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Initiating Smart City Concept for Sustainable Urban Development: A Litereture Review

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Abstract
With the rapid urbanisation in the world, there is a requirement to achieve sustainability within urban development. Smart city concept directs urban development in to a strategic path to achieve sustainability in urban development. There are various definitions available for smart cities which represents various dimensions and characteristics of smart cities. Further, initiation of smart cities has become crucial due to the challenges faced by urban planners and developers. In recent years, many initiatives have developed under the smart city label in order to provide a response for challenges facing cities today. The understanding made up on the initiation of the concept of smart cities within any region would be fruitful to review in this nature. Therefore, as the primary step governs in this study, the fundamentals of smart city concept were reviewed to achieve the sustainable urban development as the main purpose. As the main approach adopted, a comprehensive review was conducted by using the twenty six (26) research projects in key literature. The concept of smart cities, the need of smart cities for sustainable urban development and the initiative factors of smart cities were finally encountered. As the key findings derived, the main and sub initiating factors of smart city concept for sustainable urban development were determined and presented through a conceptual framework. In response to the increasing use of the concept, this paper proposes to use the developed framework as a basis to understand the concept of smart cities for its flourishing initiation.

Keywords
Smart cities, Sustainable urban development, Initiative factors, Conceptual framework

1. Introduction

Cities become more and more complex every day and an almost endless list of expected characteristics for modern cities develops at an amazing pace. As stated by Mori and Christodoulou (2012), cities play a major role in economic, social and environmental aspects. However, they generate complex challenges for governments in means of uncontrolled development, traffic congestion, waste management and complicated access to resources and crime (Peris-Ortiz, Bennett and Yábar, 2017). Many cities due to rapid population growth face conflicting issues which include problems as over consumption of resources, inadequate number of services, and an increase in pollution. Achieving sustainable goals within the city is a major problem with the criticalities arises due to the above mentioned reasons (Bifulco *et al*., 2016). To

overcome the problems generated by the urban population growth and rapid urbanization, there is an emerging necessity to make a city smart (Chourabi *et al.,* 2012). A smart city can be defined as "connecting the physical infrastructure, the IT infrastructure, the social infrastructure and the business infrastructure to leverage the collective intelligence of the city" (Harrison *et al*., 2010, p.2). A sustainable smart city develops in a manner to acquire the needs without compromising the ability of future generations to meet their own needs (Peris-Ortiz *et al*., 2017). Urbanisation increases the consumption of resources and in related emission which is an issue for sustainable development (Barles, 2010). Therefore, urban development projects aim sustainable development as a stated goal (Dale and Newman, 2009).

Urban sustainability focuses on technical issues, such as carbon emissions, energy consumption and waste management, or on the economic aspects of urban regeneration and growth (Tweed and Sutherland, 2007). With reference to Li *et al*. (2009), sustainable urban development is defined as "economic growth and efficiency, ecological and infrastructural construction, environmental protection and social and welfare progress" (p.134). As stated by Silva, Khan and Han (2018) "ability of a city to uphold the balance of eco system in all aforementioned aspects, while serving and performing city operations is known as the sustainability" (p. 698). As stated by Lazaroiu and Roscia (2012), smart city represents a society which consist of average technology size, interconnectedness, sustainability, comfortability, attractiveness and security .The concept of smart city has gained increasing importance because of enhancing the quality of life of citizens (Neirotti *et al*., 2014). Urban performance depends not only on the city's physical capital but also on the availability of human and social capital (Caragliu, Del Bo and Nijkamp, 2011). Further to authors, smart city concept is a strategic device to encompass modern urban production factors in a common framework. Hence, identifying the fundamentals of the concept of smart cities would be beneficial for any region where it can be used to make urban planners and developers aware about its initiation for sustainable urban development. Thus, as the main purpose of this paper, the fundamentals of smart city concept were reviewed to achieve the sustainable urban development. However, this is only a part of a research study in enabling smart cities in Sri Lanka: an integrated approach for building national level capacities of smart city development.

2. Initial Review of Literature

2.1 The concept of smart cities

Table 1 illustrates a comparison of evolution in the definitions of smart cities.

