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WHAT DIFFERENTIATES A SMART CITY? A COMPARISON WITH A BASIC CITY

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ABSTRACT

Distinctive nature of the problems a city holds, baptise a "smart city", which is a term, at the same time, is blamed for being befogged. Although defining the term "a smart city" is worth taking a risk, the maturity of the smart city definition in terms of practical use and research has not been reached. Even if it is defined, it would highly depend on the context and unique nature of cities. Yet there are city components that are only found in smart cities. A study of these components would be the most practical way of understanding "what make a smart city". Therefore, this study aims to analyse literature, review definitional elements of smart cities, and derive a comprehensive list of smart city components. Not being a one size fits all, smart city definitions are often interchangeable with other well-defined city conceptions. Those conceptions are a source to outline what smart cities are. Therefore, the terms digital city, intelligent city, ubiquitous city, global city, and sustainable city are compared with smart city characteristics. In the same way, definitional elements from ten latest literature sources were identified. Smart city components identified in the literature were then reviewed and combined to form a list of components under the themes; smart economy, smart people, smart living, smart environment, smart mobility, and smart governance which were supposed to integrate with Information and Communication Technology (ICT) infrastructure. While these components are the frontline, smart cities also intent to ensure urban, public services, and citizen development. With this, the paper presents a holistic summary of the characteristics that define the smartness of a smart city.

Keywords: *Definitional Elements, Smart Cities, Smart City Components.*

1. INTRODUCTION

According to the United Nations, it is expected that 60% of the World's population will live in urban areas by 2030 (United Nations, 2018). The growing urban population poses broad challenges across domains such as utilities, energy, transportation, health, safety, and environment to contemporary cities (Psyllidis *et al*., 2015). Correspondingly, these challenges create complex pressures on the aforementioned domains and several others (Caird, 2017). Such pressure urges the need of innovative arrangements which on the other hand become pressing invitations to make cities more intelligent in terms of sustainability, productivity, transparency, effectiveness, and efficiency (Gil-Garcia *et al*., 2015). With that arouse a reorientation of city conceptions in an economical, environment oriented, and provident setting (Anttiroiko *et al*., 2014). Consequently, cities have turned into knowledge cities, intelligent cities, smart cities, digital cities, or sustainable cities.

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These urban metaphors, as conceptual variants to each other, are reciprocally connected with partially overlapping definitions (Nam and Pardo, 2011). Out of them, adopting a "smart" approach via smart cities was a most celebrated phenomenon emerged aiming the mitigation of the aforementioned challenges (Chourabi *et al*., 2012). In fact, although the concept is used in various contexts and nomenclatures, it is said that smart cities are designed intending the optimal utilisation of data to ensure the quality of life, sustainability, and resource management (Loo and Tan, 2019).

However, the concept of smart cities, although proliferating in discussions, is difficult to delineate (Orlowski and Romanowska, 2019). In fact, a consensus was neither reached by the practice communities nor researchers (Gil-Garcia *et al*., 2015). Authors identified that some of the existing, narrower definitions as marketing solutions for different city-level issues. Rest of those definitions in literature depend on the interest areas of the author (Orlowski and Romanowska, 2019). Alternatively, this implies a practical problem in completely building a new city with confusing benchmarks; unless otherwise for an affinity of a particular city to overcome the existing problems with a smart city. Therefore, the most ideal way to understand and apply the term, having no intentions to compromise the identity of an existing city, is by identifying the retrofits in a smart city with compared to a basic city (Tomar and Gupta, 2019). In a way, it is the most empirical approach to enhance the effective engagement of all stakeholders, by making them aware about the required extra effort they are supposed to put in while developing and maintaining a smart city (Paskaleva *et al*., 2015). Therefore, in order to address the research problem; "what differentiate a smart city from a basic city?", the aim of this research is to review different factors that make a smart city different from a basic city by identifying the key components of smart cities.

