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There are a number of different future-city visions being developed around the world at the moment: one of them is Smart Cities: ICT and big data availability may contribute to better understand and plan the city, improving efficiency, equity and quality of life. But these visions of utopia need an urgent reality check: this is one of the future challenges that Smart Cities have to face.

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METHODS, TOOLS AND BEST PRACTICES TO INCREASE THE CAPACITY OF URBAN SYSTEMS TO ADAPT TO NATURAL AND MAN-MADE CHANGES

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SHORTCOMINGS TO SMART CITY PLANNING AND DEVELOPMENT

EXPLORING PATTERNS AND RELATIONSHIPS

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ABSTRACT

Smart city criticism concentrates on conceptual and methodological ambiguity, corporate driven utopian visions, overlooking citizen and other stakeholder potential, 'splintering urbanism', and lack of long term vision for sustainable urban development adapted to local needs. Inspired by this critical discourse, this paper aims to present smart city planning and development shortcomings on the basis of applied experience and, further, use this experience to create a new theoretical construct about shortcomings to smart city planning and development. Nine individual smart city cases (Barcelona, Stockholm, Chicago, Rio de Janeiro, PlanIT Valley, Cyberjaya, Masdar, Songdo International Business District, Konza) are explored on the basis of selected published material and in-depth case studies, highlighting the challenges and shortcomings that appeared during their development and implementation. Subsequently, the identified shortcomings are synthesized and assessed critically across contextual and strategic levels, uncovering underlying causal relationships. The findings are used to create a new theoretical construct, comprising two paths to shortcomings towards smart city planning and development.

KEYWORDS:
smart city; urban development; strategy; challenge; causes and effects

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智慧城市规划与发展的缺陷

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摘要

本文对智慧城市规划与发展的缺陷进行了探讨。具体而言，它对 11 座智慧城市的发展战略以及在规划和实施阶段所发现的缺陷展开了调查。这 11 座智慧城市分别是：巴塞罗那智慧城市 (Barcelona Smart City)、生态城市普兰尼特谷 (PlanlT Valley)、斯德哥尔摩智慧城市 (Stockholm Smart City)、网路之城赛城 (Cyberjaya)、阿布杜拉国王经济城 (King Abdullah Economic City)、马斯达尔城 (Masdar City)、斯科尔科沃 (Skolkovo)、松岛国际商务区 (Songdo International Business District)、芝加哥智慧城市 (Chicago Smart City)、里约热内卢智慧城市 (Rio de Janeiro Smart City) 和孔扎科技城 (Konza Technology City)。本文对相关调查结果进行了综述并提出了中肯的评价。具体缺陷体现在以下方面：资金和预算不足、官僚主义和组织挑战、数字服务发展和布局挑战、实体规划较差、难以吸引投资和支持新商业的发展、在用户吸引方面表现不佳以及利益相关者的阻力。接下来，本文将这些缺陷分成了两大类，并逐一分析了原因和影响。本文最后通过将过往的经验与新颖的方法相结合，提出了缓解提议。

关键词：
智慧城市；缺陷；挑战；问题；缓解

1 INTRODUCTION

Urban futures have attracted the interest of urban planners for over one century now (Papa et al., 2013); but the recent leaps in ICT and knowledge and innovation economy have created an extraordinary technology push for smart city solutions and a demand pull on the side of cities which, on one hand has made the smart city conception very popular, but on the other hand hinders the development of common understanding about what it means for a city to be 'smart' (Angelidou, 2015). Smart city plans, strategies, initiatives and solutions of all sorts and sizes are now being developed by hundreds in cities all over the world. Solutions abound; open knowledge, open government, and open source applications have enabled the development of an ecosystem of solutions, platforms and tools that cities can chose from to create their smart city agenda.

But what about shortcomings to smart city planning and development? From practical experience we know that perfectly successful strategic planning initiatives do not exist in any domain. Every project faces its own challenges, and is characterized by its own objectives and specifications.

Although critical literature towards the smart city abounds, until recently it had not dealt substantially with the practical challenging aspects of strategic planning for smart city development. Purportedly "good" practices abounded while "pitfalls" and "challenges" were downplayed - and still are, in many cases. This is largely due to the 'self-congratulatory' nature of smart cities (Hollands, 2008), which assumes that the smart city is *a priori* a successful paradigm of urban development. As many smart city projects from around the world are now entering their maturity phase, however, the volume of published in-depth smart city case study research has been growing. This valuable source of knowledge can be used to build theory from cases (Eisenhardt, 1989) with the purpose of mapping practical shortcomings in the smart city planning and development process. The results can be used in policy making towards anticipating and mitigating pitfalls in technology-led development, increasing the chance of smart city initiatives to succeed.

