, which planners attempt to include as one of the factors or indicators in smart city planning, is a concept that is hoped to increase the resistance and resilience of smart cities in dealing with unexpected predicaments, such as natural disasters, terrorism, energy crises, and climate change. When a city planned to be smart, it must also be prepared to be resilient at all times.

This paper will focus on the smart city concept with a resilience approach. The analysis is conducted through literature study and aims to redefine the smart city concept in the context of planning using a resilience approach. This paper will also describe and define the smart city concept and the meaning of recently used concepts, as well as describe the relevance and linkage of the importance of a resilience approach in defining the smart city concept. This paper consists of four major parts:

1) Introduction, which discusses the factors and background that underlie this research, a brief introduction to the definition and history of smart cities, and its linkage with resilience.
2) Methodology, which will define the research methodology used to identify and organize relevant literature into themes in order to establish the conceptual framework of the analysis.
3) Discussion, which will further explain the concept. This chapter is divided into several sub-topics, i.e. the current smart city definitions; classifying themes from the definitions found; discussing smart city plan positioning in the context of planning in the era of uncertainty; explaining the smart city concept and resilience in terms of their definition, relation, and its relevance in planning a city; and lastly, synergizing the smart city concept with a resilience approach into a new concept based on the discussion and literature.
4) Result and conclusion, this part presents a conclusion of the analysis aimed at finding the definition of a smart city concept based on resilience.

2. Research Methodology

The literature review on smart cities and resilience uses a systematic literature review methodology. This methodology is carried out by compiling previous studies that have presented facts comprehensively and balanced. The results are synthesized using narrative or qualitative techniques. This qualitative approach is used to synthesize the earlier descriptive qualitative analysis. This method is also called meta-synthesis technique, which is a technique that integrates data for a deeper and more thorough level of understanding of new concepts [24]. Data collection in systematic literature review methodology uses previous journals, internet searches, and recently published studies. Qualitative systematic literature review methodology [25] comprises the following steps:

1. Formulating the review question.
2. Conducting a systematic literature search.
3. Screening and selecting appropriate research articles.
4. Analyzing and synthesizing qualitative findings.
5. Maintaining quality control.
6. Presenting findings.

Research using a meta-synthesis method or also called qualitative data synthesis can use two approaches, i.e. meta-aggregation and meta-ethnography [26]. In the meta-aggregation approach, synthesis aims to compile previous studies in order to answer the research question. Meanwhile, in meta-ethnography, the synthesis has the goal of developing a new theory to complete the existing ones. This paper will use the first approach of meta-aggregation, to find solutions to answer the research questions about the role of the factor of resilience in the smart city concept.

In the meta-aggregation approach, the topic of analysis is elaborated into certain themes to build a conceptual framework. In these themes, articles will be searched, compared with one another and summarized. In meta-aggregation, the synthesis is an “aggregate” of various studies with the same theme. Synthesis is carried out using the following five steps: (1) extracting relevant themes and concepts from previous material; (2) results of extraction will then be organized into primary/main findings; [3] the findings will then be classified into categories; [4] each category will then be synthesized into one particular theme (adjusted with the conceptual framework compiled).

The explanation above shows that this analysis uses systematic literature review with a meta-aggregation methodology. Meta-aggregation is carried out to aggregate relevant previous studies. Therefore, in the meta-aggregation synthesis, the conceptual framework that shows the relevancy must be made in advance. Then primary study results are plotted into previously identified themes. In other words, presented in the aggregate (descriptive) model.

3. Analysis and Discussion

3.1 Defining Smart City Concept

Intrinsically, smart city is actually not a new concept, nevertheless the discussion is still warmly debate. Its definition has also spread to other areas, thus, a mutual understanding and agreement of its exact definition has not been found yet. Based on current studies, it is talked that a cities whom used smart city concept are valued to be able to increase the use of city services, hence will nevertheless enhance the level of urban management eficiency and support social, environmental, and economic sustainability. Innovative approaches are also necessary to advance the development of smart city as well as its citizen oriented urban service management for the city in order to achieve higher living standard [27].

Paralleling with the widespread of its definition, the usage and its implementation experience the same phase. However, researchers view the definition has not found a firm consistency ([16]; [9]; [10]). Analysis conducted as yet are stil debated and vastly developed, however, the fundamental problem lies in defining the real definition of smart city. There is still no mutual understanding on the word "smart" or "intelligent" of a city. The existing definition is still viewed multi interpretated, not universal, and solutions taken in problem solving are not those related to previous case problem solving ([8]; [16]; [28]; [4]).