Table 1: Definitions of the concept of smart city

Year	Source	Definition
2017	Vaquero-García, Álvarez-García and Peris-Ortiz (2017)	Develops in a manner to acquire the needs without compromising the ability of future generations to meet their own needs
2017	Ramaprasad, Sánchez-Ortiz and Syn (2017)	"Smart city is a multidisciplinary concept that embodies not only its information technology infrastructure but also its capacity to manage the information and resources to improve the quality of lives of its people" (p.15)
2013	Bakıcı *et al*. (2013)	"Smart city implies a high-tech intensive and an advanced city that connects people, information and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce and a recuperating life

		quality with a straightforward administration and a good maintenance system" (p.139)
2012	Kourtit and Nijkamp (2012)	Smart cities are "the result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities" (p.93)
2010	Harrison *et al*. (2010)	"Connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city" (p.2)

Governments have given attention to smart cities in their research and development projects. Even though, there is no common definition about smart cities (Bakıcı, Almirall and Wareham, 2013). As per the review stated in Table 1, it can be identified that there are different dimensions available for the smart city concept. Chourabi *et al*. (2012) identified that the concept of smart cities is used all over the world with different nomenclatures, context and meanings. Even though "smart city" gains wider importance with time, there is still confusion about the definition of a smart city (Albino, Berardi and Dangelico, 2015). This states the importance of identifying the fundamentals of smart cities. As stated by Han and Hawken (2017), success of smart cities should be viewed in terms of the ability to create high-quality places for everyday life.

2.2 Smart cities for sustainable urban development

In urban development, cities play a major role as it may effect on economic, social and environmental concerns in any country. Due to rapid urbanization and population growth, a city has become a crucial that need to be well planned and designed. Making smart cities has emerged as a solution for above concerns as a sustainable smart city develops in a manner to acquire the needs without compromising the ability of future generations to meet their own needs. In the urban planning field, the term "smart city" is often treated as an ideological dimension according to which being smarter entails strategic direction (Albino, Berardi and Dangelico, 2015). Cities nowadays face complex challenges in achieving goals regarding socio-economic development and quality of life. "Smart cities" is a response to these challenges which changes the path of urban development in to a strategic direction (Schaffers *et al*., 2011). Moreover, it includes individual development, institutional development, knowledge development and the development of associated decision support systems of cities (Agrawal, 2015).

2.3 Initiation of smart cities

From the definitions presented in Table 1, it was identified that different aspects of smart city concept is available. According to Giffinger and Gudrun (2010), there are six success factors of a smart city. They are smart economy, smart people, smart governance, smart mobility, smart environment and smart living. Chourabi *et al*. (2012) identified eight success factors of smart city initiatives which are namely management and organization, technology, governance, policy, people and communities, the economy, built infrastructure, and the natural environment. Nam and Pardo (2011) identified that technological factors, human factors and institutional factors as the three fundamental components of smart cities. By considering the above mentioned initiative factors, it can be identified that human factors, institutional factors and technological factors are important initiative factors within the smart city concept.

2.3.1 Human factors

A clever solution by creative people is required as an initiative factor for the development of smart cities which results sustainable urban development (Nam and Pardo, 2011). In the drive to become smart, cities will have to face certain challenges (Allwinkle and Cruickshank, 2011). A major challenge faced in the beginning of the drive to smart cities, is to adapt human resources for the change which can be mitigated by capacity building (Schaffers *et al*., 2011). With the current need of smart cities, Nam and Pardo (2011) identified the importance of people, education, learning and knowledge as they are the keys for success in smart cities. More over The smart people concept comprises various factors including affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism or open-mindedness, and participation in public life. Hollands (2008) also stated that the smart cities must seriously start with people and the human capital side. Giffinger and Gudrun (2010) identified that flexibility, creativity, open-mindedness, participation in public life, social cohesion and education as human factors required for a successful smart city.

2.3.2 Institutional factors

Governance of smart cities comes under the institutional factors. Institutional infrastructure of a smart city integrates public, private, civil, and national organisations to provide interoperation between services which results a more efficient, effective and a reliable service (Kitchin, 2014). Governance is important for the success and growth of smart cities because urban development and urban planning is based on governance with multiple stakeholders (Nam and Pardo, 2011). Collaboration, leadership, participation and partnership, communication, data-exchange, service and application integration, accountability, transparency can be identified as the factors that affect to smart governance under institutional factors (Chourabi *et al*., 2012). Participation in decision-making, public and social services, transparent governance, political strategies and perspectives are the institutional factors stated by Giffinger and Gudrun (2010). Policies of smart cities are also important for the initiation of the smart city concept because the policies can be used to identify the contribution for sustainable urban development (Yigitcanlar and Kamruzzaman, 2018). Moreover, it was identified that various regulations or accepted norms in their jurisdictions or communities is also important as fundamentals of smart cities (Allwinkle and Cruickshank, 2011).

2.3.3 Technological factors

Technological factors play a critical role in supporting decision-making, design, planning, development, and management operations of complex urban environments (Yigitcanlar and Kamruzzaman, 2018). Smart Cities base their strategy on the use of information and communication technologies in several fields such as economy, environment, mobility and governance to transform the city infrastructure and services. Information and communication technologies (ICTs) have been exerting a growing influence on the nature, structure and enactment of urban infrastructure, management, economic activity and everyday life (Kitchin, 2014). (Inter-) national accessibility, smart mobility and availability of ICT-infrastructure are considered as technological factors by Giffinger and Gudrun (2010). Accordingly, three basis factors of human, technological and institutional factors were encountered through the initial review of key literature. It was used as a basis to identify the initiative factors of smart cities concept for sustainable urban development as stated in Figure 1.

