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# A Critical Review on the Drivers and Barriers for Enabling Smart Cities

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## Abstract

Creating smart cities has grown to be vital in achieving sustainability in urban development. Further, it urges the necessity of initiating smart cities to overcome the issues owned by the rapid urbanization of countries. Initiating smart cities has become a trend in the modern world as it benefits in widespread connectivity and drive effective action, which is important for sustainable urban development. However, enabling smart cities is one of major challenges faced by countries. As previous researches stated, smart cities require funding and partnerships for its survival. Further, the need for policy changes, limited capital availability, political uncertainties and disorganized funding structures could also prevent investing in smart cities. Hence, identifying drivers and barriers for enabling smart cities has become paramount to study, thus selected as the main purpose of this research paper. Accordingly, an extensive literature survey was conducted. Fifty-two (52) key literature projects from recognised databases were critically reviewed to identify the concept of smart city, and the drivers and barriers for initiating smart cities. Finally, the most and least drivers and barriers were determined based on the critical review of literature. The probable strategies were also proposed as the main implication of this research which may ensure enabling smart cities.

## Keywords
Smart Cities, Sustainable Urban Development, Drivers, Barriers

## 1. Introduction

United Nations world population prospects distinguished that the world population will increase between 1950 and 2100 by 8.7 billion people and future population growth will be in urban areas (Heilig 2015). According to While and Whitehead (2013), the emergence of climate change is determined as a threat to socio ecological sustainability in the world. With the increasing rate of urbanisation, urban areas face the challenge of achieving sustainable development within the cities (Ju-raschek et al. 2018). Rapid urbanisation in the developed world throughout the mid-20th century has shifted to the developing regions of Asia, Latin America and Africa (Zevenbergen, et al. 2008). Remark-ably, Asian region is identified as a rapidly urbanizing region where, placing sustainability in cities is an important aspect which is required to be concerned (Ooi 2009). As stated by Schaffers, et al. (2011), smart cities is an ideological solution for sustainable urban development. In the drive to become smart, cities will have to face certain barriers (Allwinkle and Cruickshank 2011). Naphade, et al. (2011) stated that, smarter city initiatives often require extensive coordination, sponsorship and support across multiple functional silos. Many researchers have identified the importance of stakeholder management for the success of projects (Yang, et al. 2009). Moreover, Bakıcı, et al. (2013) identified that lack of skilled human capital, low level of local entrepreneurship and innovation, lack of project capital funding and global connectivity as barriers in initiating smart cities. With the growing requirement of smart cities, it is useful to review on the strategies, which can be utilized to enhance the initiation of smart cities. Hence, it was the

aim of the study. In order to achieve the research aim, objectives were lined up as, (i) to identify the enablers and barriers (ii) to review on the strategies to overcome the identified barriers.

## 2. Research Methodology

The aim of the study is to review on the strategies, which can be utilised to enhance the initiation of smart cities. A literature review is determined as a valid approach, as it is a necessary step in structuring a research field and forms an integral part of any research conducted (Easterby-Smith et al. 2002). According to Fink (1998), analysis of literature pursues the aim of opening up material that does not have to be created on the basis of a data collection by the researcher. Therefore, a comprehensive literature survey was carried out to identify the concept of smart cities and the fundamentals of the smart city concept in order to facilitate the research aim of the study. Fifty two (52) key literature were reviewed and out of them, forty (40) (76.92%) were journals. Moreover, conference proceedings, websites and other reports were utilised for pursuing a critical literature review. Google scholar, Science direct and Emerald Insight were used as the search engines for the literature review. Number and percentage of articles cited from journals and other sources are illustrated in Table 1.

Table 1: Journals and other sources

| | Source | | | | | |
|---|---|---|---|---|---|---|
| Criteria | Emerald Insight | Springer | Elsevier | Taylor and Francis | Other Journals | Other (conference papers/websites etc) |
| Number of articles referred | 4 | 6 | 14 | 8 | 8 | 12 |
| % of Nos. of papers | 7.6% | 11.53% | 26.92% | 15.38% | 15.38% | 23.08% |
| **% of Total Nos. of papers** | | | **76.92%** | | | **23.08%** |

## 3. Literature Review

### 3.1. The Concept of Smart Cities

The concept of 'smart city' is a strategic device to encompass modern urban production factors in a common framework (Caragliu, et al. 2011). According to Yigitcanlar and Kamruzzaman (2018), smart city concept is viewed as a vision to establish the 21st century's sustainable and ideal city form. Increasing evidence could be identified for smart city experiments and implementation through leadership at a city level or at a national level (Chandrasekar, Bajracharya, and O'Hare 2016). Different authors use various definitions in defining smart cities because there are various dimensions to be deliberated (Bakıcı, et al. 2013; Milenković, et al. 2017). Nam and Pardo (2011) identified that technological factors, human factors and institutional factors as the three fundamental dimensions of smart cities. Chourabi, et al. (2012) identified eight dimensions of smart cities which are namely management and organization, technology, governance, policy, people and communities, the economy, built infrastructure, and the natural environment.