2. RESEARCH METHOD

It can be seen that common city challengers related to education, traffic, health, energy, unemployment, waste, and crimes are accurately addressed by smart city provisions (Chourabi *et al*., 2012). Therefore, other than proposing a definition, understanding smart cities is more practical by identifying these components in a more comprehensive manner (Gil-Garcia *et al*., 2015). Thus, this paper mostly focuses on identifying the key components of a smart city. To achieve that outcome, different definitions and definitional elements were ascertained. To outline the major differences and to highlight the key components hidden in non-smart city definitions, firstly, smart city initiatives were compared with well-defined popular city concepts, namely digital city, intelligent city, ubiquitous city (U-city), global city, and sustainable city. It guided in identifying smart cities definitional element in literature. Subsequently, ten smart cities studies carried out in 2019 were reviewed and definitional elements were extracted. As defining the concept is still evolving, only the latest were selected. These definitional elements represented the key components which were identified afterwards. In fact, these definitional elements lead to the study by Giffinger *et al*. (2010) on which the identification of the key components was based. Therefore, literature since Giffinger *et al*.'s (2010) study up to date was reviewed.

3. COMPARISON OF CITY CONCEPTUALISATIONS WITH SMART CITY INITIATIVES

Several authors have identified that investigating the popularly used city concepts facilitate setting out a multidimensional facet about smart cities (Nam and Pardo, 2011). In other words, while defining a basic city is highly subjective, several highlights of different city conceptions allow identifying the novelty of smart cities. Table 1 includes a comparison (based on the most obvious differences) with some of the labels which were controversial in certain marketing contexts.

Table 1: Comparison of city conceptualisations with smart-city initiatives

Different City Conceptions	Smart City	Source
1. Digital city		
Main focus is on the technological attributes of a city	Focus is not limited; deals with enhancing the quality of life, sustainable development, pollution reduction, energy management, management of urban green spaces, and all other aspects of daily life.	Caragliu *et al*. (2011)
2. Intelligent city		
Solutions encourage advancing human intelligence and innovative/ quality decision-making / problem-solving using larger datasets and effective user engagement	Provision of solutions are on the basis of improving vibrant communities in urban systems with the use of ICT-based instrumentation, sensors, and smart devices.	Komninos (2015)
3. Ubiquitous city (U-city)		
Represents a sustainable and environmental conscious smart city	U-city's vital services include smart education, transport, homes, and medicare.	Lee *et al*. (2008)
4. Global city		
In means of the inception, smart cities are the advanced versions and are number of steps ahead of global cities	Although ICT infrastructure is significant in the both, smart cities are more community oriented and are apprehended to deal with community initiatives	Yadav and Patel (2015)
5. Sustainable cities		
Concept is developed on the basis that implementation of smart solutions in line with smart technologies leads to sustainability	The concepts were branched out and parallel. Therefore, can rather introduce the compatible version as "smart sustainable city".	Elgazzar and El-Gazzar (2017)

Based on the most obvious differences, it is apparent that a smart city represents something more than the above different types of cities, except for the U-city which defines itself revolving around the term smart city. Some chronological studies have identified that smart city is the upshot of the global city development process where it carries the major aspects of global cities, liveable cities, and sustainable cities plus knowledge-based urban development and community participation (Yadav and Patel, 2015). In the process of looking at the variances, ICT plays a main role resulting in most of the concepts to overlap (Hartley, 2005). Comparison with different city concepts remarkably bring out two cornerstones; urban development, attributing to the technology-oriented knowledge economy and public sector development in terms of high-quality

government operations with ICT-driven corporate practice and cross-sectoral innovation (Goodspeed, 2014).

4. ELEMENTS OF RECENT SMART CITY DEFINITIONS

According to Batagan (2011), common root causes for problems in cities including inefficient communication, inefficient use of resources, limited access to administrative data, erroneous information, and poor disaster resilience are addressed in theming smart cities. Similarly, Monzon (2015) brought in European and international experience in addressing several problems related to economy, infrastructure, community, governance and services, and resources in European cities to the Mediterranean Region smart city projects. This implies that by introducing different themes, smart cities ensure the problems occurred in basic cities would not take place any longer. They are mostly the definitional elements that most authors highlight (Yigitcanlar *et al*., 2018). However, the smart city concept is still evolving (Tomar and Gupta, 2019); therefore, the concept should be understood in the latest context as shown in Table 2.