In the history of its development, the roots of smart city idea has long begun, it was when Singapore develop long-term planning agenda by implementing the concept The Intelligent City" (Toh, M. H., & Low, L.,1993, in [29], followed by Adelaide City, whom in 1994 applied the Smart City Adelaide (SCA), the concept which uses technology and communication infrastructures to provide electronic service in the field of commercial in its utilization by the local residents. Infrastructures developed by using software applications through telecommunication providers. Others alike projects that has also showed up during those times are, Singapore's IT 2000 " Intelligent Island" I implemented by Singapore's National Computing Board (NCB), and Silicon Valley (JVSV BLUW 93), the "Joint Venture : Silicon Valley " (JVSV) project [23].

Based from the above various project examples, identified that the idea of smart city originally aim to advanced city quality to be "smart" through the improvements on technology infrastructure, ICT in particular, by developing software applications while seeking assistance from private sector vendor for ideas development and implementation, but, over time, the development of the concept had increased quite rapidly, both in terms of publications and application, especially since the EU in 2010, introduced the smart city project, a project that aims to develop intelligent solutions for future challenges, like urbanization, globalisation, dan weather changes ([6] & [5]).

Some other reasons supporting the development of smart city are, the extensive use of technology devices, such as: mobile devices and the internet in all level of community, the circumstances in which urban dimension is constantly getting higher and the need to protect the environment from pollution and high energy consumption [30]. Whereas, in fact, understanding this smart city concept, is not limited to the use of ICT and modern technology only, roles of other aspects also plays an important part. The encroachment of this concept to different areas are still warmly debated. This theory supported by Caragliu et al., 2011 [18], of whom said that a city is modified into smart city when it has invested on human capital, social capital, transportations, and modern ICT, along with creating a sustainable economic and high quality of life, with good natural resources management through participatory governance. Goldsmith and Crawford, 2014 [19], had also mentioned about the importance of community participation and leadership factor in an effort to implement smart city concept. Other than that, community empowerment and linkages between the actors are seen needed [20].

The development of smart city concept, the implementation can be phased into three main group, starting from focusing only to hardware or so called smart city as digital city, then shifted to software only, known as social inclusive city, and lasted with, focusing on both, which formed smart city as City with high quality of life [31].

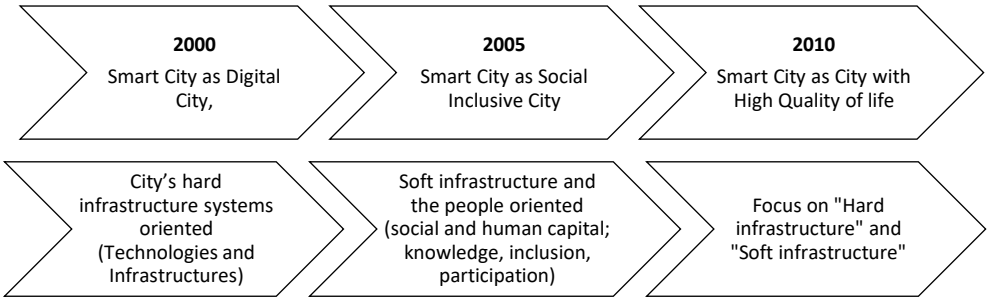

Figure. 1 Evolution of the smart city concept.

There are four preferred approaches in the strategic planning of smart cities. One approach comprises planning which focuses on hard infrastructure, e.g. the management of transportation, water, sewerage, waste, and energy. Another planning approach focuses on soft infrastructure, which comprises a focus on communities, community capacity building, human resources, knowledge improvement, community participation, social innovation, social justice, etc. Every approach in strategic planning has its own advantages and disadvantages. Therefore, if a city plans to use the smart concept, it must first identify its local characteristics, potential, priorities, and its needs in terms of creating a global market and availability of technology [32].

Some definitions of the smart city emphasize the use of modern technology in daily urban life, which enables the city to produce an innovative transportation and infrastructure system and an efficient energy saving system [33]. However, quite a few definitions refer to factors that improve the city's quality of life. Figures 1 and 2 give an overview of smart city definitions based on their orientation of the concept.

Table 1. Smart city definition oriented and focusing on 'hardware'.

