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journal homepage: www.elsevier.com/locate/techforeAn exploration of smart city approaches by international ICT firms[☆]Daniel van den Buuse^a, Ans Kolk^{b,*}^a University of Amsterdam Business School, Amsterdam University of Applied Sciences, the Netherlands^b University of Amsterdam Business School, the Netherlands

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ABSTRACT

As part of the growing interest in cities to address persistent sustainability issues in society, ‘smart cities’ have increasingly become a ubiquitous phenomenon globally. For multinational enterprises (MNEs), this has provided opportunities to develop and market technological innovations to facilitate the creation of smart cities, given that the deployment of information and communication technology (ICT) is commonly considered to be a central tenet of smart cities. This paper explores the strategic approaches of three MNEs from the ICT industry (IBM, Cisco, and Accenture) as suppliers of ‘smart city technologies’, rooted in an international business perspective. Based on qualitative data collected from semi-structured interviews and documentation on firm activities related to smart cities, our study offers two contributions. First, the empirical analysis provides insight into how MNEs have developed resources and capabilities in the smart city realm from a multitude of smart city engagements globally, and shows how firm-specific strategies and programmes for smart cities (IBM Smarter Cities, Cisco Smart + Connected Communities, and Accenture Intelligent Cities) have facilitated this process. Second, it provides an actor-centric perspective on the (potential) role of business in the emergence and spread of technological innovations for urban development, helping to address the need for further insights into (smart) cities and stakeholder involvement in sustainability transitions.

1. Introduction

In addressing persistent environmental sustainability issues in society, the international diffusion of technologies which enable resource-intensive economic activities to become more efficient is a central factor (Herring, 2006; Herring and Sorrell, 2009). A substantial part of these activities is taking place in centres of urban agglomeration. According to UN (2016) figures, approximately 4 billion people (54% of the world's population) live in cities and metropolitan areas, with 1.7 billion people living in cities with at least 1 million inhabitants. Given that cities account for approximately 60% to 80% of energy consumption and carbon emissions (UNEP, 2011), and that further urbanization is expected to take place in the decades to come, mitigating environmental sustainability issues related to energy, mobility, and water and waste management in cities is a major challenge. City governments, particularly of capital cities and other large urban areas, have increasingly started to address issues related to environmental sustainability and greenhouse gas (GHG) emissions over the last decade (Bulkeley, 2010; Hodson and Marvin, 2009).

As part of the increasing attention to the geography of sustainability transitions (Bridge et al., 2013; Coenen et al., 2012; Hansen and Coenen, 2015; Smith et al., 2010; Truffer and Coenen, 2012), cities have recently received attention as geographic contexts to address sustainability issues (Bulkeley et al., 2010; Geels, 2011; Hodson and Marvin, 2010; Nevens et al., 2013; Nevens and Roorda, 2014; Simmons et al., 2018). This stream of research has highlighted the need to examine responses of different types of actors in transition processes towards more sustainable modes of production and consumption in society (Farla et al., 2012; Markard et al., 2012). However, while the importance of firms in this regard has been emphasized as well (e.g. Geels, 2014), specific studies on the strategic approaches of ‘firms-in-industries’ in this realm are lacking, which is where insights from the business literature and concomitant conceptualizations can add value. This study aims to provide such a contribution by examining strategies of multinational enterprises (MNEs) from the information and communication technology (ICT) industry in the emergence and spread of ‘smart city technologies’ for resource-efficiency in cities.

We embed our analysis in international business research, a field in

Abbreviations: FSA, firm-specific advantages; ICT, information and communication technology; MNEs, multinational enterprises

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which the geography of internationalization strategies is becoming a central theme within the debate on globalization versus localization of MNEs (Beugelsdijk and Mudambi, 2013; Rugman and Verbeke, 2004; Verbeke and Asmussen, 2016). However, as will be further explained below, the subnational level has been underexposed, although attention for especially the concept of so-called ‘global cities’ (cf. Sassen, 2000, 2005) has recently emerged for explaining the geographic dispersion of firm activities in host environments (Goerzen et al., 2013; Mehlsen and Wernicke, 2016). Conceptually, this paper thus seeks to bridge the gap between geography/regional studies and international business research, while it empirically contributes a missing sustainability dimension in studies on MNEs and cities, and adds an actor-oriented perspective to the sustainability transitions literature. More specifically, we focus on ‘smart’ cities which, as part of the growing interest in the potential of cities in addressing persistent sustainability issues, are increasingly becoming a ubiquitous phenomenon globally.