Starting from the previous reflections, the purpose of this paper is to present smart city planning and development shortcomings on the basis of applied experience and, further, use this experience to create a new theoretical construct about shortcomings to smart city planning and development.

The following section (2) presents the basic critical arguments towards smart cities. Section 3 explores nine individual smart city cases and the challenges that appeared during their development and implementation on the basis of selected published material and in-depth case studies. Subsequently, the identified shortcomings are synthesized and assessed critically by uncovering causal relationships among them (section 4). Section 5 presents the conclusions of this paper.

2 REVIEW OF LITERATURE ON SMART CITY PLANNING AND DEVELOPMENT SHORTCOMINGS

2.1 CRITICAL LITERATURE TOWARDS THE SMART CITY

In the course of the past decade, along with the increasing popularization of the smart city idea, a growing number of smart city scholars and practitioners engaged in addressing the smart city through a critical lens. This section aims to highlight the most important points emerging from this discourse by citing the most influential academic publications in this regard. It clusters smart city criticism across five levels: (i) conceptual and methodological ambiguity, (ii) ICT and corporate driven utopian visions (iii) overlooking citizen and other stakeholder potential, (iv) 'splintering urbanism', unequal representation, privacy and security concerns and (v) lack of long term vision for sustainable urban development adapted to local needs. These points are analytically described in the following paragraphs.

Hollands (2008), in his widely cited seminal paper, *'Will the real smart city please stand up?'*, essentially launched the smart city criticism discourse by pointing out underlying issues of conceptual and ideological ambiguity, observing the 'self-congratulatory' nature of so-called 'smart cities'. Seven years later, Hollands (2015) returned with his paper *'Critical interventions into the corporate smart city'* whereby, among others, he notes that current conceptions about smart cities bring together so many disparate theories, city systems and functions, that it is essentially impossible to embed all smart city aspects in a single ideological framework (Hollands, 2015). The contribution of smart cities to sustainable developmen remains vague (Salvati et al., 2013). Arguably, smart cities are shaped by diverging conceptual variations, fragmentary thoughts and conflicting ideological and conceptual roots (Fernández-Vázquez & López-Forniés, 2017; Kitchin, 2015; Meijer & Bolívar, 2016; Pierce & Andersson, 2017; Van den Bergh & Viaene, 2015). Further, the lack of documentation and established performance metrics hinders an assessment of the efficiency of 'smart' interventions that can be justified towards replication (Glasmeier & Nebiolo, 2016). Hollands (2008), Van den Bergh and Viaene (2015) and Glasmeier and Nebiolo (2016), note the use of the smart city idea as a *label* and *means of promotion* used by city administrators and politicians. Smart technologies, they observe, are put forward as marketable, off-the-shelf products, instead of serving purposes of public benefit and common good.

Furthermore, smart cities put forward business-led urban development as one of their foremost priorities (Hollands, 2008), with concepts of technology-led smart city development originating not only form the business sector (technology vendors and consultants), but also government (the European Commission, for example) and academia (computer sciences) (Fernández-Vázquez & López-Forniés, 2017). As a result, smart city initiatives and technologies are increasingly driven by business imperatives, with smart city planning and control being handed over to private organizations, creating a risk of lock-in around proprietary technologies and raising issues about the management of these systems after the departure of the corporates (Buck & While, 2015; Datta, 2015a; Glasmeier & Nebiolo, 2016; Greenfield, 2013; Kitchin, 2015; Marvin & Luque-Ayala, 2013; Pierce & Andersson, 2017). Due to their nature, corporate smart city initiatives tackle a limited range of social and environmental priorities and fail to develop the capacity of a city's people to actually learn and deeply engage in the smart city discourse (Marvin & Luque-Ayala, 2013). In addition, an efficiency and reflexivity gap between vendor led, fixed smart city solutions and solutions-driven, promptly available smart city technologies is observed (Glasmeier & Nebiolo, 2016).

