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Who built Songdo, the "world's first smart city?" questioning technology firms' ability to lead smart city development

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ABSTRACT

The media often depicts major information and technology (ICT) firms, such as IBM, Google, and Cisco, as the principal driving forces of smart city development. However, we argue that traditional urban development actors, such as real estate developers and national and local governments, play larger roles. ICT firms have limitations as leaders of major smart city development because of two important factors: 1) financially, the ICT budget is merely a small portion of the total greenfield smart city development budget, and 2) the ICT product lifespans are much shorter than that of the built environment. We explain how these two issues cause several practical problems that are obstacles to ICT firms taking charge of major smart city development. To this end, we refer to findings from an in-depth case study of the Songdo International Business District, which some have dubbed "the world's first smart city," allegedly built by Cisco.

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Introduction

Has the advent of smart cities changed the traditional division of labor among urban development actors? In the media, Google, Cisco, IBM, and other ICT firms have often been depicted as the main driving forces of smart city development. Over the last few years, however, ICT firm-led smart city developments have faced major setbacks or even permanent cancelations. For example, in May 2020, Alphabet, Google's holding company, canceled its Sidewalk Toronto, a project involving a 4.9-hectare site on the waterfront (Cecco 2020). Moreover, Cisco ceased the sale of the Cisco Kinetic for Cities, the company's

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Internet of Things platform for smart cities (Tilley 2020). Both companies have attributed these decisions to financial trouble caused by the COVID-19 pandemic, but we suspect that ICT firms have fundamental limits in leading smart city development. The COVID-19 pandemic was certainly unexpected; however, downturn forms part of the property cycle that is almost always considered in a major development, which means that developers should always be prepared for a downturn. If they had been prepared, they could have responded to the downturn the COVID-19 pandemic caused. In the case of Sidewalk Toronto, it is posited that residents' dissatisfaction and negative media coverage significantly contributed to the project's cancellation. Discontent and resistance from residents and other stakeholders constitute an inherent aspect of urban development, but Alphabet appeared unprepared to address these obstacles effectively (Mitanis 2020).

Whether ICT firms play a leading role in smart city development is an important question because urban development actors' characteristics heavily influence urban development outcomes. Each firm has its own identity characterized by its organizational culture and business strategy, but firms in the same industrial sector are likely to have certain commonalities. If ICT firms become the main actors in smart city development, urban development researchers should collect information about organizational culture and business strategies in the ICT sector to understand the smart city development process and outcomes. A shift in the development leadership would also imply a certain level of obsolescence of the existing urban development knowledge stock that is focused on traditional key actors, such as real estate developers, local and national governments, architects, and contractors.

Urban development researchers have accumulated a large knowledge stock pertaining to the division of labor in the urban development process and international differences since the debates on the building provision structure (Ball 1986a, 1986b). One of the main findings is that in the liberal real estate market, government bodies delineate the perimeter through urban planning, but the real estate developer is the main actor in charge of the actual development process, as it is the developer who chooses urban designers, architects, construction companies, and other contributors. In more interventionist markets such as China and South Korea, major developments are more strongly shaped by the government's vision. In both types of markets, ICT firms are hired by the developer, alongside other subcontractors, and the ICT firms are simply expected to install ICT infrastructure as per the instructions that the developer give them.

Does this division of labor, including ICT firms' role, differ in smart city development? With the smart city becoming the norm rather than a peculiar urban development experiment, are ICT firms supplanting developers and/or the government as the main actor? We answer negatively and claim that the knowledge that has been accumulated about each urban development actor's

role will continue to be useful even if the smart city becomes the norm in urban development. We support this argument with an in-depth case study of the Songdo International Business District (SIBD; "Songdo" hereafter), which some have been calling the "world's first smart city" (Bilotta 2014; Chan 2016). SIBD has attracted considerable scholarly interest, and some researchers have analyzed various actors' roles in its development (H. B. Shin 2016; H. R. Shin, Park, and Sonn 2015; Sonn, Shin, and Park 2017). However, the extant works do not pay particular attention to SIBD's smart city aspect, and none offer a view as to whether ICT firms can play a leading role in smart city development.