Table 2: Smart cities definitional elements

Source	Descriptions
Anthopoulos *et al*. (2019)	All means of innovations in the urban atmosphere (ICT-based, yet not necessarily) that purpose to improve the city dimensions including economy, people, government, mobility, environment, and living.
Xie *et al*. (2019)	Upgraded quality of life, sustainable urban environment, use of advanced ICT, public government openness, encouraged community participation, effective management of traffic and public transport, intelligent device control, optimum resource utilization, improved environmental protection, and improved public services.
Abbas *et al*. (2019)	Architecting the smart cities require innovative engineering approaches. Complex information, computation and communication systems, and critical infrastructure management
Ismagilova *et al*. (2019)	Intelligent use of ICT in an interactive infrastructure, innovative and advanced services to the community, having an impact on the quality of life, and sustainable administration of natural resources.
Samih (2019)	Living solution, integrates different facilities and improve the services for citizens, typify the importance in sustainability of resources, and applications for next generations.
Blanck *et al*. (2019)	Performs well in governance, environment, people, economy, living, and mobility. Built on the smart incorporation of contribution and activities of self-decisive, free, and updated citizens.
Tomar and Gupta (2019)	Makes mutual concessions between modern technology and native methods.
Qian *et al*. (2019)	Human and societal capital investments, modern-day communication infrastructure, sustainable economic growth, participatory governance, natural resources management, and advanced infrastructure (physical, modern ICT, social, and business) integration to sustain the city's collective intelligence
Sharma and Meyer (2019)	Integration of ICT into the urban structure including the operation of urban services, efficient management of shared resources by operators themselves

Source	Descriptions
	with the aid of electronic monitoring and control, implementation of ICT in different fields to encourage innovations, and knowledge that ICT can convey.
Heaton and Parlikad (2019)	Well-being and satisfaction of citizen. Building Information Modelling (BIM) acts as a catalyst to the development of smart cities, increasing number of documentations including specifications, reports, and guidance.

The above definitional elements are a result of studies on different smart city projects carried out by several researchers. Such lessons learned infer that intelligent use of ICT, sustainable urban environment, advanced infrastructure, encouraged community participation, well-being and satisfaction of citizen, optimum utilization of resource, well-performing governance, innovations, information management, and sustainable economic growth cannot be overlooked in understanding what makes smart cities phenomenal with compared to a basic city. Having mutual concessions between modern and natives' methods, as well as relationship with BIM are quite unpopular, especially, absent in similar reviews carried out earlier (Albino *et al*., 2015; Gil-Garcia *et al*., 2015; Yigitcanlar *et al*., 2018), yet worth noticing. By and large, with critical infrastructure and information management, modern advanced ICT applications, and urban innovations smart cities appear to upgrade the quality of life of its citizens and sustain the urban system development by addressing compulsory city dimensions and domains.

5. COMPONENTS THAT DIFFERENTIATE A SMART CITY FROM BASIC CITIES

While basic cities cannot be defined, basic cities in this study refer to all those cities which are in need of solutions with innovative systems for those complex challenges they face for just being that city. In line with smart cities definitional elements, researchers and industry players together with government and central agencies have come up with different models that invoke the aspects of urban life which are to be upgraded through smart cities (Bifulco *et al*., 2016). Dividing the study of the whole city into different dimensions allows a better understanding of each aspect in terms of strengths, weaknesses, threats, and opportunities (Orlowski and Romanowska, 2019). Different inventors of these models, named the content of their models. The "components" of the smart cities are referred by various names such as drivers and smart initiatives (Bifulco *et al*., 2016), technology capabilities that improve city responsibilities in a framework (Berst *et al.*, 2014), characteristics (EU-European Parliament, 2014), and components (Gil-Garcia *et al*., 2015).

Among the considerable number of literature considered in summarising the components, the most cited and widely used include six characteristics and 33 basic requirements under each factor (Bifulco *et al*., 2016). These characteristics include smart economy, smart people, smart governance, smart living, smart environment, and smart mobility (Giffinger *et al*., 2010). This was used by EU-European Parliament (2014) as well.

In addition to other characteristics, Batagan (2011) and Kamrowska-Zaluska *et al*. (2016) also gave importance to smart education and smart healthcare, which were already identified under smart living by Giffinger *et al*. (2010). Economic competitiveness, image and trademarks, productivity, flexibility in the labour market, as well as international embeddedness and use of online trade were repeated in both Batagan's (2011) and Giffinger *et al*.'s (2010) studies. Authors identified production diversity, quality, and

affordability of research and development newly under smart economy. This was again identified by Bosch *et al*. (2017) as well. Under smart governance, every component was repeated. Smart education included fondness towards lifelong learning and participation in public life which are included under smart people by Giffinger *et al*. (2010). Breakdowns under smart living and smart environment were the same.