Stakeholder engagement is broadly cited as a fundamental pillar of the smart city in many wordings (for example grassroots engagement, bottom-up engagement) and is associated with related the conception of 'smart communities' (Bencardino & Greco, 2014; Komninos, 2011; Mosannenzadeh & Vettorato, 2014). Cities are 'messy' places (Greenfield, 2013), and regardless of the approach, the essence is that stakeholder empowerment is an enabling ingredient of the smart city: citizens, businesses and civil servants should act as empowered data and knowledge generators and contributors, agents, implementers and assessors of smart city policy. Behavioral changes are required towards the sustainable smart city development (Salvati et al, 2013). Although integrated stakeholder segmentation efforts in a smart city context have taken place in the past (Mosannenzadeh & Vettorato, 2014), existing smart city models frequently fail to identify stakeholders and describe their roles (Harrison, 2017; Pierce & Andersson, 2017; Vanolo, 2016). This is a common situation across smart city initiatives, driven by the dominance of supply-driven smart city solutions and the aforementioned different ideological stances across academic, corporate and government literature (Angelidou, 2015; Kitchin, 2015; Marvin & Luque-Ayala, 2013). It results to a loss of the opportunity to experiment with innovative solutions, tailor smart cities to user needs, capitalize on the problem solving capacity of the populace, provide new insights and obtain buy-in from stakeholders. Some smart city critics have proposed 'smart urbanism' as an alternative conceptual fundament towards integrated and participative urban growth driven by bottom-up innovation and creativity (Kitchin, 2014; Luque-Ayala & Marvin, 2015).

Furthermore, weak stakeholder participation in the smart city and the diffusion of entrepreneurially led smart cities raise questions regarding democratic representation and citizenship (Angelidou, 2014; Datta, 2015b; Greenfield, 2013; Hollands, 2015; A. Townsend, 2013), in turn posing negative implications about public space privatization, social polarization and gentrification (Hollands, 2008; Hollands, 2015). Smart cities also raise concerns about security, privacy and panoptic surveillance on different levels (Elmaghraby & Losavio, 2014; Kitchin, 2015; van Zoonen, 2016). Failing to account for the implications of smart city technology and 'networked urbanism' on urban life and urban citizens (Kitchin, 2015), technologically mediated urban living inevitably contributes to the creation of the phenomena of 'splintering urbanism' (Graham & Marvin, 2001) and 'urban digital divides' (Crang et al., 2006), with urban infrastructures enhancing spatial inequality instead of contributing to the creation of inclusive communities. Public policy is shifting away from its principal scope, which is to serve social objectives, such as provision and accessibility to quality infrastructure, education and other amenities. It is not clear who the main beneficiary of the smart city is, and furthermore to whom the smart city services will be accessible to. Smart cities, as costly, privileged, all-encompassing places, eventually risk becoming a commodity of the elite (Glasmeier & Nebiolo, 2016).

Finally, smart cities often omit accounting for a long term vision for long term, sustainable urban development, despite the efforts undertaken so far (Papa et al., 2013) as well as its potential contribution to urban resilience (Papa et al., 2015). They suffer from the dominance of one-size-fits-all smart city narratives, which do not consider the history, culture and social, economic, political and other features of cities (Kitchin, 2015). Solutions often focus only on one city system (Glasmeier & Nebiolo, 2016). Zubizarreta et al. (2015), after an analysis of more than 60 smart city applications in 33 cities, actually confirmed that smart city applications are in most cases designed as isolated tools, without contributing to the development of a broader ecosystem and failing to position themselves within a vision that promotes integrated and sustainable development. As a result, many smart city initiatives do not consider how urban systems and development areas (e.g. energy and urban living) can work together in order to achieve efficiencies.

Arguably, the criticism points mentioned above are inherently interrelated – for example, conceptual ambiguity is partly driven by the diffusion of corporate driven smart city visions, and weak stakeholder engagement posits 'splintering' pressure on the urban fabric.

Furthermore, in parallel to this ideological and theoretical criticism towards the smart city, the smart city criticism discourse is becoming stronger of the basis of evidence-supported arguments.

2.2 PREVIOUS EFFORTS TO IDENTIFY AND EXPLORE SMART CITY CHALLENGES

As many smart city initiatives from all over the world are now entering their maturity phase, we are beginning to have an increasing amount of evidence-based information about their priorities, characteristics and results. As a result, there has been a growing volume of scientific literature focusing on specific, in-depth case studies about smart city strategies, describing –among others- smart city strategy shortcomings[1]. In parallel, a limited number of efforts to analyze smart city cases comparatively has also been undertaken, as described in the followings.

More particularly, Pierce and Andersson (2017), in a research conducted across 10 mid-sized European cities[2], identified and grouped smart city development and implementation challenges in two domains: technical and non-technical. The technical domain includes challenges with regards to interoperability and privacy, while the non-technical domain includes challenges related to collaboration, financing, governance and awareness

[1] Although background work was undertaken in this area for the purpose of selecting the case studies and sourcing material for this research, it is out of the purpose of this paper to list all the available literature with this respect.