No	Definition	Reference
1.	A smart city is a city that monitors and integrates the condition of every critical infrastructure, such as roads, bridges, tunnels, railway, subway lines, airports, ports, communications, water, electricity, and major buildings, A smart city must conduct preventive maintenance, surveillance on security aspects, and maximize service for the community [34].	Hall, 2000.
2.	IBM defines the smart city as the skill of a city to use information and communication technology to sense, analyze, and integrate key information of the core systems in running a city [35].	IBM, 2015.
3.	The smart city is a concept that aims for the residents, object, utilities, and other city elements to be well connected by using new and advanced technologies provided anywhere, in order to significantly increased the living experience in the 21st-century urban environment [6].	Northstream, 2010, in Cocchia, 2014.
4.	The smart city is a digitalized city product combined with the 'internet of things' [36].	Sue et al., 2011.
5.	A smart city is a city that is able to harmonize many types of technologies as diverse as water recycling and advanced energy grids and also uses mobile communication, aiming to reduce environmental impacts to offer residents a better quality of life [11].	Setis-EU, 2012.
6.	A smart city is where the advantages of technology products are available within reach to make living in the big city much more convenient [37].	Townsend, 2013.

No	Definition	Reference
7.	ICT and technology utilization as an effort to restore and improve the quality of life and degradation of environmental qualities [38].	IEEE, 2014.

Apart from an orientation on hardware, the smart city concept also focuses on software aspects, or better yet, on both.

Table 2. Smart city definitions focusing on people and 'software'.

No	Definition	Reference
1.	A smart society is a community that consciously makes effort to use information technology in improving their quality of life by cooperating with the government and other factors linked as a whole in significant and fundamental ways, not separately [6].	California Institute, 2001, in Cocchia, 2014.
2.	A smart city is a city with a good appearance and is built with a smart combination of its qualities, independent and with awareness of its residents [39].	Giffinger, 2007.
3.	A city transforms into a smart city when it has invested in human and social capital, as well as in traditional and modern ICT, creating sustainable economic growth and a better quality of life, with good management of human resources through participatory governance [18].	Caragliu et al., 2009.
4.	Smart cities are defined as geographic regions that possess advanced technologies such as ICT, logistic, energy production, which can benefit its residents in terms of their wellbeing, inclusion, and participation, improving their quality of life and the development of intelligence [29].	Dameri, 2013.
5.	A smart city utilizes ICT and technology to achieve welfare, effectiveness, and competitiveness of the city [32].	Angelidou, 2014.

Based on the internet searches, sourced from various smart city articles, the definition of smart city that focuses on hardware are relatively more that those found on software focuses, in fact, some of those seems vague and bias. The harmonization of both focus, are viewed as best step to establish a new smart city definition.

3.2 Smart City Definition

Definitions of the smart city are grouped based on various perspectives in several research publications. One focus is on 'hardware' and ICT. The discussion can be classified into four parts: (1) ICT (Information and Communications Technology) and modern technology is seen as the key driver in the smart city concept ([40]; [41]; [42]; [5]; [43]; [44]); (2) the role of ICT and technology in actualizing the welfare, effectiveness, and competitiveness of its residents [32]; (3) the utilization of advanced technology products to make living in a big city much more convenient [37]; (4) a broader understanding; the utilization of ICT and technology also constitutes an effort to improve the quality of life and prevent the degradation of environmental quality [38].

From the grouping of definitions, it is evident that the focus on 'hardware' is more dominant than the 'software' sides. Group 1, 3, and 4 emphasize the 'hardware' sides, and group 2 focuses more on the software side. In practice, cities mostly apply the concept proposed by EU, in which implementation is aimed at improving the environment. This is based on the desire to obtain public funding for projects undertaken to create a better city form. This is different to researchers in an academic environment, who do not only focus on the environment but also on other issues such as improving the quality of life,

which relies on the level of culture, data information, sharing of knowledge and its relation to some aspects of community life, such as human capital, communication between citizens, etc. [6].

The grouping of smart city concepts is also carried out by other experts, one of which groups smart city concepts into four themes [45],: (1) innovation, economy, competitiveness, and added value on the global level, with a focus on added value locally in a global context, as well as a focus on innovation so people will have global talent and a global network to increase competitiveness; (2) a focus on developing technology and ICT; (3) attention to stakeholders of development, which emphasizes the importance of the private sector and smart social community capital, the importance of community involvement and the leadership factor in implementing smart cities, along with community empowerment; (4) the process towards a smart city, both in the process of analysis of the smart city as a model or as a development process, top down as well as bottom up. Cocchia, 2014 [6] also grouped some definitions based on their field and focus, taken from frequently cited literature: (1) the role of public services and the private sector in improving the quality of life; (2) the importance of attention to the damage caused by urban activities; (3) the importance of the concept of good natural resource management; and (4) sustainable economic growth.