Our research employed multiple data collection methods. First, actors involved in the Songdo development were extensively interviewed in the period 2008–2021. Interviewees included civil servants in local and central governments, employees of the developer and other relevant firms, civil society activists, and journalists. Second, media reports and government documents were reviewed. Media reports were used mainly to check simple facts and numbers. Finally, one of this paper's authors was involved in the SIBD development in a high-level managerial position with responsibilities related to SIBD's smart city aspects as well as to corporate strategy in the period 2005–2012. Her experiences and observations were used in this research. All these data, particularly the aforementioned author's personal experiences, were cross-checked against one another.

Dearth of "who" questions amidst a flurry of "what" questions

The literature on smart cities is rife with "what" questions. What is the smart city? What should be done to build a smart city? What are the smart city's positive and negative impacts? (Dameri 2013; Giffinger et al. 2007; Klauser, Paasche, and Söderström 2014; Müller, Park, and Sonn 2022). Researchers have provided various definitions of "smart city," as Park and Yoo's (2022) literature review shows. Regarding the question of what should be done to build a smart city, some scholars have focused on better application of ICT, and others have emphasized civil participation opportunities (Caragliu, Del Bo, and Nijkamp 2011; Del-Real, Ward, and Sartipi 2021; Devlin and Coaffee 2021; Giffinger et al. 2007; OECD 2018). Regarding the positive and negative impacts of smart cities, many previous studies have presented evidence of positive impacts on economic development (Kumar and Dahiya 2017), environment sustainability (Ferrara 2015; Haque, Chin, and Debnath 2013), and citizen participation (Ferrara 2015; Gil-Garcia, Zhang, and Puron-Cid 2016), and pandemic control (Sonn, Kang, and Choi 2020; Sonn, Jung Won, and Jae Kwang Lee. 2020). Addressing the same question, other authors have considered the negative side, such as some residents' exclusion from governments' drive for smart cities (Hollands 2015; van Gils and Bailey 2021; Zhou et al. 2021), potential privacy issues related to enhanced data collection in smart cities (Batty et al. 2012; Neirotti et al. 2014;

J. W. Sonn and J. Lee 2020), and the problem of a universal smart city model that may or may not be able to handle unique local problems (Cicirelli et al. 2017; Silva et al. 2018).

Compared to these "what" questions, the "who" question––that is, who are the main smart city development actors?––has been discussed much less frequently. Due to the scarcity of research on this subject, we are limited to sketching what some actors have done in smart city governance. In most cases, the (national or local) government initiates smart city projects to derive urban economic development, governance efficiency, better public service delivery, and more active citizen engagement (Alawadhi et al. 2012; Meijer and Bolívar 2016; Pereira et al. 2017). Real estate developers' roles in smart city projects are mainly in three areas: financing, mentoring, and testing new ideas (Al-Hader and Rodzi 2009; C. Kim 2010; Tan and Taeihagh 2020). Citizens are sometimes given more than the usual opportunities to participate and express their preferences (Albino, Berardi, and Dangelico 2015; Taewoo and Pardo 2011).

We argue that the existing literature has two serious limitations in its treatment of smart city development actors. First, actors' roles are only briefly discussed. Specifically, papers on whether ICT firms play the leading role are nearly nonexistent, with the only notable exception being N'Diaye et al. (2018), who found that Japanese residential developers are in the lead position, not ICT firms in their overseas smart city projects. The second limitation of the existing literature is that actors' roles are described in the context of a functional division of labor, and the process of dividing the work and assigning roles is described as peaceful, whereas the power struggle over leadership and profit that obviously exist in smart city development has not been studied sufficiently. The only exceptions are some case studies of East Asian smart cities (Hu and Wang 2016; Shen et al. 2018; Y. Wu et al. 2018) that emphasize the government's dominance as reducing the potential for conflict.

Identifying information and technology firms' role in the Songdo greenfield smart city development

Why a greenfield smart city?

