Understanding ‘smart cities’: Intertwining development drivers with desired outcomes in a multidimensional framework

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ABSTRACT

The convergence of technology and the city is commonly referred to as the ‘smart city’. It is seen as a possible remedy for the challenges that urbanisation creates in the age of global climate change, and as an enabler of a sustainable and liveable urban future. A review of the abundant but fragmented literature on smart city theories and practices, nevertheless, reveals that there is a limited effort to capture a comprehensive understanding on how the complex and multidimensional nature of the drivers of smart cities are linked to desired outcomes. The paper aims to develop a clearer understanding on this new city model by identifying and linking the key drivers to desired outcomes, and then intertwining them in a multidimensional framework. The methodological approach of this research includes a systematic review of the literature on smart cities, focusing on those aimed at bringing together and developing the key drivers—productivity, sustainability, accessibility, wellbeing, liveability, governance. These drivers and outcomes altogether assemble a smart city framework, where each of them represents a distinctive dimension of the smart cities notion. This paper helps in expanding our understanding beyond a monocentric technology focus of the current common smart city practice.

1. Introduction

Improper and deliberate human activities pushed the planet into the Anthropocene epoch—characterised by significant impacts on geology, ecosystems, and climate change (Dízaroglu & Yigitcanlar, 2014; Smith & Zeder, 2013). Despite representing only about 2% of the geographic space and accommodating over 50% of the world population, cities today produce 80% of greenhouse gas (GHG) emissions and consume 80% of the world’s resources (Arbolino, Carlucci, Cira, Ioppolo, & Yigitcanlar, 2017; Arbolino, Carlucci, Cira, Yigitcanlar, & Ioppolo, 2018; Ioppolo, Cucurachi, Salomone, Saija, & Shi, 2016; Ioppolo, Heijungs, Cucurachi, Salomone, & Kleijn, 2014; La Greca & Martinico, 2016). A heavy reliance on non-renewable resources increases GHG emissions including a vast amounts of carbon-dioxide (CO₂) responsible for global warming (Goonetilleke, Yigitcanlar, Akoko, & Egodawatta, 2014; Mahbub, Goonetilleke, Akoko, Egodawatta, & Yigitcanlar, 2011; Szopik-Depczyńska et al., 2017; Yigitcanlar, Dodson, Gleeson, & Sipe, 2007).

At the dawn of the catastrophic global climate change era, ‘smart cities’ came to the scene as a potential panacea to, somehow, reverse or ease the impacts of ill urbanisation, industrialisation, and consumerism practices (Taamallah, Khemaja, & Faiz, 2017; Trindade et al., 2017; Wiig, 2015). Although the initial rationale for the smart city developments was mostly related to environmental concerns, the practice, unfortunately, indicates that only marginal attention is paid to these concerns. Current practice is mostly unidimensional with technology at the core (Yigitcanlar, 2016). This unidimensional focus is a result of, as well as points to, a number of challenges that smart city practice is facing to overcome. These are briefly elaborated below.

Firstly, the fourth industrial revolution (Industry 4.0) helps leading
global cities to advance their innovation edges, and hence, further se-
cure their global hub status in innovation and knowledge generation
(Edvardsson, Yigitcanlar, & Pancholi, 2016; Yigitcanlar, Guaralda,
Taboada, & Pancholi, 2016; Yigitcanlar, Sabatini-Marques, Costa, 
Kamruzzaman, & Ioppolo, 2017). Subsequently, cities that are fall-
ing behind started to strategize their economic development to increase
abilities in fostering, attracting, and retaining innovation activities
(Holland, 2015; Millar & Choi, 2016; Pancholi, Yigitcanlar, & Guaralda,
2017a; Yigitcanlar, Edvardsson, et al., 2017). Smart cities agenda in
many cities—e.g., Amsterdam, Vienna—goes hand-in-hand with these
knowledge-based economic development efforts (Carrillo, Yigitcanlar, 
García, & Lönqvist, 2014; Esmaeilpoorarabi, Yigitcanlar, & Guaralda,
2016, 2018; Sarimin & Yigitcanlar, 2012). Today, smart cities are seen
as the hubs of technological innovation—e.g., San Francisco, Seoul—
(urban areas generate 93% of the world’s patented inventions) rather
than cities of sustainable development.

Secondly, smart city projects, nonetheless, are big and expensive
capital investments—supposed to drive societal and environmental transforma-
tions—, thus very hard to properly deliver. Current practice is highly
ad hoc in nature in transforming cities and societies into truly
smart ones. For example, after over a decade of investment, Sengdo City
(Korea)—widely referred to as the world’s first smart city—is still a
‘work in progress’ project without achieving any concrete desired out-
comes (Yigitcanlar & Lee, 2014). This ad hoc approach makes the smart
city practice highly risky to accurately identify, produce and/or meet
desired socio-spatial outcomes.

Next, Han and Hawken (2018, p. 1) underline the monocentric focus
on technology of the present smart city practice by stating: “Current
curso on smart cities is obsessed with technological capability and
development. Global rankings reduce cities to a one-dimensional busi-
ness model and series of metrics. If the term ‘smart city’ is to have any
enduring value, technology must be used to develop a city’s unique
cultural identity and quality of life for the future.” The comprehension
of smart cities in current practice carries a risk of leading to a long-term
trend towards increasing dependency on technology, and negligence of
socio-spatial issues (Yigitcanlar, 2016).