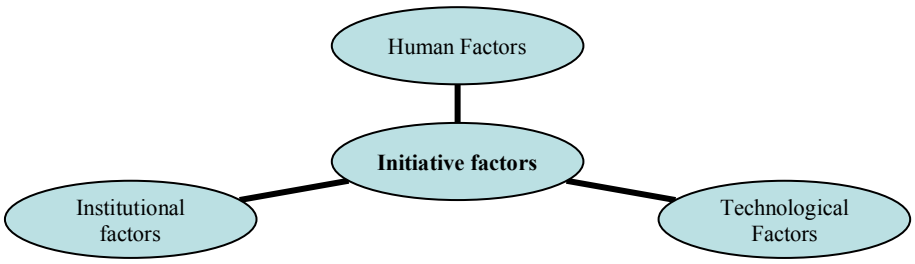

Figure 1: Initiative Factors of smart cities

3. Research Methodology

A comprehensive literature survey was carried out to identify the concept of smart cities and the fundamentals of the smart city concept for sustainable urban development. Twenty six (26) research projects in key literature were reviewed. Majority of the literature (81%) were obtained from recognised research databases of Emerald Insight (8%), Springer (15%), Elsevier (35%) and Routledge (23%) by using the search engines of Google Scholar, Science Direct and Emerald Insight. Only 19% of papers were reviewed from other sources including conference papers and websites as stated in Table 2.

The key literature were reviewed and analysed under the key headings of human, technological and institutional factors which were derived through initial review of literature. The key findings were determined by considering the majority of responses countered in review.

Table 2: The review criteria adopted

	Source				
Criteria	Emerald Insight	Springer	Elsevier	Routledge	Other (conference papers/websites etc)
Number of articles referred	2	4	9	6	5
% of Nos. of papers	8%	15%	35%	23%	19%
% of Total Nos. of papers		**81%**			**19%**

4. Initiative Factors of Smart Cities Concept for Sustainable Urban Development

The ten (10) key research projects in key literature were specifically reviewed and the initiative factors of smart cities concept for sustainable urban development were identified. Table 3 summarises the review of main and sub factors encountered.

Table 3: The review of initiative factors

Factors of smart city	Sources									
	1	2	3	4	5	6	7	8	9	10
Human factors					√	√	√			√

Flexibility						√	√			
Creativity						√	√	√		
Open-mindedness						√				
Participation in public life					√				√	
Social cohesion							√			
Education	√			√	√	√	√	√		
Ethnic plurality						√				
Institutional factors		√			√			√		
Governance					√		√	√	√	
Policies					√			√		√
Regulations		√						√		
Accepted norms		√								
Technological factors			√			√	√			√
Information and communication technologies	√		√	√		√	√	√	√	√
Accessibility			√		√	√	√			
Mobility	√		√			√	√		√	√

Sources: 1. Albino, Berardi and Dangelico (2015); 2. Allwinkle and Cruickshank (2011); 3. Bifulco *et al*. (2016); 4. Allwinkle and Cruickshank (2011); 5. Chourabi *et al.* (2012); 6. Giffinger and Gudrun (2010); 7. Lazaroiu and Roscia (2012); 8. Nam and Pardo (2011); 9. Schaffers *et al*. (2011); 10. Neirotti *et al*. (2014)

The initiative factors reviewed in Table 3 are described below.

4.1 Human factors

Caragliu, Del Bo and Nijkamp (2011) stated that human capital, education are important drivers for urban development. Allwinkle and Cruickshank (2011) also stated that education of the community initiates sustainable urban development which leads to smart cities. Flexibility, creativity and open mindedness creates a smart living environment which directs for sustainable urban development (Giffinger and Gudrun, 2010). Moreover, it was stated that ethnic plurality and education will create a link within the city which will be an initiative for smart cities.

4.2 Institutional factors

Allwinkle and Cruickshank (2011) identified that norms, regulations link members in the community and leads for a city to be smart. Governance, policies and regulations enables and directs the citizens to act sustainably (Nam and Pardo, 2011). Therefore for sustainable urban development, institutional factors play a major role. Chourabi *et al.* (2012) also stated that good governance can lead and guide a city to be smart which is a strategy for sustainable urban development. Furthermore Lazaroiu and Roscia (2012) revealed about the importance of smart governance in the path for a city to be smart.

4.3 Technological factors

As stated by Albino, Berardi and Dangelico (2015), high-quality and more efficient public transport are considered a key element for sustainable urban development. Authors further stated that new approaches related to urban services have been based on harnessing technologies, including ICT result in sustainable city development. However, it was revealed that ICT should be taken as an approach to enhance the quality of life. Bifulco *et al.* (2016) also identified that ICT applications, transportation systems, mobile devices allow people to participate and contribute to their urban development to be sustainable.