Chourabi *et al*. (2012) have also identified few sectors under which they assigned similar components, namely management and organization, technology, governance, policy, people and communities, economy, built infrastructure, and natural environment. Their explanations for the economy were in line with Giffinger *et al*.'s (2010) smart economy. They further specified the desired outcomes as business and job creation, workforce development, and productivity. In fact, Bosch *et al*. (2017) identified employment as a component itself, as "people and community" aspect aims to enrich the quality of life by making the citizens more educated, informed, and participatory (Chourabi *et al*., 2012). As per Chourabi *et al*. (2012), in order to emphasise the success factors for projects with extensive use of ICT, related managerial and organisational attributes are addressed along with identifying e-government initiatives under "management and organization"; meanwhile "technology" here refers to sufficient resources to avoid a digital divide and provisions for smart computing technologies, "built infrastructure" refers to the ICT infrastructure and the related, and "policy" context discuss about removing legal and regulatory barriers. This "built infrastructure" was themed as smart architecture and technologies by Ismagilova *et al*. (2019).

Lee *et al*. (2013) in their framework mentioned smart governance which is one of the six characteristics by Giffinger *et al*. (2012). This too present a different angle of governance by bringing in the need of a dedicated organization and defining the roles of its team for promoting the development of smart cities with a proper performance measures, along with policy context as discussed by Chourabi *et al*. (2012). Rest of the concerns were on the areas of urban openness, service innovation, partnerships formation, urban proactiveness, and infrastructure integration.

Berst *et al.* (2014), sets out a list of vital services, namely built environment, energy, telecommunication, transportation, water and wastewater, health and human services, public safety, and payments that cities require. It also highlighted the technological capability in terms of instrumentation and control, connectivity, analytics, interoperability, data management, security and privacy, and computing resources. Kamrowska-Zaluska *et al*. (2016) also identified the same set of services.

Gil-Garcia *et al*. (2015), identified knowledge economy and pro-business environment as a new aspect that was not directly presented in other frameworks. Rest of the component include public services; city administration; collaborative governance, its engagement, policies and other institutional arrangements; human capital and creativity; city infrastructure and built environment; natural environment and ecological sustainability; ICT; and other technologies, data, and information.

Smart economy initiatives such as innovative spirit; economic competitiveness, image and trademarks; international embeddedness or use of on-line trade; smart people initiatives such as ethnic/social pluralism and participation in public life; smart governance initiatives such as participative decision-making; public and social services (including and related to health and human services, water and wastewater, energy, waste management, public safety, payments, and finance); services, infrastructure, and

application integration; smart mobility initiative like sustainable and safe transport systems; smart environment initiatives like zero pollution; environmental protection; sustainable resource management and smart living initiatives such as community health; individual safety; housing quality, built environment, or city infrastructure; and education facilities (smart education) put forward by Giffinger *et al*. (2010) were identified by Bosch *et al*. (2017) as well. The authors newly brought in "green economy".

Yigitcanla *et al*. (2018) extracted four of the areas Giffinger *et al*. (2010) focused, namely productivity and innovations in economy, liveability and wellbeing of the society, accessibility and sustainability of the environment, and governance and planning by the government. Anthopoulos *et al*. (2019), after reviewing a number of city conceptualisation models, developed a unified model with eight viewpoints, namely governance, planning and management, city architecture, data and knowledge, people and environment, energy, and health together with six benchmarking tools addressing the smart city development, smart monitoring, policy impact, city capacity and sustainability.

All in all, with the reviewed studies it can be identified that in Ismagilova *et al*.'s (2019) study although they did not represent a framework, the grouping/theming was almost an amalgamation of the all related work. Especially, the representation took the form of an extended review of Giffinger *et al*.'s (2010) components with an understanding of Berst *et al.*'s (2014) framework. However, the outcome of the study would rather be an add on to Ismagilova *et al*.'s (2019) theming and breaking down of components by (Giffinger *et al*., 2010). Figure 1 presents the combined list of the components.