Fourthly, the popularity of smart cities agenda is mainly an outcome
of the aggressive promotion/push of major global technology, de-
velopment, and consultancy firms and their programs—e.g., KPMG and
CISCO’s partnership in smart cities, and IBM’s Smarter Planet, and
Smarter Cities Challenge initiatives (Alizadeh, 2017). While smart
city sceptics raised their concerns about the ongoing global craze on this
new city brand (Anthopoulos, 2017; Grossi & Pianezzi, 2017; Kunzmann,
2014), many governments across the globe are still jumping on
the smart city bandwagon by turning a blind eye to these warnings
(Caragliu, Del Bo, & Nijkamp, 2011; Townsend, 2013).

Lastly, there are too many smart city definitions/con-
ceptualisations—focusing on separate aspects of drivers or out-
comes—in the rapidly growing literature. These are coined by scholars
and commercial, government and international organisations and
mostly vague or inchoate in conception (Dameri, 2013). However,
more to the infancy, interdisciplinary nature or generally poor con-
ceptualisation, there is not a commonly agreed definition of smart ci-
ties. This is due to the lack of a sound and/or common conceptual
understanding. Scholars, practitioners, and organisations developed
their frameworks that suit their own particular practical perspecti-
ves—rather than (in general) a generic framework outlining the com-
plexities and links of various dimensions of smart cities in a compre-
hensive and at the same time a simple way.

Against this backdrop, this paper aims to address the broad con-
ceptualisation and multidimensionality issues through developing a
better understanding of the smart cities notion—in terms of identifying
the key development drivers and desired outcomes and placing them
under a multidimensional framework. This would, in turn, help urban
administrators and smart city practitioners better grasp the smart city
notion and assist them in undertaking necessary actions to utilise the
smart city drivers to achieve the desired outcomes. The methodological
approach adopted in this research includes a systematic but at the same
time critical review of the interdisciplinary literature on smart cities
focusing on conceptual analysis in order to develop a multidimensional
framework. By developing such framework, this study contributes to
the efforts of a few other scholars, who have developed multi-
dimensional conceptualisations and frameworks, and expands the un-
derstanding beyond a mostly monocentric focus of the current common
smart city practice.

2. Smart cities in a nutshell

2.1. Origin and definition

In recent years, the development of smart cities is at the forefront of
the urban discourse due to rapid urbanisation rate and associated so-
cioeconomic, environmental and governance challenges, along with the
global innovation leadership challenge (Belanche, Casaló, & Òrtis,
2016). Nevertheless, the concept of smart city is not new. The term was
first coined in the mid-1800s to describe new cities of American West
that were efficient and self-governed. However, it has its contemporary
origins in the ‘smart growth’ movement of the 1990s—referencing to
sustainable urbanisation (Eger, 2009; Albino, Berardi, & Dangelico,
2015; Susanti, Soetomo, Buchori, & Brotosunaryo, 2016).

Since 1990s, the smart city concept has evolved to mean almost any
form of technology-based innovation in the planning, development,
deployment and operation of cities, for example, the deployment of
smart mobility solutions to combat urban traffic challenges (Battarra,
Gargiulo, Pappalardo, Boiano, & Oliva, 2016; Harrison & Donnelly,
2011; Yigitcanlar, Fabian, & Coiacetto, 2008). With the offerings of
digital technologies and online urban planning opportunities, this
concept increased its popularity among the urban technocrats (Aina,
2017; Pettit et al., 2018; Yigitcanlar, 2005, 2006).

Although originated from the smart growth movement, a smart city
can be, sometimes mistakenly, termed in other jargons. These include
sustainable city (Bulkeley & Betsill, 2005), digital city (Aurigi, 2005),
intelligent city (Komninos, 2008), ubiquitous city (Lee, Yigitcanlar,
Han, & Leem, 2008), techno-centric city (Wills & Aurigi, 2017), crea-
tive city (Baum, O’Connor, & Yigitcanlar, 2009), and knowledge city
(Yigitcanlar, Velibeyoglu, & Martinez-Fernandez, 2008). However, the
notion of smart city is not equivalent to these city brands; but smart
cities carry some of the common characteristics of other city brands or
their conceptualisations. For example, an intelligent city is not
equivalent to the notion of smart city, instead it focuses on only either
a single aspect of the smart city field (e.g., ICT) or on other less closely
related issues (e.g., resilient city). These branding variations have oc-
curred as a result of different interpretations of what an ideal city
should be like, and which policies these cities utilise to sustain growth,
and address socio-spatial inequalities of resources (Chang, Sabatini-
Marques, da Costa, Selig, & Yigitcanlar, 2018). However, subsequent to
the increasing popularity of the smart city phenomenon, in recent years
many cities across the globe incorporated the ‘smart’ tag in their
brands. For instance, Songdo was initially branded as a ‘ubiquitous city’,
but the new brand is now a ‘compact smart city’.

During the last two decades, the pace of globalisation has ac-
celerated a number of large multinational corporations’ focus on the
lucrative smart urban technology and engineering solutions. IBM,
Cisco, Microsoft, Hitachi, Samsung, LG, Siemens, ARUP, KPMG, and
number of national telecommunication companies—e.g., Alcatel, KT
Corporation—are among the front-runners of the industry that led the
expansion of smart cities movement, and technology deployment across
the global cities (Yigitcanlar, 2016). Moreover, today various tech-
nology and car manufacturing companies—e.g., Google, Uber, Volvo,
Tesla, Audi, BMW, Mercedes-Benz, Nissan to name a few—also joined
the smart cities bandwagon with their smart mobility solutions of au-
tonomous vehicles or driverless cars (Shladover, 2017). The global