These two groupings show that concepts with a focus on hardware are not too dominant; instead, there is more focus on aspects of environmental improvement, innovation, process, and the improvement of community's quality of life through smart city concepts.

3.3 Resilience Approach in Smart City Concept

The increasing urban population creates significant challenges for the city, such as urbanization, climate change, terrorism, and the increased risk of natural disasters. To face these circumstances, the city must learn to adapt in dealing with these challenges; cities must learn to develop its resilience in facing the problems of this era of unpredictability and uncertainty. The concept of resilience is a means to deal with these challenges. In the context of urban planning, the strategies that have been implemented mirror the philosophy of sustainable development, which focuses on managing resources to ensure the welfare of future generations. The study of resilience in sustainable development initially focuses on ecological safety. However, as the concept developed it was viewed as an important step in building sustainability [46].

The concept of resilience was initially introduced by a well-known ecologist, CS. Holling, who in 1973 suggested two general approaches, i.e. first, man and nature are closely linked and evolve together and must thus be conceived as one social ecology system; second, the responses of this system towards changes are unpredictable, but not proven [47]. After that, the focus resilience changed to disasters ([48] & [49] and then to social study ([50]; [51]; [52]), social-ecology studies [53] [54], and entered the field of planning ([55]; [56]; [57]; [58]).

In planning, the concept of resilience is developed by Wildazsky in 1988. It has evolved from the context of extremely powerful disasters, terrorism, energy crises, and climate change ([56];[59]); social-ecological resilience in a context of communicative planning [57]; and collaborative planning for governance in addressing resilience [58]. Following is a scheme of the three main stages of evolution of the concept of resilience.

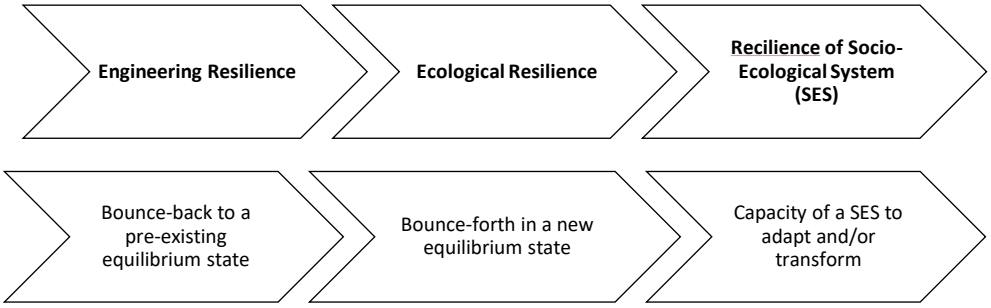

Figure. 2 Evolution of the concept of resilience.

Table 3. Definitions and understanding of the concept of resilience, particularly in the science of urban planning.

No	Definition	Reference
1.	Planning urban resilience is conducted to analyze the impact of pressures that a city faces. Therefore, its planning requires an evaluation of the city's vulnerabilities, understanding of the process, procedures, interaction, and capacity building to develop several components structures and their interaction with the main purpose achieving resilience [19].	Desouza and Flanery, 2013.
2.	The concept of resilience is used as a critique towards sustainability, which gained popularity in a different field of policy [60].	Davoudi, 2012.
3.	Resilience has 3 features, i.e. persistence, adaptability, and transformability which each interact from the local to the global scale [61].	Folke, 2006.
4.	Resilience refers to the capacity of individuals, households, groups in society, or systems to absorb and recover from the impact and danger of climate change and other shocks and stresses in the long term [62].	Turnbull et al., 2013
5.	Factors that affect resilience comprise institutional, political, cultural, social, environmental, human, economic, and physical factors. All factors are expected to become a unity and fair [62].	Turnbull et al., 2013
6.	A resilient city mirrors urban capacity through its individuals, communities, institutions, companies, and system to survive, adapt and develop, no matter how hard or great the shock faced [63].	Arup, 2013.
7.	A resilient city is a city that is capable of enduring and absorbing the impact of hazards, shocks, and pressures through adaptation or transformation in order to ensure long-term sustainability as well as basic functions, characteristics and structure [64].	UNISDR, 2012.
8.	Resilience is the capacity of a social-ecological system and its components to overcome hazardous shocks and pressures at a precise and efficient time to respond, adapt, and change ways to recover, maintain, and improve the main functions, structures, and identities in preserving the capacity to growth and changes [65].	IPCC, Arup, in ICLEI, 2016.
9.	A vision of a resilient city reflects the efforts to enhance the city's ability to respond to heterogenic pressure factors (climate, environment, energy and economy) with targets to ensure a higher quality of life and sustainable urban development [31].	Papa et al., 2015.