While a plethora of definitions and terminologies is used (Albino et al., 2015; Allwinkle and Cruickshank, 2011; Ahvenniemi et al., 2017; De Jong et al., 2015; Gil-Garcia et al., 2015; Höjer and Wang, 2015), a central tenet of ‘smart cities’ is the use of ICT to address one or more sustainability issues, improve the efficiency of urban services, and contribute to the economic competitiveness and liveability of cities (EU, 2014; Hollands, 2008; Townsend, 2014). For firms, particularly in the ICT industry, smart cities have emerged as strategic growth markets. ICT MNEs report investments in developing and marketing technologies which facilitate the creation of smart cities (Macomber, 2013), a market which is expected to grow from US\$400 billion at present to US\$1.5 trillion by 2020 (Deloitte, 2015). While firms in the ICT industry thus seem to be in a strong position to contribute to more sustainable modes of energy consumption in cities, as suppliers of smart city technology-based solutions, their strategic approach to smart cities has not been the subject of much research, with a few exceptions (Paroutis et al., 2014; Söderström et al., 2014). Based on an analysis of primary and secondary documents plus interviews, this paper explores the approaches to smart cities taken by three ICT MNEs (IBM, Cisco, and Accenture). Specifically, it focuses on how these firms have leveraged their international network of subsidiaries to build a strategic presence as smart city technology suppliers in a large number of cities globally.

The paper is structured as follows. The first part of the next section (Section 2.1) gives an overview of the body of literature on smart cities from interdisciplinary backgrounds, and identifies opportunities to further explore the role of firms in smart cities based on these existing studies. This is followed by a theoretical framework rooted in the international business literature in Section 2.2, which elaborates on the opportunities for MNEs to integrate and leverage resources and capabilities from embeddedness in multiple urban contexts in order to build their activities in the market for smart city technologies. Subsequently, section 3 gives an overview of the research methodology and selected empirical case studies, while section 4 explores how the ICT MNEs approach smart cities and to which degree they perceive smart cities to become growth markets. Section 5 reflects on the findings in relation to the literature and discusses the main contributions. Finally, section 6 identifies limitations and implications, considering the broader debate on firms as actors in transitions and opportunities for future research.

2. Theoretical background

2.1. Smart city technologies and sustainable urban development

Smart cities have emerged as an object of scientific enquiry in a number of academic disciplines, including urban studies, public governance, environmental studies, and computer science. Scholarly work in this field has been instrumental in defining the phenomenon of smart cities, by reviewing existing definitions and terminologies adopted in existing publications, and by taking stock of a smart city’s core

components including economic, political, technological, institutional, infrastructural, social, and governance factors. In addition to these characterizations of smart cities at a higher level of abstraction, publications that present empirical case studies on specific smart city initiatives and programmes have provided a more practical perspective on how smart city initiatives and projects unfold in a specific context.

From existing definitions and terminologies adopted to characterize the phenomenon of smart cities, it is evident that the smart city has remained a rather ambiguous concept to date. The lack of a clear-cut definition widely adopted in academic disciplines is also reflected in the terminology. Terms used for smart cities in different studies are largely used interchangeably, and include references to sustainable cities, green cities, low-carbon cities, eco-cities, intelligent cities, resilient cities, knowledge cities, and digital cities (Ahvenniemi et al., 2017; Albino et al., 2015; Allwinkle and Cruickshank, 2011; De Jong et al., 2015; Durán-Sánchez et al., 2017; Gil-Garcia et al., 2015; Höjer and Wang, 2015; Komninos and Mora, 2018; Mora et al., 2017; Mora et al., 2018; Meijer and Bolívar, 2016; Neirotti et al., 2014). A very generic distinction can be made between terminologies and definitions for ‘sustainable cities’ and ‘smart cities’: the former includes a broad set of definitions incorporating many dimensions related to urban sustainability issues and the overall liveability of cities, while the latter explicitly includes the widespread deployment of technological innovation as central in addressing urban sustainability issues (EU, 2014). Kramers et al. (2014, 53) state in this respect that “ICT can be used to achieve cities’ climate targets by lowering energy use and GHG emissions from other sectors”, thereby providing “great potential for supporting the transition to more sustainable cities”.

One of the most comprehensive definitions of smart cities is proposed by the International Telecommunication Union (2015), which is based on 120 definitions adopted by academics, international organizations, companies, and trade associations. Interestingly, it includes both smart and sustainable: “a smart and sustainable city is an innovative city that uses information and communications technologies and other means to improve living standards, efficiency of urban management and urban services and competitiveness while meeting the needs of current and future generations in the sectors of the economy, society and the environment” (International Telecommunication Union, 2015, 13). This definition reflects that the deployment of ICT-based solutions to address urban sustainability issues and enhance the quality of urban services is an integral part of smart cities, embedded in broader development goals related to economic, environmental, and social dimensions. Other academic studies propose similar characterizations of smart cities (Angelidou, 2015; Caragliu et al., 2011; Giffinger et al., 2007; Hollands, 2008; Komninos, 2011, 2014; Leydesdorff and Deakin, 2011; Lombardi et al., 2012; Schaffers et al., 2011; Stratigea et al., 2015), in which technological solutions are deployed in cities for sustainable development in fields such as energy, mobility, water and waste management, and other urban services.