Ruhlandt (2018) distinguished that smart cities as a multi-dimensional mixture (human, infrastructure, entrepreneurial capital) that are merged, coordinated and integrated using new technologies to "address social, economic and environmental problems involving multi-actor, multi-sector and multi-level perspectives. Dameri (2013) defined smart city as a "well defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of wellbeing, inclusion and participation, environ-mental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development" (2549). As stated by Ramaprasad, et al. (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). According to Angelidou (2014), smart cities represent a conceptual urban development model based on the utilization of human, collective, and technological capital for the enhancement of development and prosperity in urban agglomerations.

In this research smart city is defined as,
"Smart City is a multidisciplinary concept that connects technological factors, institutional factors and human factors in order to achieve a greener city with higher quality of life and sustainable economic growth."

## 3.2. Importance of Smart Cities for Sustainable Urban Development

Rapid economic growth has been beneficial to the cities as they have become centres of production, commerce, education and governance (Jago-on, et al. 2009). However, it has also created environmental problems, in air and water quality, decreasing water supply, insufficient housing and sanitation facilities, traffic congestion and increasing solid waste. Rapid increase of urbanization is an opportunity as well as a challenge to the country's effort in achieving sustainable urban development (Henderson, et al. 2009). As stated by Kagan, et al. (2018), different definitions and criteria are available for sustainable urban development depending on the population growth and on the requirements of sustainability. Definitions of sustainable urban development are presented in Table 2.

Table 2: Definitions of sustainable urban development

| Year | Reference | Definition |
|---|---|---|
| **2017** | Bibri and Krogstie (2017) | "Achieving a balance between the development of and equity in the urban areas and the protection of the urban environment" (p.189) |
| **2015** | Maclaren, (as cited in (Hassan and Lee 2015) | Strategies and processes that drive the progress in the field of sustainability within urban areas |
| **2009** | Li et al. (2009) | "Economic growth and efficiency, ecological and infrastructural construction, environmental protection and social and welfare progress" (p.134) |
| **2003** | Brindley (2003) | "Revalidation of urban living, in contrast with the geographically dispersed city and the high levels of personal mobility that have increasingly become the norm"(p.53) |

By analysing the sustainable development definitions presented in Table 2, sustainable urban development is defined in this research as,
"Achieving a balance between urban development with economic growth, efficiency, environmental protection and with social and welfare progress".

In recent years, sustainable development is a widely used term, which has an influence on urban planning and development (Dempsey et al. 2011). Moreover, ongoing concentration of the global population in urban areas, implies the increasing importance of addressing issues of sustainable development (Höjer and Wangel 2015). Sustainable urban development has become a key target due to rapid urbanization and because of social, environmental, and economic problems in cities (Hassan and Lee 2015). Nilssen (2018) stated that smart city is becoming an increasingly popular focus in achieving sustainable urban development. Recently, the concept of smart city has become important in urban development planning because, the local authorities face challenges regarding the resolving of climatic, energy and urbanization problems (Sikora-Fernandez 2018). According to Neirotti, et al. (2014), the concept of smart city has gained an increasing importance because of enhancing the quality of life of citizens. Smart cities are important in having a better environment, social and economic conditions and in improving the attractiveness and competitiveness (Trindade, et al. 2017). Hashem, et al. (2016) stated that, smart cities play a key role in enhancing human life, transportation, health, energy and education. Bello, et al. (2018) mentioned that, initiating smart cities benefits in intelligent sensing, widespread connectivity and drive effective action which is important for sustainable urban development. Moreover, Zhang, et al. (2018) also stated the importance of smart cities for achieving urban sustainability to gain a sustainable and healthy future. The above factors ascertains the significance of smart cities for sustainable urban development.

### 3.3. Drivers and Barriers in Initiating Smart Cities

Technology, actors, policies, goals, vision and governance are identified as drivers of smart city development (Dameri 2013). Moreover to Dameri (2013), the main driver for smart city birth and development is technology. Anttiroiko, et al. (2014) also identified the importance of smart use of ICTs as a driver in initiating smart cities. Physical capital, natural capital, social capital and digital capital are the drivers of smart cities identified by Abdoullaev (2011). VanWinden and Van Den Buuse (2017) stated that, smart city projects require support from municipalities and run in partnerships with funding from subsidies. Table 3 summarises the key drivers encountered in key literature.