Understanding the smart city planning concept by incorporating elements of resilience can be re-interpreted to find a new definition. Based on the previous discussion, it can be concluded that the existing definitions of the smart city are insufficient and an additional definition is required. In the context of urban planning, particularly for smart city concepts, the resilient city plays an important role.

A city as a complex system and its resilient capacity needs to be developed; the multi-component capacity, which is the process and interaction that raises it above the city's physical limits. When a city is considered smart it is important to be resilient at any time [22]. Therefore, the concept of resilience is one of the key factors in smart city planning.

Based on various definitions about smart cities and resilience, the existing concepts and definitions of the smart city need to be redefined and complemented. To redefine the concept, the following steps conducted: gathering previous smart city definitions focusing on hardware aspects, to deduct the most frequently used terms in literature, which will be a reference in the re-interpretation of the smart city with a focus on 'hardware'.

The most frequently used terms in literature on the smart city with a focus on hardware consist of: (1) first, the utilizations of modern or advanced technology in information and communication; (2) second, the importance of integrated infrastructure, utilities, and urban systems; and (3) finally, the goal of the smart city concept, i.e. to improve the quality of life and to restore degraded environmental quality. From the analysis, it is can be concluded that the definition of the smart city with a hardware orientation is a concept of a city that utilizes modern and advanced information and communication technology in order to realize city planning that offers a better quality of life and better environment quality in the city. The re-definition process of software aspects also uses the same steps, the software-focused smart city concept also refers to the most frequently mentioned terms in current definitions. From the selected literature, the most frequently discussed material consists of (1) the role of using information and communication technology; (2) the awareness and intelligence, well-being, participation, effectiveness, and competitiveness of the city's community; (3) the objective of the smart city to create higher quality of life and to improve environment quality. From the analysis, it can be concluded, that the software-focused smart city concept relates to the utilization of information and communication technology as a means to obtain high quality of life and improve environmental quality.

3.4 Analysis

Analysis of the above definitions shows that the hardware-oriented and software-oriented definitions commonly mention the utilization of information and communication as well as the objectives, which are improved quality of life and of the environment, while the difference is the object of the smart city concept. The hardware-oriented concept focuses on the city's infrastructure, utilities, and urban system, whilst the software-oriented concept emphasizes the community, e.g. intelligence, wellbeing, participation, effectiveness and competitiveness.

In this paper, the factor of resilience will only be included in the definition of the smart city concept with a software-oriented approach. The combination of the definitions of the smart city concept and resilience is expected to establish a new definition that will represent both concepts.

The definition of resilience is based on the most commonly discusses aspects in literature. Based on the analysis, the most commonly appearing and discussed aspects are: (1) the city's capacity in dealing with pressure, shocks, and hazards; (2) the ability to survive and adapt, being resilient and able to transform; (3) the process of dealing with changes in the era of uncertainty; (4) toward sustainability. Based on the literature, it can be analyzed that resilience is the capacity of a city to deal with pressures, shocks, and hazards, in an effort to survive, adapt, be resilient, and able to transform through a process in facing changes in the uncertainty era towards city's sustainability.

Through re-definition of the concept mentioned above, the re-definition of the smart city concept based on a resilience approach should, thus, at least comprise some of the following factors: (1) the role of information communication technology utilization; (2) the awareness and intelligence, well-being, participation, effectiveness and competitiveness of the community; (3) the ability to deal with pressure, shocks and hazards; (4) to survive, adapt, have determination, and able to transform; (5) the process of facing changes in the era of uncertainty; (6) to create a high quality of life as well as improve environmental quality; (7) towards sustainability. Overall, it can be concluded that a smart city with a resilience approach is a concept that utilizes ICT in enhancing awareness, intelligence, well-being, and community participation in dealing with pressures, shocks, and hazards in order to survive, adapt, be

tough, and be able to transform to have a future with a better environment and higher quality of life, which is sustainable in facing the era of uncertainty.

4. Conclusions

The phenomena of urbanization and the development of information technology lead to the emergence of the smart city idea. Initially, this concept was expected to overcome city issues while considering the environment. As the concept developed, it is widely used in urban planning and is supported and adopted by many institutions, such as the European Commission, Setis-EU, OECD, etc. Since then, publications and analysis related to smart cities experienced a fast development. However, since the concept has become widespread, its original meaning and definition are still vaguely defined and there is still inconsistency in defining the smart city concept. Moreover, several new terminologies are used in the smart city concept, e.g. ubiquitous city, wired city, knowledge city, digital city, etc.