Additionally, empirical case studies on specific smart city initiatives and programmes have provided more insight into how these initiatives and programmes unfold in real-life contexts. This work consists of single or multiple case studies of smart city initiatives, which mostly adopt an exploratory and interpretative approach, and focus on one or more local contexts. Research includes studies on smart city initiatives in specific European cities which have been particularly active in this field, such as Barcelona (Bakıcı et al., 2013; Grimaldi and Fernandez, 2017) and Helsinki (Hielkema and Hongisto, 2013), as well as comparative studies on smart city initiatives in multiple cities in Europe, North America, and Asia (Alawadhi et al., 2012; Lee et al., 2014; Ojo et al., 2015). A particular subset of these studies addresses newly-built smart cities that have been purposively developed to test and experiment with smart city technologies in a controlled setting. Attention is paid to key characteristics of high-profile newly-built smart cities, including New Songdo City in South Korea, Masdar City in Abu Dhabi, Sitra Low2No in Finland, and PlanIT Valley in Portugal (Alusi et al.,

2011; Amitrano et al., 2014). There are also publications that contain more in-depth, single case studies on specific initiatives, such as Cao-feidian International Eco-City in China (Joss and Molella, 2013). For most of these initiatives, MNEs are identified as part of the consortium of public and private partners, thus working in collaboration with city governments, albeit their role is not explicitly addressed in these studies.

Furthermore, scholarly work on ‘urban climate governance’ (Betsill and Bulkeley, 2006; Bulkeley et al., 2010; Bulkeley and Betsill, 2005), ‘urban climate change experiments’ (Broto and Bulkeley, 2013; Bulkeley and Broto, 2013), and ‘urban transitions labs’ (Nevens et al., 2013; Nevens and Roorda, 2014) have yielded insight into the responses of city governments to sustainable urban development. While this literature does not explicitly refer to ‘smart cities’, it emphasizes the importance of implementing technological innovations to address urban sustainability issues related to climate change. Bulkeley and Betsill (2005, 45) state in this respect that many city governments “have undertaken innovative measures and strategies to reduce their impact on climate change, which can act as demonstration projects or form the basis for new experimentation”, whereby “strategies to implement urban sustainability usually rest on the development of exemplary projects or ‘best practices’, from which lessons can be learned, and applied, within the urban arena or transferred between cities”. This reflects that city governments have actively started to address urban sustainability issues on a global scale (Bulkeley, 2010; Hodson and Marvin, 2009), which has created opportunities for firms to develop and market technological innovations to facilitate this process.

Two studies specifically address the role of firms as suppliers of technological innovations for smart cities, both in relation to IBM’s ‘Smarter Cities’ programme. Paroutis et al. (2014) examined how smart city technologies have provided IBM with a growth option in response to the economic recession of 2007–2008. The authors state that smart city technologies can provide ICT firms with a strategic growth option, and that IBM’s strategic approach to smart cities “utilizes IBM’s core competencies of solving complex problems and being a technical innovator”, whereby it “re-uses existing components and solutions where possible” (Paroutis et al., 2014, 269). In addition, Söderström et al. (2014) characterize IBM Smarter Cities as a form of ‘corporate storytelling’, in which IBM aims to position itself to city governments as an ‘obligatory passage point’ to address urban sustainability issues through ICT-based solutions. They give a rather critical view of IBM’s activities and mention that “the smarter city discourse is a framing device” which “is primarily a strategic tool for gaining a dominant position in a huge market” (Söderström et al., 2014, 315). However, both studies illustrate the potential growth market for ICT MNEs that supply technological solutions to make cities more sustainable and resource-efficient.

This paper aims to further explore how, and to which degree, ICT MNEs have the potential to position themselves as international smart city technology suppliers, by developing and exploiting resources and capabilities which are rooted in their smart city engagements in a large number of cities globally. This adds a novel actor-centric perspective on the role of the private sector in the creation of smart cities, and provides insight into the strategic approaches of ICT MNEs to the emergence and spread of smart city technologies in an international context. Section 2.2 will discuss how MNEs can integrate resources and capabilities from local contexts in which they are embedded through their network of subsidiaries, related specifically to the context of smart cities.