Accordingly, as the key outcome of this initial review paper, a conceptual framework graphically represents the factors and sub factors of the initiation of smart cities concept. The developed framework is presented in Figure 2.

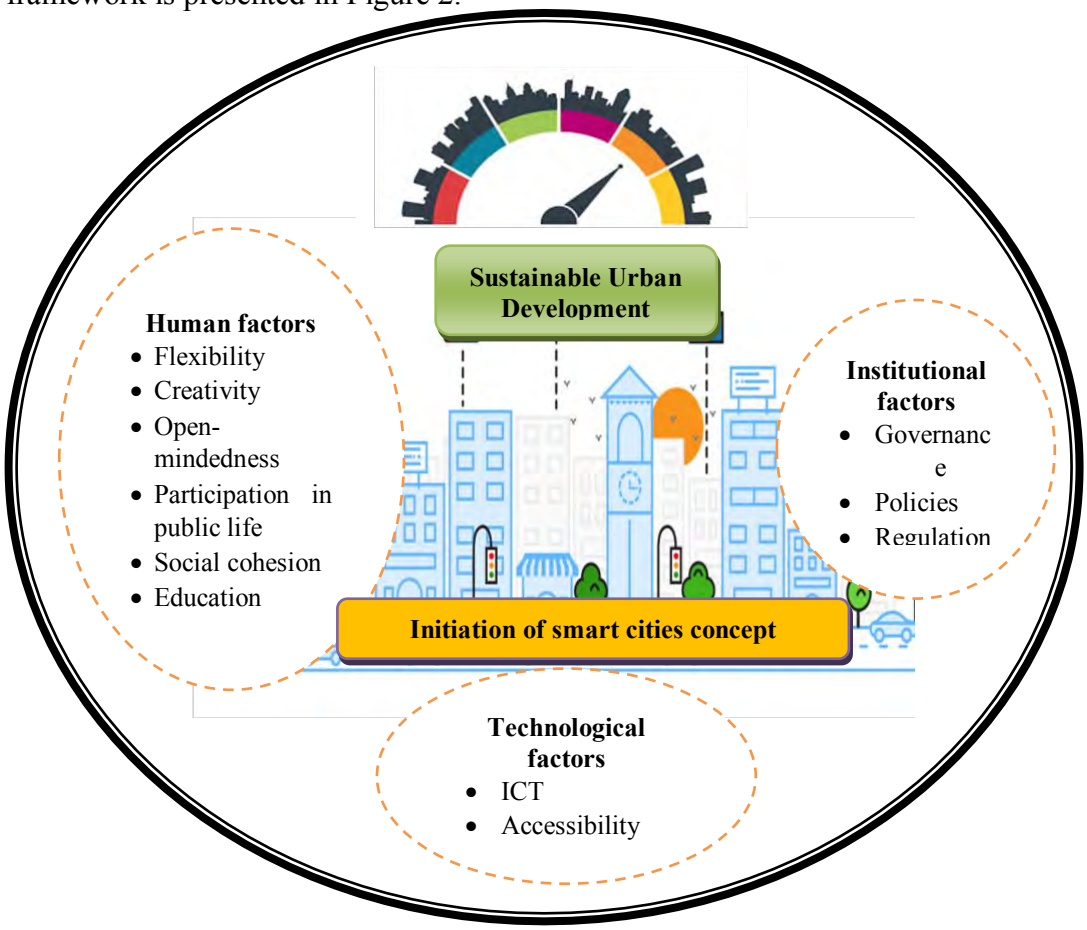

Figure 2: The conceptual framework

In the conceptual framework drawn in Figure 2, the bigger circle represents the concept of smart cities. The three (3) fundamental factors of the smart cities are represented by the three smaller circles within the concept. Sub factors of the human factors, institutional factors and technological factors were stated within each circle to achieve sustainable urban development through the successful initiation of the concept of smart cities.

5. Summary

With the rapid urban development, cities are facing many issues due to lack of sustainable practices. This leads a requirement for a city to be subjected under sustainable urban development. The concept of smart cities directs urban development to be sustainable. The requirement of smart cities initiates the necessity of identifying the fundamentals of smart cities. Three main factors were identified through the literature review as human factors, technological factors and institutional factors. Under the category of human factors, seven (7) sub factors were identified where four (4) sub factors were identified under institutional factors. Further, three (3) technological factors were also identified. The conceptual framework was developed as the major deliverable of this paper where it can be used as a basis to enhance the imitation of smart

cities concept for sustainable urban development. Further, it would also be the first step in achieving the whole aim of the total study of enabling smart cities in Sri Lanka: an integrated approach for building national level capacities of smart city development.

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