Currently, the most prominent literature on the smart city concept focuses on the development of modern technology and information communication technology. ICT and modern technology are considered as key to the smart city concept and all planning processes are conducted based on ICT for efficiency, whereas in fact, this is not the main factor. A city as a complex system needs to build its resilience capacity. Unpredictable events and natural disasters might happen anywhere and anytime. Such issues should be considered in a smart city as a system. In urban planning, when a city is planned to be smart, it is important to be resilient at any time.

This paper aims to redefine the smart city concept through literature study, in the context of the current uncertainty era, with a resilience approach. Literature review on the smart city and resilience is conducted using a systematic literature review methodology. The methodology consists of summarizing previous research and carry out with a more comprehensive and balanced analysis. Synthesis uses a narrative technique with a meta-aggregation approach. This aim to aggregate relevant analysis and research, which is then re-interpreted to gain a new understanding concerning the definition and concept of the smart city.

From the above discussion, it can be concluded that the smart city concept through a resilience approach can be redefined as a concept of a city that utilizes ICT to increase citizen's awareness, intelligence, wellbeing as well as community participation in facing pressures, shocks, and hazard in order to be able to survive, adapt, be tough, and able to transform, in order to that the community achieve a higher quality of life and environment, which is sustainable in facing the future era of uncertainties.

References

[1] United Nations, Department of Economic a, nd Social Affairs, Population Division, and United Nations, Department of Economic a, World Urbanization Prospects The 2014 Revision. New York, 2015.

[2] OECD, "OECD Environmental Outlook to 2050. The Consequences of inaction," OCD Publ., 2012.

[3] A. Cocchia, "Smart and Digital City: A Systematic Literature Review," in Smart City, R. P. Dameri and C. Rosenthal-Sabroux, Eds. Cham: Springer International Publishing, 2014, pp. 13–43.

[4] T. Nam and T. A. Pardo, "Conceptualizing smart city with dimensions of technology, people, and institutions," 2011, p. 282.

[5] R. Jucevičius, I. Patašienė, and M. Patašius, "Digital Dimension of Smart City: Critical Analysis," Procedia - Soc. Behav. Sci., vol. 156, pp. 146–150, Nov. 2014.

[6] A. Cocchia, "Smart and Digital City: A Systematic Literature Review," in Smart City, R. P. Dameri and C. Rosenthal-Sabroux, Eds. Cham: Springer International Publishing, 2014, pp. 13–43.

[7] M. Angelidou, "Smart cities: A conjuncture of four forces," Cities, vol. 47, pp. 95–106, Sep.

2015.

[8] H. Chourabi et al., "Understanding Smart Cities: An Integrative Framework," 2012, pp. 2289–2297.

[9] M.-L. Marsal-Llacuna, J. Colomer-Llinàs, and J. Meléndez-Frigola, "Lessons in urban monitoring taken from sustainable and livable cities to better address the Smart Cities initiative," Technol. Forecast. Soc. Change, vol. 90, pp. 611–622, Jan. 2015.

[10] R. S. Wall and S. Stavropoulos, "Smart cities within world city networks," Appl. Econ. Lett., vol. 23, no. 12, pp. 875–879, Aug. 2016.

[11] European Commission, "Communication from the commission. Smart cities and communities – European innovation partnership," Brussels, 2012.

[12] H. Ahvenniemi, A. Huovila, I. Pinto-Seppä, and M. Airaksinen, "What are the differences between sustainable and smart cities?," Cities, vol. 60, pp. 234–245, Sep. 2016.

[13] D. Schuler, "Digital Cities and Digital Citizens," presented at the Revised Papers from the Second Kyoto Workshop on Digital Cities II, Computational and Sociological Approaches, 2001, pp. 71–85.

[14] H. Couclelis, "The Construction of the Digital City," Environ. Plan. B Plan. Des., vol. 31, no. 1, pp. 5–19, Feb. 2004.

[15] K. Ergazakis, K. Metaxiotis, and J. Psarras, "Towards knowledge cities: conceptual analysis and success stories," J. Knowl. Manag., vol. 8, no. 5, pp. 5–15, Oct. 2004.

[16] R. G. Hollands, "Will the real smart city please stand up?: Intelligent, progressive or entrepreneurial?," City, vol. 12, no. 3, pp. 303–320, Dec. 2008.

[17] L. Anthopoulos and P. Fitsilis, "From Digital to Ubiquitous Cities: Defining a Common Architecture for Urban Development," 2010, pp. 301–306.