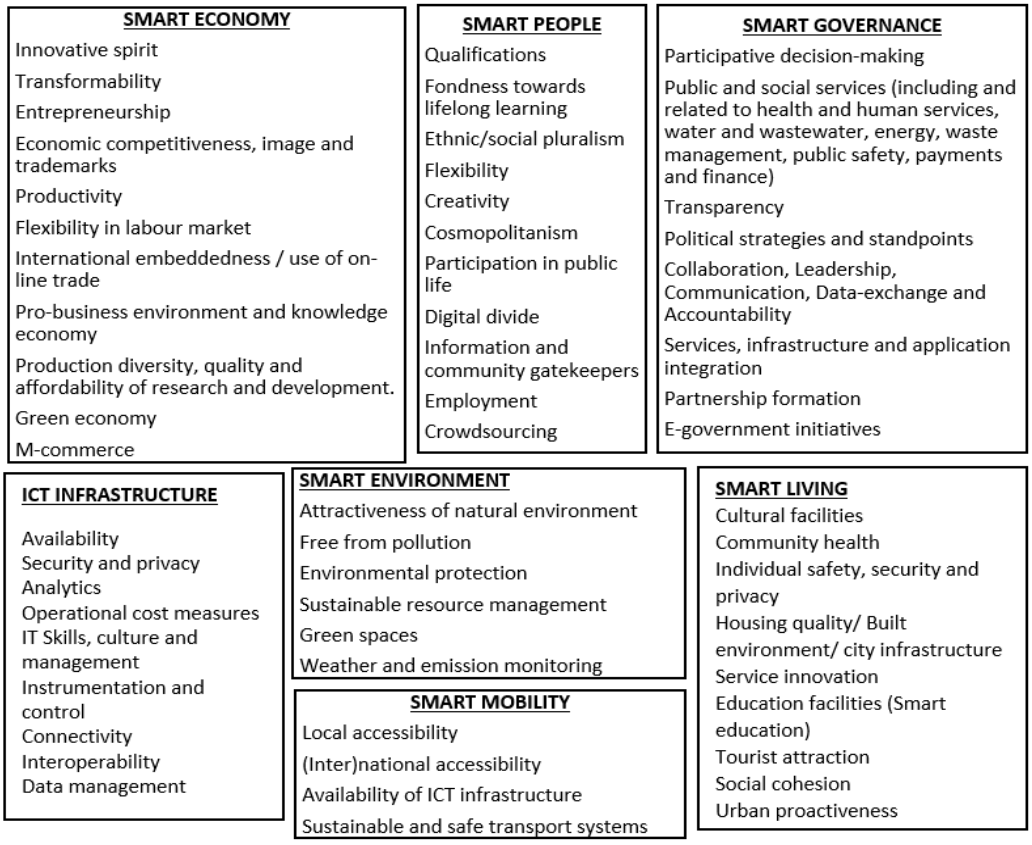

Figure 1: List of components that differentiate a smart city from a basic city

However, this classification does not form a framework, yet a representation as a list. Due to that reason, although Ismagilova *et al*.'s (2019) theming was not a framework but a list of interpretations by the authors, additional terms such as green spaces, weather and emission monitoring under smart environment, crowdsourcing under smart people, M-commerce under smart economy were also identified as components.

6. CONCLUSIONS

Smart cities can be built either as a solution to different existing and completely new problems basic cities face, so as to upgrade the quality lives of citizens and to remark the development in a country. In the corresponding cases, cities can be redeveloped or retrofitted and completely planned from the inception respectively. While the first scenario only focuses 'the challenges a basic city has' so that they can be addressed through smart cities, the second scenario is where the themes of smart cities and accepted characteristics comes in handy. Whatsoever, all definitional elements, components, comparisons with defined city concepts allow outlining the concept and identifying the difference between a basic city and a smart city through understanding the problematic conditions that required to be addressed and what more a smart city will have in compared to a basic city.

The definitional elements clarify that integration of ICT into the urban structure has not been defocused although a priority was given also to integration of infrastructure, data management, and smart people. In fact, while identifying the smart city characteristics some authors have identified smart economy, living, environment, people, governance, and smart mobility as characteristics while ICT facilitation, data management, and analytics as indicators under each of those components. Although the universality of definitions was a question, it can be identified that characteristics are more or less the same, provided that differences in city notion are acceptable. Therefore, although this study does not intent to outline a new framework, all the listed key components are what differentiate a smart city from a basic city. Similarly, by comparing smart city descriptions with other city concepts not only helps to identify smart characteristics but also signifies the existence of smart cities.

In conclusion, the difference of a smart city from a basic city lies with the "smart" prefix before economy, governance, environment, people, living, and mobility. Breaking down of economy, governance, environment, people, living, and mobility into components define the aforementioned smart prefix. Integration of them on an ICT infrastructure, data analytics, and real-time control completes a "smart city" which majorly aims on urban, public services, and citizen development.

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