Table 3: Drivers in initiating smart cities

| **Drivers** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Technology | √ | √ | √ | √ | |
| Stakeholders | √ | | √ | | √ |
| Policies | √ | | | | √ |
| Governance | √ | | √ | √ | √ |
| Required funding | | √ | | √ | √ |
| Goals and vision | √ | | | | |
| **Sources:** 1. Dameri (2013); 2. Anttiroiko, et al. (2014); 3. Abdoullaev (2011); 4. VanWinden and Van Den Buuse (2017); 5. Chourabi, et al. (2012) | | | | | |

According to Hernández-Muñoz, et al. (2011), lack of ICT infrastructure and knowledge related for technological advancement is a challenge in adopting smart cities. Moreover, Elmangoush, et al. (2013) also highlighted the requirement of knowledge and competence in initiating smart cities. The need for policy changes, limited capital availability, political uncertainties and disorganized funding structures prevent in-vestment in initiating smart cities (Vilajosana, et al. 2013). Scuotto, et al. (2016) mentioned that, building knowledge and creating relationships with external stakeholders is a barrier in initiating smart cities. Initiating smart cities require consideration of the stakeholders who need to be involved in the planning and governance of the city. Hence, it is also considered as a barrier for adopting smart cities (Höjer and Wangel 2015). Furthermore, modelling, understanding, and influencing human behaviour, and creating trust in technologies act as key challenges (Naphade, et al. 2011). Bakıcı, et al. (2013) identified lack of skilled human capital, funding and global connectivity as barriers in a smart city development project. Table 4 summarises the barriers in initiating smart cities.

Table 4: Barriers in initiating smart cities

| **Barriers** | **1** | **2** | **3** | **4** | **5** | **6** |
|---|---|---|---|---|---|---|
| Lack of technology | √ | | | | √ | |
| Lack of knowledge and competence | √ | √ | | √ | | √ |
| Limited capital availability | | | √ | | | √ |
| Political uncertainties | | | √ | √ | √ | |
| Disorganised funding structures | √ | | √ | | | |
| Creating relationships with stakeholders | | √ | √ | √ | √ | √ |
| **Sources:** 1. Hernández-Muñoz, et al. (2011); 2. Elmangoush, et al. (2013); 3. Vilajosana, et al. (2013); 4. Scuotto, et al. (2016); 5. Höjer and Wangel (2015); 6. Bakıcı, et al. (2013) | | | | | | |

### 3.4. Strategies to Overcome the Barriers in Initiating Smart Cities

In the consideration of the identified barriers, it can be identified that most of the barriers are due to improper stakeholder management. Therefore, managing these stakeholders of a smart city project is required for the success of the project. According to (Rose 2013) (as cited in Aragonés-Beltrán, et al. 2017), stakeholders can be "an individual, group, or organization who may affect, be affected by, or perceived itself to be affected by a decision, activity or outcome of a project" (p.451). Moreover to the author, stakeholder can have a positive or negative impact on the project. As stated by Karlsen (2002), stakeholders play a major role in the accomplishment of the tasks in a project. Handling different set of stakeholders across different levels is identified as a challenge which can be overcome through stakeholder management (Sunder M 2016). Stakeholder management focuses on understanding the nature of the relationships between the stakeholders (von Meding, et al. 2013). Ac-cording to Wagner Mainardes, et al. (2012), stakeholder management concept is to recognise, analyse and examine the individual and group characteristics that influence or are influenced by the project or organisational behaviours and actions. Verdicts of the above literature findings states the importance of effective stakeholder management, which is required for the success of building the base of smart city development.

Governance is a key 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). Utilisation of political strategies with transparent governance will provide the required capital and funding for the development of smart city projects (Giffinger and Gudrun 2010). With reference to (Chourabi, et al. 2012), effective communication, leadership and accountability are also beneficial for the initiation of smart cities, which is a global concern. A major challenge faced in the beginning of the drive to smart cities, is to adapt human re-sources for the change, can be mitigated by capacity building (Schaffers et al. 2011). As defined by (Chaskin 2001), capacity building at the individual level concentrates on "instrumental skills to support employment and on opportunity for civic engagement" (p.306). Moreover, capacity building includes individual development, institutional development, knowledge development and the development of associated decision support systems (Agrawal 2015). According to Hollands (2008), people undergoing capacity building will be able to seek a balance economic growth with sustainability more efficiently in smart cities. Public Private Partnership (PPP) is also identified as an advantageous solution for enabling smart cities (Chan, et al. 2010). Milenković, Rašić, and Vojković (2017) identified that, PPP models provide a better outcome in developing smart cities, crowdsourcing and democratic ecologies provide better and more efficient public services by taking advantage of private sector's competence. PPP benefits all the stakeholders in a smart city deployment and is one of the popular implementation models used for the development of smart buildings and infrastructure (Vilajosana, et al. 2013).

A conceptual model was developed to visually represent the identified barriers and proposed strategies as presented in Figure 1. In the developed model, rectangles represent the barriers and strategies and moreover, the barriers have been linked with the suitable strategy. The conceptual model could be utilised in enabling smart cities in any context for enhancing sustainable urban development.