[18] A. Caragliu, C. Del Bo, and P. Nijkamp, "Smart Cities in Europe," J. Urban Technol., vol. 18, no. 2, pp. 65–82, Apr. 2011.

[19] S. Goldsmith and S. Crawford, The Responsive City: Engaging Communities Through Data-Smart Governance, 1 edition. San Francisco, CA: Jossey-Bass, 2014.

[20] S. Kumar, "Institutional Arrangements for Managing Large-Scale Recovery: Key Lessons from 2004 Tsunami," in Recovery from the Indian Ocean Tsunami, R. Shaw, Ed. Springer Japan, 2015, pp. 103–119.

[21] L. Anthopoulos, M. Janssen, and V. Weerakkody, "Comparing Smart Cities with Different Modeling Approaches," presented at the International World Wide Web Conference Committee (IW3C2), Florence, Italy., 2015.

[22] K. C. Desouza and T. H. Flanery, "Designing, planning, and managing resilient cities: A conceptual framework," Cities, vol. 35, pp. 89–99, Dec. 2013.

[23] Direktur Perkotaan dan Perdesaan,, Kementerian PPN/ Bappenas, "Pengembangan Kota Cerdas di Indonesia," presented at the Konferensi e-Indonesia Initiative (eII) dan Smart Indonesia Initiatives (SII) Forum ke-1, Bandung, Indonesia., Oktober-2015.

[24] A. Perry and N. Hammond, "Systematic Review: The Experience of a PhD Student.," Psychology Learning and Teaching, vol. 2 (1), 2002.

[25] C. Francis and Baldesari, "Systematic Reviews of Qualitative Literature," Oxford: UK Cochrane Centre, 2006.

[26] S. Lewin, Methods to Synthesise Qualitative Evidence Alongside a Cochrane Intervention Review. London: London School of Hygiene and Tropical Medicine, 2008.

[27] D. Belanche, L. V. Casaló, and C. Orús, "City attachment and use of urban services: Benefits for smart cities," Cities, vol. 50, pp. 75–81, Feb. 2016.

[28] N. Komninos, P. Tsarchopoulos, and C. Kakderi, "New services design for smart cities: a planning roadmap for user-driven innovation," 2014, pp. 29–38.

[29] R. P. Dameri and C. Rosenthal-Sabroux, Eds., "Smart City and Value Creation," in Smart City, Cham: Springer International Publishing, 2014, pp. 1–12.

[30] I. Oberti and A. S. Pavesi, "The triumph of the smart city," TECHNE - J. Technol. Archit. Environ., vol. 0, no. 5, pp. 117–122, 2013.

[31] R. Papa, A. Galderisi, M. C. Vigo Majello, and E. Saretta, "Smart and Resilient Cities. A Systemic Approach for Developing Cross-sectoral Strategies in the Face of Climate Change," TeMA - J. Land Use Mobil. Environ., vol. 8(1):19-49, 2015.

[32] M. Angelidou, "Smart city policies: A spatial approach," Cities, vol. 41, pp. S3–S11, Jul. 2014.

[33] P. Lombardi, "New challenges in the evaluation of Smart Cities," Netw. Ind. Q., vol. 13, no. 3, pp. 8–10, 2011.

[34] P. Hall, "Creative cities and economic development," Urban Stud., vol. 37, no. 4, pp. 639–649, 2000.

[35] "IBM - United States," 01-Oct-2015. [Online]. Available: http://www.ibm.com/smarterplanet/us/en/.

[36] K. Su, J. Li, and H. Fu, "Smart city and the applications," 2011, pp. 1028–1031.

[37] A. M. Townsend, Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia, 1 edition. New York: W. W. Norton & Company, 2013.

[38] IEEE (the Institute of Electrical and Electronics Engineers), "IEEE Smart Cities," 2014. .

[39] G. Rudolf, C. Fertner, H. Kramar, R. Kalasek, N. Pichler-Milanovic, and E. Meijers, "Smart cities-ranking of european medium-sized cities," Rapp. Tech. Vienna Cent. Reg. Sci., 2007.

[40] J. A. A. González and A. Rossi, "New trends for smart cities, open innovation mechanisms in smart cities. European commission with the ICT policy support programme.," vol. 270896, 2011.

[41] C. Harrison and I. A. Donnelly, "A Theory of Smart Cities," Proc. 55th Annu. Meet. ISSS - 2011 Hull UK, vol. 55, no. 1, Sep. 2011.

[42] H.-N. Hsieh, C.-Y. Chou, C.-C. Chen, and Y.-Y. Chen, "The evaluating indices and promoting strategies of intelligent city in Taiwan," 2011, pp. 6704–6709.