Our research aim to understand ICT firms' role by focusing on greenfield smart city development. We chose a greenfield smart city because such cases have a methodological advantage over smart city projects in the existing built area. A development in the latter, which we can call a brownfield smart city, would not have served this study's purpose because those actors are likely to behave in similar ways as actors executing other types of government contracts, such as landscaping a neighborhood park or renovating public toilets. That is because these small projects have numerous restrictions; for instance, a new ICT facility

needs to be compatible with the existing ICT infrastructure, and if its physical size is large, it may be restricted by the design codes and planning regulations applicable to the area as well. Additionally, location, type, and beneficiaries are politically sensitive. Given all these costs and restrictions, it is natural that an ICT firm would be unwilling to lead the project and assume all the responsibilities. Additionally, given that the government incurs the cost, it is natural for the government to assume a leading role. Even if a study of these small projects finds that an ICT firm is merely a passive contractor, such findings do not completely eliminate the possibility of an ICT firm playing a leading role in other types of smart city projects.

Conversely, a greenfield smart city development offers a natural experiment for our research. Given that the site would be empty, politics around the project would be relatively simple. Further, because the size is usually larger, ICT firms would be attracted by the opportunity to earn considerable profits and/or prestige. Most importantly, because everything is designed and built from scratch, non-ICT elements can be designed to work with smart technology, which makes an ICT firm's leadership feasible. If an ICT firm cannot lead the project despite these advantages in greenfield smart city development, we can safely conclude that an ICT firm has limitations in leading a smart city development. Therefore, as previously mentioned, a greenfield smart city offered a clear methodological advantage for this study. Additionally, the study has significant practical value. Analysis of ICT firms' role in the greenfield setting will be helpful in understanding the numerous ongoing greenfield smart city development projects in the Middle East, India, China, and other regions.

Approach of this paper

In studying ICT firms' role in smart city development, we build upon the theoretical tradition in urban studies that examines the actors of urban development. Since the 1970s, the literature has paid attention to the socio-economic aspects of the built environment development (Harvey 1978; Knox 1991). The social relations that condition social agencies' actions and interactions in the production, allocation, and consumption of the built environment have been studied by many including those who explicitly use the building provision structure approach (Ball 1986b; Ball and Harloe 1992). Many actors participate in housing provision, including government bodies, real estate developers, construction managers, architectural and urban designers, residents, non-governmental organizations (NGOs), universities, and political parties. More recently, emphasis has been placed on issues such as one actor's influence on another, differences in subcategories among seemingly homogeneous groups of actors, and understanding actors' decisions by treating them as rational economic agents (Adams, Croudace, and Tiesdell 2012; Bulan, Mayer, and Somerville 2009).

The extant body of related literature has established that developers play the leading role in producing and transforming the built environment in most countries (Coiacetto 2006; Gillen and Fisher 2002; Nas 2005). Developers' actions are normally within the perimeters that governments delineate through urban planning, environmental and health regulations, the tax system, and others. However, instead of accepting government-set perimeters, developers also negotiate with the government, lobby for regulation changes, and sometimes even shape governmental organizations in advance (H. M. Kim, Sabri, and Kent 2020; Leffers 2018).

However, these actors' roles are not identical across national borders. For example, in liberal markets, such as the United Kingdom, there is a relatively clear division among financiers, developers, and builders, and each acts according to their individual profit calculation (Adams, Croudace, and Tiesdell 2012). In China, the local government and state-owned enterprises (SOEs) dominate the real estate market, and large SOEs have multiple functions in urban development as investors, developers, and service providers (Hsing 2010; Shatkin 2017; F. Wu 2018). In South Korea, the country in which the present empirical study is based, developers are not independent actors in largescale development projects. Major construction companies backed by large conglomerates are bigger players who can easily access financing by using their enormous assets as collateral. The "developer" is often a special purpose company created for a single project under a construction company's leadership (Y. J. Kim and Choi 2015; Sonn 2019; Sonn and Kim 2020). In both China and South Korea, the government plays a bigger role than its counterparts in liberal market economies. The government often has a clear vision for developments, and developers are often required to work within that vision (H. B. Shin 2016; Sonn and Shin 2020).