[2] Aarhus (Denmark), Bristol (UK), Dublin (Ireland), Eindhoven (Netherlands), Helsingborg (Sweden), Lund (Sweden), Malmö (Sweden), Rotterdam (Netherlands), Santander (Spain)

raising. They found that the most pressing challenges lie with cross-departmental and outward collaboration and coordination of recourses, closely followed by the challenge of securing the necessary financial recourses.
Fernández-Vázquez and López-Forniés (2017), in analyzing and comparing smart city initiatives while focusing on the role of citizens in the smart city, examined 200 scholarly papers to identify the characteristics of ICT based smart cities versus the characteristics of citizen based smart cities[3]. Among others, as weaknesses in ICT based smart cities they identify i. poor citizen participation, ii. fuzzy goals and iii. private benefits. In citizen driven smart cities they identify i. lack of funds, ii. poor communication power and iii. need for new tools/methods.
Ojo et al. (2014) studied comparatively ten smart city programmes[4], creating a framework for smart city initiative design addressed to policy makers, practitioners and smart city stakeholders. Their findings deal, among others, with the challenges (technical, management, governance) encountered by policy makers into implementing the initiatives. These are related with attracting and sustaining stakeholder interest from the civil and private sector, including marginal communities and financing difficulties.
Neirotti et al. (2014), analyzing comparatively 70 smart city programmes around the world[5] on the basis of secondary sources, identify smart city application domains and further examine their relationship with contextual factors (geography, demography, economy, development policies). Among others, they note that smart city initiatives are variably affected by contextual political, economic and cultural factors which present different obstacles, depending on the case. The authors highlight the need to adopt bottom-up engagement approaches in cities that are currently not very advanced in technological and economic terms.
Heo et al. (2014) explore the requirements and challenges in smart systems' integration through use cases. Their approach is purely technical, focusing on areas of i. smart power grids, ii. structural and surveillance applications, iii. transport and traffic management, iv. food, water quality and environmental monitoring and v. ubiquitous healthcare applications. The identified technical challenges with respect to the integration of the previous systems are related with interoperability, scalability, infrastructure management, data privacy and security.
This paper diversifies its positioning from the previous research efforts in that it engages in a investigation into the shortcomings of each smart city initiative, sourcing and processing material from published case study research, rather than settling with material from smart city project websites. It also differs substantially in that it seeks to create theoretical constructs from observation (Eisenhardt, 1989), rather than vice-versa, which is the standard approach followed in previous work.

3 RESEARCH APPROACH

The research approach used is "theory building from cases" (Eisenhardt, 1989), whereby a number of case studies are analyzed internally and comparatively in order to create a theoretical construct in an inductive way. The emerging theoretical constructs reflect relationship patterns within and across the cases and can be used, among others, to provide description. Following the recommendations of Eisenhardt (1989), the selection of the case studies aimed at the selection of polar types, i.e. cases that are very different and represent extreme situations. Other important factors that drove the selection of the cases is the maturity of the initiatives, which is a precondition for being able to identify shortcomings, and the availability of information through scholarly publications (academic journal and conference papers, theses and research reports) -particularly in-depth case studies into smart city cases and their shortcomings. The collected data were arranged in a tabular display,

[3] the authors do not mention the exact smart city initiatives
[4] Smart Amsterdam (Netherlands), Climate Smart Malmo (Sweden), Smart City Malta (Malta), Masdar Smart City (United Arab Emirates), PlanIT Valley (Portugal), Smart City Singapore, (Singapore), Smart Curitiba (Brazil), Smart Songdo (South Korea), Tianjin Eco-City (China), Yokohama Smart City (Japan).
[5] the authors do not mention the exact smart city initiatives

which features shortcomings pertaining to the context of the smart city strategy and the strategy itself (Section 4, Table 1). Using this display, the collected information was scanned vertically and horizontally multiple times to uncover underlying patterns and hidden relationships. The patterns that appeared more frequently were in turn used to create two new constructs which describe relationships across smart city planning and development shortcomings.

4 RESEARCH FINDINGS AND SYNTHESIS OF RESULTS

4.1 THE SMART CITY CASES AND THEIR SHORTCOMINGS

This section presents the nine smart city cases of this paper and the shortcomings that appeared during their development and implementation.