[43] S. Paroutis, M. Bennett, and L. Heracleous, "A strategic view on smart city technology: The case of IBM Smarter Cities during a recession," Technol. Forecast. Soc. Change, vol. 89, pp. 262–272, Nov. 2014.

[44] D. Washburn, U. Sindhu, S. Balaouras, R. A. Dines, N. M. Hayes, and L. E. Nelson, "Helping CIOs Understand 'Smart City' Initiatives De ning the Smart City, Its Drivers, and the role Of the CIO," MA: Forrester Research, Inc., vol. Cambridge, 2010.

[45] R. Sutriadi, Perspektif Perencana: Smart City, Inovasi, Kota Komunikatif, dan Kota Berkeadilan. Bandung, Indonesia.: Inside Publisher, 2015.

[46] Levin, "Science and Sustainability," Ecol. Appl., vol. 3, no. 4, pp. 759–762, 1993.

[47] C. S. Holling, "Resilience and Stability of Ecological Systems," Annu. Rev. Ecol. Syst., vol. 4, pp. 1–23, 1973.

[48] P. Timmerman, Vulnerability, resilience and the collapse of society: a review of models and possible climatic applications. Toronto: institute for Environmental Studies, University of Toronto, 1981.

[49] G. A. Tobin and B. E. Montz, Natural Hazards: Explanation and Integration, 1 edition. New York: The Guilford Press, 1997.

[50] W. N. Adger, "Social-Ecological Resilience to Coastal Disasters," Science, vol. 309, no. 5737, pp. 1036–1039, Aug. 2005.

[51] B. Obrist, C. Pfeiffer, and R. Henley, "Multi-layered social resilience: a new approach in mitigation research," Prog. Dev. Stud., vol. 10, no. 4, pp. 283–293, Oct. 2010.

[52] R. K. Larsen, E. Calgaro, and F. Thomalla, "Governing resilience building in Thailand's tourism-dependent coastal communities: Conceptualising stakeholder agency in social–ecological systems," Glob. Environ. Change, vol. 21, no. 2, pp. 481–491, May 2011.

[53] C. S. Holling, "Understanding the Complexity of Economic, Ecological, and Social Systems," Ecosystems, vol. 4, no. 5, pp. 390–405, Aug. 2001.

[54] B. Starzomski, "Berkes, F., J. Colding, and C. Folke. 2003. Navigating social-ecological systems: Building resilience for complexity and change. Cambridge University Press, Cambridge, UK.," Ecol. Soc., vol. 9, no. 1, Jan. 2004.

[55] A. Wildavsky, Searching for Safety. Transaction Publ., 1988.

[56] D. R. Godschalk, "Urban Hazard Mitigation: Creating Resilient Cities," Nat. Hazards Rev., vol. 4, no. 3, pp. 136–143, Aug. 2003.

[57] B. Goldstein, "Resilience to surprises through communicative planning," Ecol. Soc., vol. 14, no. 2, p. 33, 2009.

[58] J. E. Innes and D. E. Booher, Planning with Complexity: An Introduction to Collaborative Rationality for Public Policy, 1 edition. Milton Park, Abingdon, Oxon ; New York, NY: Routledge, 2010.

[59] L. J. Vale and T. J. Campanella, Eds., The Resilient City: How Modern Cities Recover from Disaster, 1 edition. New York: Oxford University Press, 2005.

[60] S. Davoudi, "Resilience: A Bridging Concept or a Dead End? "," Plan. Theory Pract., vol. 13, no. 2, pp. 299–333, Jun. 2012.

[61] C. Folke, "Resilience: The emergence of a perspective for social–ecological systems analyses," Glob. Environ. Change, vol. 16, no. 3, pp. 253–267, Aug. 2006.

[62] M. Turnbull, C. L. Sterrett, and A. Hilleboe, Toward Resilience: A Guide to Disaster Risk Reduction and Climate Change Adaptation. Practical Action Pub, 2013.

[63] ARUP, "Arup | Publications | City Resilience Index," 2013. [Online]. Available: http://publications.arup.com/publications/c/city_resilience_index. [Accessed: 19-Feb-2017].

[64] UNISDR, How To Make Cities More Resilient A Handbook For Local Government Leaders. Geneva: United Nations, 2012.

[65] ICLEI, "Resilient Cities - ICLEI: Glossary of key terms," 2016. [Online]. Available: http://resilient-cities.iclei.org/resilient-cities-hub-site/resilience-resource-point/glossary-of-key-terms/. [Accessed: 18-Feb-2017].