Songdo International Business District

The so-called Songdo smart city's official name is SIBD, which is part of the Inchon Free Economic Zone. As part of Inchon, which is the country's third-largest city, Songdo is only 40 km from Seoul, and 12.4 km from Inchon International Airport, the country's main airport. It is a mixed-use development on 53.4 km^2 of reclaimed land on Inchon's seafront. The development costs around USD 20 billion and comprises diverse facilities such as office and mixed-use buildings, a convention center, an international school, a museum, a cultural center, a golf course, a park, and high-rise residential buildings. Its planned completion was 2015, but various factors caused a delay. In 2023, at the time of writing this paper, the project is still ongoing.

The conception of SIBD predates the smart city flurry by at least two decades. In the mid-1980s, a group of local actors had the idea of reclaiming the seafront and creating a new business district in keeping with a vision of a northeast Asian

business hub. They garnered residents' and local elites' support, which led the local government to strongly advocate for the project. They could not, however, obtain the central government's permission amidst the implementation of strict growth control on the capital region. In 1987, the president's emphasis on housing prompted the local actors to add more housing to the Songdo plan and change its name to Songdo New Town; these changes secured the national government's support. The 1998 East Asian economic crisis also bolstered support for the Songdo project, as the national government earmarked Songdo as part of an economic recovery strategy and designated it, along with two adjacent districts, as the Inchon free economic zone, cementing the Songdo development.

In 2002, Gale International, a medium-sized developer from Massachusetts, and the construction division POSCO, a major Korean builder, co-established New Songdo International City LLC (NSIC hereafter) as the developer, and purchased land from the Inchon Metropolitan Government (Huh 2016).

Throughout Songdo's history, various concepts have been used to legitimize the development at different points in time, with varying importance. These include northeast Asian business hub, free economic zone, new town, eco-city, media valley, green city, ubiquitous city, and airport city. Smart city was among the many concepts used. Although some of these characterizations, such as free economic zone and new town, majorly impacted the development, several others only left minor marks (H. R. Shin, Park, and Sonn 2015; Sonn and Park 2023; Sonn, Shin, and Park 2017).

Main songdo smart city development actors in each phase

Master plan phase

Cisco was not the first ICT firm involved in the Songdo development. After 2005, the developer NSIC aggressively promoted Songdo's smart city image. NSIC needed a partner specializing in ICT, but it was the policy of the South Korean government that compelled NSIC to limit its selection to domestic firms. At that time, the South Korean government was actively subsidizing Korean companies for the application of ICT in the built environment as part of its push for the "ubiquitous city," a concept that is a predecessor of the smart city (I. Kim 2007). NSIC chose LGCNS, and they jointly created Songdo U-Life LLC (U-Life, hereafter) to oversee the smart aspect of the development. Within NSIC, there was a shared understanding that U-City was a marketing concept and that U-Life was NSIC's marketing arm (Songdo U-Life n.d., 7).

LGCNS also oversaw the U-City master plan, with support from NSIC and POSCO. The ICT infrastructure plan is normally a part of the electric sub-plan, but the U-City master plan had a higher status as a separate sub-plan that would be implemented parallel to the general city plan. This elevation of the status of ICT

was impactful in marketing because it symbolized the emphasis on ICT infrastructure in Songdo. However, that was an administrative change, and only a limited number of corresponding changes were made to the actual construction. If the changes had been substantial, the U-City plan should have been completed before the general plan and would have then been revised to harmonize with the other sub-plans. However, the infrastructure sub-plan was completed in late 2005, several months after the completion of the master plan. None of the interviewees perceived any major disruption due to late completion of the U-City plan because the delay did not affect other works in Songdo's development (H. Lee 2006).

An example of a U-Life planned business was that a local Internet service provider (ISP) would monitor and send warning notifications in the event of fine dust, road freezing, and traffic congestion, among others, which could generate profit and provide free public crime and disaster monitoring. Other planned U-Life businesses included household automation, education, health, and transportation (Ahn 2008).