Barcelona's Smart City strategy (Spain) is built around 'international promotion', 'international collaboration' and 'local projects'. The strategy establishes collaboration channels among government, industry, academia and citizens (Angelidou, 2016; Bakici et al., 2012; Barcelona Smart City official website, 2016). Harrison (2017) notes a misalignment of the city's strategy with the reality and needs of Barcelona's urban population –actually, the initiative faced opposition from specific neighborhood associations and raised 'splintering urbanism' concerns (March & Ribera-Fumaz, 2016). However, Barcelona's smart city initiative is currently in the process of transitioning from a more of top-down to a bottom-up one (Calzada, 2017), using tools and methodologies such as smart districts, open collaborative spaces, infrastructures and open data. To implement the strategy, a major organizational reform took place, resulting in the creation of the 'Urban Habitat Department' (the 'smart city' department). The City of Barcelona faced challenges in securing the necessary funds, providing exact and appropriate infrastructure and in the deployment and management of wireless networks. Cross-departmental cooperation has also been challenging, due to the difficulty to clearly define the roles and responsibilities of each person and authority (Bakici et al., 2012). In addition, the massive restructuring of services and budgets that took place for the creation of the Urban Habitat department faced opposition from some citizen groups.

In the smart city strategy of Stockholm (Sweden), environmental and information technology is tested and used extensively throughout the city's infrastructure, with the purpose of creating an innovation ecosystem that involves the city's inhabitants, industry and the public sector (Buscher & Doody, 2013; Stockholm smart city official website, 2014). One of the key challenges to the implementation of the strategy has been financing; the need to have funds available upfront in order to make investments is one of the constant issues to be tackled. Furthermore, as every change risks raising society's resistance, city employees and the city council need to be constantly informed and convinced about the importance of the smart city project (Buscher & Doody, 2013).

The city of Chicago (USA), driven by a vision towards more transparent, accountable and democratic governance, pursued a data driven smart city strategy for leveraging technology in order to promote inclusion, engagement and innovation. The project foresees the collaboration of the public, the private and the third (social) sector to develop the city's infrastructure, 'smart' communities, civic innovation and technology companies (Buscher & Doody, 2013; City of Chicago, 2013; Goldstein, 2013; O'Neil, 2013; Smart Chicago official webpage, 2014). The smart city of Chicago had to address a host of issues normally associated with open data, including privacy, interoperability, scalability, consistent and automatic updating of data, and creating user friendly interfaces (Goldstein, 2013). Also, building an ecosystem of open government, vibrant user communities, potential investors and meaningful datasets required a continuous and concerted effort on the side of the city (O'Neil, 2013). That said, acquiring the necessary financial capital and technical expertise for the project was one of the strategy's key challenges, as an array of private and public foundations were

required to contribute knowledge and other recourses for the realization of the initiative (Buscher & Doody, 2013; O'Neil, 2013). Another key issue was re-tooling the Chicago City's IT department to meet the new requirements of the smart city strategy (Buscher & Doody, 2013).

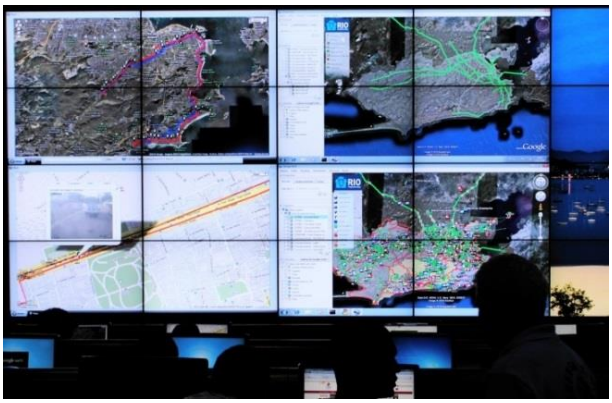

Fig. 1 - 2 Rio Operations Center

The smart city of Rio de Janeiro (Brazil) is a collaboration of the city with technology vendor IBM to become a 'smarter city', created in the prospect of the 2016 Olympics and the 2014 World Cup. Rio is now equipped with a citywide Emergency Response System that collects sensor-and-camera-generated data that enable informed decision making in policing, traffic and energy management (Buscher & Doody, 2013; Goodspeed, 2015; Rio de Janeiro Centre of Operations official website, 2014). Rio de Janeiro's smart city initiative, however, focuses on anticipating and mitigating urgent situations across the city, rather that addressing 'wicked' problems of the urban environment, such as social inclusion and the provision of appropriate infrastructure (Goodspeed, 2015). Progress has been slow to fulfill the set goals, especially regarding user engagement and open data. Bureaucratic issues have also been raised.