## 4. Summary

In the present Cities are facing complex challenges in attaining sustainable development within the context with the rapid urbanisation. Verdicts of the critical literature survey prove that cities are getting more condensed in the future. Therefore, an emerging requirement of smart cities can be determined. Though the requirement of initiating smart cities is getting increased, there are barriers, which are required to be overcome. Six (6) barriers were identified through the literature survey aslack of technology, lack of knowledge and competence, limited capital availability, political uncertainties, disorganised funding structures, creating relationships between stakeholders. These identified barriers can be overcome through six (6) main strategies, which are effective political strategies, development of suitable policies, human capacity building, stakeholder management, effective communication and PPP. These identified strategies could be utilised in enabling smart cities, which is a solution for rising global concern on achieving sustainable urban development.

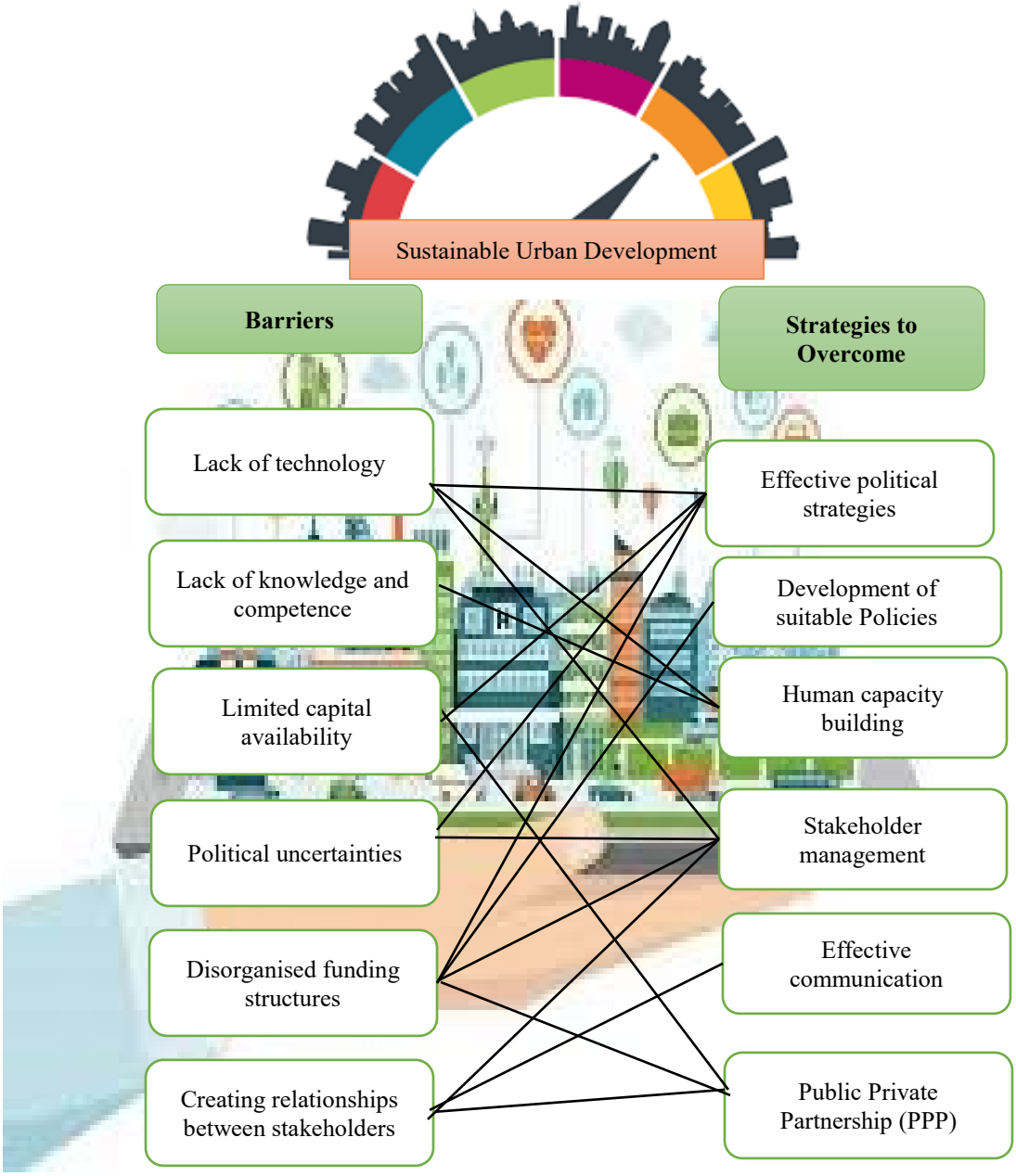


Figure 1: Strategies to overcome the identified barriers

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