To include all these services in the U-City plan, LGCNS had to have numerous meetings with the builder, which resulted in frequent conflict. An overall difference in business culture is obvious, but the main source of conflict was, of course, the building costs. LGCNS used the U-City concept to justify its installation of expensive, cutting-edge facilities; the builder was interested in reducing costs because the developer was paying the builder a fixed fee. However, because the builder had poor knowledge of ICT infrastructure, LGCNS managed to lead the early planning phase (H. Lee 2006).

Implementation of the U-City plan and LGCNS

Installation of smart services was mostly abandoned because of the 2007 global financial crisis and the South Korean government's revival of its new apartment price cap. The latter was the direct cause because it rendered the businesses that had pledged to subsidize the smart city facilities and services unable to fulfill their promise, which meant that the developer had to charge the users directly; that is, the developer aimed to make the smart services a default property feature and add the cost to the apartment price. This could have worked because the extra cost was small relative to the apartment price, and buyers would not have minded paying it. However, the government's price cap policy made it impossible. The price cap meant that the apartment sale price was fixed, so any extra cost would reduce the developer's profit; therefore, the developer made the smart services options that were offered to home buyers at an additional cost.

Unfortunately, the majority of home buyers were unwilling to pay. A high-level NSIC manager whom we interviewed in December 2022 recalled a survey result indicating that less than 1% of potential buyers

of apartments would be willing to pay extra for smart services such as remote health care. Other types of users were not excited about smart city services either, as exemplified by teachers in international schools. Specifically, LGCNS intended to provide highly advanced facilities for international schools, but the teachers expressed a desire for basic services such as high-speed Internet and LCD monitors (Limited Liability Company 2005).

Ultimately, U-Life had to find a way to cover the costs of the smart services by creating its own profit-making business. They planned to identify a special-purpose company that would profit from holding a monopoly on internet service provision and IP phones within Songdo and use that profit to maintain the other ICT facilities and services. This plan was later found to be infeasible for legal reasons. Creating a local monopoly was illegal, as there were multiple companies competing in the national internet provision market at the time.

Ultimately, the developer canceled most of the smart services, and Songdo was only equipped with high-quality networks inside the buildings, a smart car parking system, and security services. This rendered Songdo not particularly smarter than other new developments in South Korea. However, LGCNS did not strongly oppose the developer's decisions. Of course, LGCNS on-site workers were disappointed that their years of hard work to bring the smart service plan to fruition had disappeared. The workers only subsequently learned that this was so because LGCNS management had been unwilling to cause trouble with the developer by pushing hard for smart services from the beginning for two reasons. First, LGCNS top management knew that the developer was unwilling to spend extra money on smart services, which meant that LGCNS would not make a considerable profit (interview with an LGCNS site manager, October 2022). Second, LGCNS top management also knew that the national government was losing interest in promoting U-City and would therefore be unwilling to offer financial support for U-City projects. Without government support, LGCNS and the other major ICT firms did not see a reason to continue with U-City businesses.

After the cancellation of nearly all smart services, Songdo became purely a real estate project. Even LG, the conglomerate to which LGCNS belongs, invested in Songdo as a real estate investment. Nevertheless, these missed opportunities for smart cities turned out to be blessings because in the following years, smartphone services developed rapidly, and many of the services that LGCNS and Songdo U-Life envisioned have become widely available through smartphones anywhere in the country. By 2012, 67.6% of Koreans owned a smartphone, giving Korea the world's highest smartphone ownership rate, according to some statistics (B. Kim 2013). If Songdo U-Life's planned services had actually been provided, they would have been competing in the local market against smartphone-based national service providers and would likely have lost that market without recovering the initial investment.

For NSIC, the real problem was not the absence of smart services but rather the lack of a marketing concept. As explained earlier, the U-City concept was a marketing tool for NSIC. Without it, NSIC desperately needed new marketing strategies (Gale International 2010). Cisco emerged onto the scene during that moment of desperation.

Cisco's arrival

Cisco has worked with LGCNS on various projects, including Songdo, as an LGCNS's subcontractor. However, in 2009, Cisco announced a Songdo investment plan and became a major actor independent of LGCNS (S. Kim 2009). Cisco wanted to become a shareholder in the Songdo development, with the intention of using it as a testbed for its smart connected city concept. Underlying this decision was Cisco's repeated failure to find a new market, which made the company desperate in capturing the emerging smart city market.