Fig. 3 - 4 Images of PlanIT Valley

Cyberjaya (Malaysia) is a planned smart city which is part of the broader government policy for advancing the country's innovation and knowledge economy. The city is expected to become a global ICT hub by attracting world-class multimedia companies, professionals and students (Brooker, 2008; Cyberjaya official website, 2011; Nordin, 2012). The project has suffered bureaucratic challenges and political conflicts, as the city's development is shared among a federal authority, a private company and a government-owned company (Brooker, 2008). The initially foreseen development cost for Cyberjaya has more than doubled up to date, with 17 property developers involved in Cyberjaya's development so far (Nordin, 2012). On the physical level, the city has been criticized as overly labor-focused, suffering from lack of social amenites and negelecting the

need for social life (Brooker, 2008). Many workers of the city choose not to live there, but commute there only for their work (Nordin, 2012). Many companies have registered their address in Cyberjaya for tax benefit reasons, but did not actually move their major operations there (Brooker, 2008). Therefore, the city is practically empty; public spaces are empty; the city's streets -apart from working hours- are empty, too; the city is culturally destitute (Brooker, 2008) and socially dead (Yusof, 2008).

Masdar City (Abu Dhabi, United Arab Emirates) is another well-known planned smart city, designed on the principles of environmental sustainability. Its economy revolves around cleantech research and development, pilot projects, technology and materials testing (Crot, 2013; Cugurullo, 2013; Günel, 2014; Masdar City official website, 2013). Masdar is living proof of the challenges in achieving integrated, self-regulated urban development across different functional domains of the city (Glasmeier & Nebiolo, 2016). With the onset of the global economic crisis, the government of Abu Dhabi decreased its financial backing of the project (Cugurullo, 2013). What is more, Masdar faced difficulties in attracting investment and startups (Kingsley, 2013). '*There's limited indigenous talent and local markets are too small to justify localizing a lot of Research and Development',* according to S. Geiger, Masdar's co-founder and director in the period 2006-2009 (Kingsley, 2013). In 2010, the project's leaders had to make a major review of the project and scale down and even shelve some of its parts (Alusi et al., 2010; Crot, 2013; Cugurullo, 2013). In 2013 only 100 people were living on the site (Cugurullo, 2013) and life there '*cannot be described as urban'* (Kingsley, 2013).

Fig. 5 - 6 Central Courtyard of the Masdar Institute Campus (left) and Central Spine Showing Light Rail Transit and Retails -artist impression (right)

Songdo International Business District (South Korea) is a planned city which is a model of sustainable, city-scale development and innovation and aims to become a central business hub in Northeast Asia (Alusi et al., 2010; Lee & Oh, 2008; Shwayri, 2013; Songdo IBD official website, 2013; Yigitcanlar & Ho Lee, 2014). The city faced strong opposition by local stakeholders and environmentalist groups, as the reclaimed land upon which Songdo was built was formerly an area of important wetlands and fishing grounds (Shwayri, 2013). It is a city which combines green and smart urbanism in an environment of entrepreneurial urbanization which is socially segregated and presents limited learning, knowledge exchange and societal embedding opportunities (Benedikt, 2016; Carvalho, 2015). Songdo's history has been repeatedly shaped by governmental policies with periods of support and periods of neglect. Budget shortages have also been a major problem (Shwayri, 2013); the need for more funding has almost doubled the cost of the venture (Lee & Oh, 2008). There have been significant delays in permits and in construction (Lee & Oh, 2008) -actually the development and implementation plan was revised 10 times only in the period 2008-2010 (Shwayri, 2013).

The last city, Konza (Kenya), is a planned smart city to be developed close to Nairobi, designed on the basis of sustainable design principles and expected to advance technology growth in Kenya. Its economy will focus on four sectors: education, life sciences, telecom and information technology and business process outsourcing

(Konza City official website, 2014; Watson, 2013). The project has suffered major delays (Mutegi, 2014). Although some funds have already been allocated for Konza, they were not spent due to strict procurement laws or because they are dispersed across various government agencies (Mutegi, 2014). Konza has also been subject to criticism for social and spatial gentrification. There has been concern that Konza's properties and lifestyle will be financially unaffordable for locals (Watson, 2013).

Fig. 7 Aerial view of Songdo

4.2 SYNTHESIS OF FINDINGS

Arguably, some of the above smart city shortcomings stem from contextual factors, such as the broader political environment and related policy priorities, as well as the broader characteristics, structure and culture of the implementing authority. Other smart city shortcomings are related to the smart city strategy itself, and particularly how it has been designed and implemented. Table 1 arranges the research findings into these broad categories (context and strategy) and serves as the basis for a further analysis into the causal relationships among the identified shortcomings. After a thorough horizontal and vertical analysis of these findings, a series of insights emerged, as described in the followings.