As a company that started as a network provider, Cisco's strength always lay in network installation, a strength that is useful for smart cities. Cisco wanted to install its teleconferencing system, Telepresence, in Songdo's residential areas. Doing so would have increased the cost of an already expensive development, but NSIC accepted Cisco's proposal because the Cisco brand would add prestige to Songdo and offer some continuity with the deceased U-City concept. Despite Cisco's small share in the development, Cisco and NSIC agreed to market Songdo through Cisco's brand (Cisco 2011).

Cisco bought a share of the development with a USD 30 million investment, installed Telepresence, and used Songdo as a demonstration to potential global buyers. However, Cisco failed to achieve largescale sales of Telepresence anywhere else. Ultimately, Cisco's most enduring standout mark in Songdo was building the Global Center of Excellence, which was merely a showroom for Cisco products.

Cisco's failure, however, did not mean the other actors' failure. From the outset, most actors held the opinion that Cisco's fancy marketing would not influence how Songdo was built, as all actors, including Cisco, knew that Cisco's main business would be installing Telepresence. Cisco considered providing paid services, but the local actors knew that such a plan was doomed from the beginning because tenants would not consider new smart city services indispensable, and national ISPs were already offering similar services at much lower prices. Subsequently, when mobile services diversified in 2010, Cisco's plan to charge a fee for smart services became even more unrealistic. Nonetheless, NSIC and Cisco did not hesitate to use the service plans in their marketing (Y. Lee 2011).

Can an ICT firm be the main actor of a smart city development?

This brief history of Songdo and ICT firms' involvement in the Songdo development suggests that ICT firms can only play a limited role. Although ICT firms have been extremely visible in connection with the ubiquitous city concept and later the smart city concept, they have by no means been the driving force of such developments. Rather, in the case study, the developer invited ICT firms onboard because their presence would be useful in marketing. Between LGCNS and Cisco, Cisco was more globally visible, but LGCNS took a much larger profit because they oversaw infrastructure installation, including internet cable wiring, in the early stage of the development.

Regarding whether this finding can be generalized, is it possible that the only reason ICT firms could not take the lead in Songdo was because of the smart city's novelty? If ICT firms accumulate sufficient experience over time, can they eventually claim the leading role? Evidence from Songdo persuades us otherwise, as ICT firms seem to have fundamental limitations.

Firstly, from a financial perspective, an ICT firm cannot be the main actor because the ICT portion of the total urban development budget is relatively small. In the case of Songdo, Cisco invested USD 30 million, which is less than 0.1% of the total development budget. One may imagine a scenario where an ICT firm mobilizes financing to cover a bigger portion of the budget than just the ICT portion, thereby dominating the project; however, we do not believe that such a scenario is realistic. Global ICT giants such as Cisco are certainly much bigger than most real estate developers, which means that their total financial capacity would also largely exceed that of developers. However, the difference is that real estate developers tend to invest in a few projects over the long term and multiply their capital through leveraging and by bringing in financial investors, whereas multinational ICT firms such as Cisco typically work on hundreds of projects, each of which has a relatively short lifespan compared to a major real estate development. As such, even an ICT giant like Cisco cannot mobilize sufficient capital to dominate a major greenfield smart city development––but developers can.

Another issue is time. ICT firms are accustomed to product sales rather than long-term project maintenance. Here, it is important to note that a company's usual business model heavily influences the way in which that company handles a new project. The CEO's mind-set, the corporate culture, the company's organizational character, and the way partnerships with other companies are established, among other factors, fit the company's typical business model. A project that diverges from that familiar business model is difficult to execute because every project element needs to be coordinated with all of the company's existing settings, which were designed according to the usual business model. Developing a greenfield smart city certainly would not fit an ICT firm's usual business model because such a development takes at least two decades, usually

longer. For this reason, Cisco's main intention with its investment in SIBD was to sell Telepresence, not lead the development or manage Songdo in the long term. That is also the reason we have concluded that other ICT firms would be unwilling to spend decades managing a greenfield smart city project.

The likelihood of a downturn in the property cycle before project completion worsens matters for ICT firms. No consensus has been reached about the property cycle's exact length, but researchers have agreed that there is always at least one downturn in two decades. Hence, when a development takes two decades or longer, dealing with downturns is regarded as a normal part of business, and real estate developers are prepared. However, ICT firms are unfamiliar with taking the risk of a huge initial investment that is locked into a project for many years, especially during the downturn part of the cycle.

However, for a smart city to be ready for future technological development after the development's initial completion, would it not be beneficial if an ICT firm, instead of a developer, was in charge of the development? We are not persuaded that this is so. The reason, once again, is time. ICT changes quickly, whereas urban development takes a considerable amount of time. Major projects such as Songdo normally take two decades or longer to be completed, and it is impossible to predict the trajectory of ICT development during that time. This unpredictability complicates city design based on planned services that require future ICT. When facing this challenge, whether an ICT firm is leading the project makes little difference.

We have established that ICT firms are unlikely to be the leading actors in the development phase of a smart city; however, the question of long-term management remains. One may assert that an ICT firm would have an advantage in long-term smart city maintenance because hardware and software must be continually updated to keep a smart city smart.

However, once installed, a smart system lasts, even after better and newer alternatives are developed. Unfortunately, keeping abreast of the latest technology by replacing existing hardware every time there is a new innovation does not make economic sense. That is why we contend that management by an ICT firm has no real advantage over that of a traditional real estate firm. What about smart cities that intend to stay on the cutting edge? Even if cities with the ambition to always be on the cutting edge are in the minority, could an ICT firm be a better manager of those cities than a traditional real estate developer? It is unlikely. Developing service concepts and inventing new equipment are difficult tasks that require large-scale investments. However, once a service has been showcased and the necessary facility specifications are known, latecomers can easily imitate the service. Moreover, a real estate developer is in a good position to make ICT firms compete for contracts, whereas the only survival strategy available to an ICT firm is to continue innovating and participating in smarter city building, which requires moving on quickly rather than committing to an older project.

For these reasons, we believe that there are fundamental limitations preventing ICT firms from becoming the real driving force of greenfield smart city development. Traditional actors (i.e. real estate developers), not ICT firms, are the main driving force. This means that the urban development knowledge stock that researchers of the city have accumulated over the last several decades remains useful for understanding smart cities.

Conclusion

In this paper, we have presented evidence that ICT firms' involvement in SIBD was primarily concerned with installing infrastructure. Hence, the ICT firm's role is comparable to that of other specialized service providers who are afforded only marginal control over the development's long-term vision and strategy. We have highlighted the fundamental limitations that ICT firms face in playing a leading role in smart city development.

Many of these limitations arise from information technology's short lifespan. However, this could change if technology's lifespan is extended, a plausible scenario given that innovation tends to slow down as a sector matures. Currently, the rapid development of smart city technologies means that their application carries the inherent risk of quickly becoming obsolete. This uncertainty is the key reason why mature technology is often favored, even in smart cities. Consequently, the built environment is often designed to be compatible with mature technology, making smart cities appear similar to other recently constructed cities. In the coming decades, if smart technologies mature and their lifespans are extended, ICT firms' business strategies could adapt more readily to the long-term nature of urban development. However, this raises the question of whether smart cities would still be considered smart. Typically, we do not give special names to cities equipped with longstanding infrastructure such as traffic lights, subway networks, and sewage systems. Over time, today's smart technologies may become core infrastructure and lose their label as unusual amenities, at least in advanced economies. Thus, ICT firms may diversify into urban development as easily as civil engineering firms have.

One cautionary note we would like to offer is that smart city development is not immune to the usual risks associated with real estate development. Smart city projects are funded through conventional financing and executed by regular real estate developers and can thus be suspended or subject to developer default, particularly during general real estate crises such as the 2008 global economic downturn or the current real estate crises in China and South Korea. Therefore, smart city initiatives should be no exception to the standard precautions governments are advised to take through planning and other regulations applicable to real estate projects.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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