Across all cases, it appears that the economic aspects of smart city strategies are the foremost issue of concern and source of problems both for planned and existing cities. Bureaucracy is also among the top challenges hindering the advancement of smart city strategies. It discourages investment and slows down financing procedures, resulting to delays in the implementation or downsizing of the smart city project. The main causes of bureaucracy in smart city strategies are complex legal frameworks, diverging political priorities, dissidence among stakeholders and the prevalence of political interests. Another significant challenge is ICT weaknesses, namely systems integration, software/hardware updates, lack of trained staff and a creativity gap. Stakeholder skepticism is more of an occasional challenge, which might be overcome by consultation and meaningful engagement in the smart city design and implementation process. The main causes of stakeholder resistance are accessibility and representation concerns, environmental, economic and real estate interests and a climate of resistance to a possible change of the status quo.

SMART CITY PLANNING AND DEVELOPMENT SHORTCOMINGS

CITY /	CONTEXTUAL			STRATEGIC			
LEVEL	POLICY	ORGANISATION	PHYSICAL PLANNING	TECHNOLOGY	FINANCING	TIMING	STAKEHOLDER RESONANCE
Barcelona (existing)		Organisational restructuring, cross departmental collaboration, roles' definition	Splintering urbanism' concerns	Infrastructure selection, deployment and management	Financing challenges		Stakeholder skepticism, resistance on the side of society
Stockholm (existing)		Organisational stakeholder scepticism			Financing challenges		
Chicago (existing)		Re-tooling organisation to meet requirements		ICT infrastructure challenges, Open Data challenges	Creative ways to increase funds, contribution for private and non-profit sector		Creating engaged, vibrant communities of developers and users
Rio de Janeiro (existing)		Bureaucratic legal framework & administrative structures	Splintering urbanism' concerns	Technologically determined, too ambitious		Schedule delays	Low citizen uptake
PlanIT Valley (planned)			Too ambitious	Technologically determined, too ambitious	Budget shortages	Schedule delays	
Cyberjaya (planned)	Changing officials, change in policy direction, diverging policies	Bureaucratic legal framework & administrative structures. Unclear organisational / leadership roles.	Poor urban design, too fragmented development, too ambitious, several plan reviews	Technologically determined, too ambitious, infrastructure challenges, services only partially implemented, surveillance and censorship	Cost more than doubled	Schedule delays	Low citizen uptake due to lack of social life, low investment attraction, inability to pass as international business hub
Masdar (planned)	Changing officials, change in policy direction	Bureaucratic challenges. Agency to facilitate bureaucratic processes	Poor urban design, too fragmented development, too ambitious, several plan reviews	Technologically determined, too ambitious	Authority reduced budget	Schedule delays	Low citizen uptake due to lack of social life, insufficient indigenous talent, small market potential, global financial crisis
Songdo (planned)	Changing officials, diverging policies	Bureaucratic legal framework & administrative structures	Too ambitious, plan reviews, real estate speculation, privatisation of public space	Technologically determined, too ambitious	Cost more than doubled	Schedule delays	Stakeholder skepticism, a socially segregated place. Inability to pass as international business hub
Konza (planned)		Bureaucratic legal framework, weak cross departmental collaboration, too many stakeholders		Technologically determined		Schedule delays	Low citizen uptake due to due to high cost of living

Tab. 1 Smart city planning and development shortcomings. Categorization of research findings

Brownfield (existing cities) initiatives usually face shortcomings related to organizational issues, such as securing cross departmental collaboration, aligning internal stakeholders, defining clear roles and workforce upskilling. Technological challenges are mostly related with issues of privacy, security and interoperability. While there are frequent financing challenges, as well, these are usually mitigated through the application of innovative or creative business models which establish alternative collaboration routes and bring in external stakeholders. Citizen uptake and stakeholder resonance is critical in smart city initiatives implemented in existing cities, as citizens need not only to be informed, but actively engaged in the co-design of the smart city solution.

Greenfield (new/planned) smart cities, on the other hand, face more massive challenges, typically associated with financing and timing. The research shows that greenfield developments, being massive and ambitious projects, usually face multiple challenges in terms of funding and investment attraction, which makes their advancement slow and sluggish within the current globally restrained real estate market and preference for low risk investment. In terms of physical and ICT infrastructure, many of them are too ambitious to realize, resulting in financing problems, slow advancement rate, and partial cancellation. Other smart city plans are characterized by poor urban design (too strict zoning regulations, inadequate social amenities, architectural repetition, spatial fragmentation etc.), which in hindsight discourage resident and investment attraction.

4.3 BUILDING THEORY FROM RESEARCH

What emerges is that most of the previous shortcomings are interconnected; some complications may be the outcome of the very same cause, while one complication may trigger the appearance of another. We can actually identify two principal path dependencies of co-existing shortcomings (Figure 10).

The first causal path begins with contextual shortcomings (top left box in Figure 10). The pattern is more or less the same in all the cases: the state does not adequately support and facilitate the smart city venture, while lingering bureaucratic problems and changes of key persons in the organizational structure render the venture slow, sluggish and costly. Implementing organizations fail to align stakeholders and establish internal and external collaboration channels. As bureaucratic, administrative and managerial problems accumulate, the interest on the side of investors fades away, and so does its uptake/embracement by citizens. The smart city project stagnates by being unable to secure funds due to the low uptake and low stakeholder resonance, resulting to schedule delays, which in turn enhance stakeholder disengagement and create a self-feeding cycle of entrapment.

The second causal path of shortcomings begins with poor or too ambitious planning, either or both in physical and digital terms (bottom left box in Figure 10). Physical plans of smart cities are characterized by poor and outmoded urban design (too strict zoning regulations, inadequate social amenities, architectural repetition, spatial fragmentation etc.). In other cases, the digital services of smart cities fail to live up to the set standards, rendering the city anything else but 'smart' and creating concerns of privacy, security and panoptic surveillance. Technically speaking, such smart city initiatives are partly or fully unrealizable, resulting to financing deficits, slow advancement, and in many cases cancellation of parts of the project. At the same time, this situation discourages the involvement of residents and the attraction of investment on the side of businesses. Failing to attract international and well educated citizens hinders the development of dynamic local economies that appeal to international businesses. Failing to engage and attract the interest of service users leads to a low uptake of the smart city services. The abovementioned self-feeding cycle of entrapment appears again. Complications backlog and become hard to overcome.

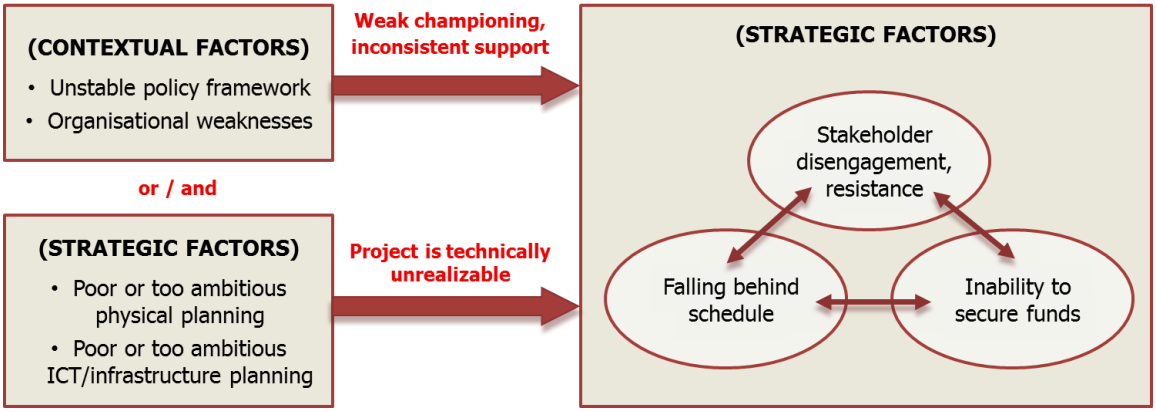

Fig. 8 Theoretical construct: two smart city challenges path dependencies

5 CONCLUSIONS

The smart city strategy discourse is full of smart city strategies that commence with very ambitious plans, only to soon confront detrimental challenges stemming from their context or their own design. In many cases, smart city initiatives were forced to downsize their scope, cancel or alter parts of their plans and revert to creative and alternative ways for securing funds. Based upon this general observation, it is suggested to maintain a more realistic grounding of how far a smart city strategy can go.

Becoming a smart city usually involves large investments in infrastructure and organizational change. Furthermore, smart cities capitalize both on physical and digital assets, meaning that a big number of stakeholders and possible partnership schemes may arise, as well as that highly complex procedural and financing processes are included. Therefore smart cities should be developed upon a clear and simple strategy and plan, capitalizing on thoroughly defined business and governance models.

In an ideal world, smart cities would be developed by solid administrative structures, free from bureaucratic shortcomings on all government levels and with funds allocated and secured in advance, guiding the smart city project firmly and efficiently towards its goals. The reality, however, is very different, and as with any urban development strategy, smart city shortcomings should be anticipated and planned for. By doing so, cities can both avoid their appearance and identify and mitigate them as they emerge.

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IMAGE SOURCES

Cover: author's elaboration

Fig. 1 - 2: http://www-03.ibm.com/press/us/en/pressrelease/33303.wss

Fig. 3 - 4: http://www.living-planit.com

Fig. 5 - 6: http://masdarcity.ae/en/

Fig. 7: http://www.songdo.com/

Fig. 8: author's elaboration

Tab. 1: author's elaboration

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