2.2. An international business perspective on firm strategies

The geography of firms’ strategies has emerged as a central theme in international business research, as part of the debate of the globalization versus localization of MNEs. While the influence of institutional coherence within the Triad regions (Rugman and Verbeke, 2004, 2005) and country-specific variations (Bartlett and Ghoshal, 1989; Prahalad and Doz, 1987) on the international strategies of MNEs has been well-

established, the subnational level has remained relatively unexplored to date. The subnational level is an important unit of expansion, given that firms strategically locate their activities in particular agglomerations rather than in arbitrary locations within host countries, driven by subnational spatial heterogeneity between locations (Beugelsdijk et al., 2010; Beugelsdijk and Mudambi, 2013).

Related to the international strategies of firms, the distinct characteristics of global cities have recently gained attention to explain their attractiveness for MNEs in their location strategies (Goerzen et al., 2013; Mehlsen and Wernicke, 2016). Goerzen et al. (2013) found that 77% of MNEs locate activities outside their home market in global cities, which the authors attribute to a combination of firm-level and subsidiary-level factors related to corporate strategy, investment motives, and proprietary resources and capabilities. The degree of liability of foreignness experienced by firms, which include cost incurred outside a firm’s home market arising from unfamiliarity with the host environment and coordination of activities across geographic distances (Zaheer, 1995), is an important factor in this respect. Global cities are characterized by three distinctive features, including a high degree of global interconnectedness, the prevalence of a cosmopolitan environment, and the widespread availability of advanced producer services (Sassen, 2000, 2005), making them deeply connected and interlinked with each other despite a lack of geographic proximity (Sassen, 2005). Mehlsen and Wernicke (2016) state that locating activities in global cities rather than in peripheral areas is associated with a lower liability of foreignness, as a result of these distinct characteristics. This offers the potential for substantially lower investment costs and/or greater efficiency in developing and exploiting firm-specific advantages (FSAs) between different locations in the MNE network (Rugman and Verbeke, 2007, 2008). FSAs can be characterized as a firm’s proprietary knowledge and capability to control, coordinate, and manage its assets over geographic distances (Rugman and Verbeke, 1992, 2003), and are closely interlinked with a firm’s resources and capabilities (Kolk and Pinkse, 2008), which include “all assets, capabilities, organizational processes, firm attributes, information, knowledge” (Barney, 1991, 101).

For the international spread of smart city technologies, this implies that an MNE’s presence in global cities can potentially facilitate the effective transfer of FSAs between different cities, which have been developed through a multitude of local smart city engagements. Meyer et al. (2011, 241) state that MNEs are well-positioned to access resources and capabilities from multiple local contexts in order to create competitive advantages, and state that the “diversity of local contexts enables the MNE to access knowledge from many different knowledge clusters and hotspots”. Similarly, Mudambi and Swift (2011, 186) emphasize that MNEs can potentially develop competitive advantages from their embeddedness in multiple local contexts, given that this “allows them to tap into many local systems of innovation to access diverse knowledge bases and integrate them”. Related to the market for smart city technologies, this implies that an MNE’s ability to leverage resources and capabilities beyond a specific context, and deploy them throughout the wider MNE network of subsidiaries, is an important prerequisite in building their position as international smart city technology supplier.

In this respect, Rugman and Verbeke (1992) make a distinction between location-bound and non-location-bound FSAs. On the one hand, location-bound FSAs are limited in their deployment to their domain of operation. Given that their value is constrained to the local context in which they are embedded, these FSAs cannot be transferred throughout the MNE network and be utilized in other host contexts. On the other hand, non-location-bound FSAs can be deployed beyond the specific domain in which they have been developed in the MNE network, to other local contexts in which the MNE is present through its network of subsidiaries, making them particularly valuable for MNEs (Rugman and Verbeke, 1992, 2003, 2007). In order for FSAs developed at the local level to be non-location-bound, several criteria need to be

met. Most importantly, local resources and capabilities need to be specialized, as well as valuable, rare, and imperfectly imitable from a resource-based perspective (Barney, 1991). If specialized resources and capabilities of subsidiaries are integrated with existing resources and capabilities embedded throughout the MNE network, they can become part of a firm's FSAs (Rugman and Verbeke, 1992). In addition, a subsidiary's specialized resources and capabilities need to be recognized by corporate management, and achieve legitimacy and acceptance in the wider MNE network, in order to be effectively utilized and leveraged to other localities (Rugman and Verbeke, 1992, 2003).

For non-location-bound FSAs, the degree of liability of foreignness experienced by firms is an important factor in their effective utilization throughout the wider MNE network. When the distance between home and host market in terms of regulatory, institutional, economic, and cultural dimensions increases, it limits the relevance of non-location-bound FSAs (Rugman and Verbeke, 1992, 2007). The preference for global cities in MNE location strategies for locating firm activities in host markets (Goerzen et al., 2013), implies that firms can transfer and deploy non-location-bound FSAs more effectively across national borders, given the reduced amount of liability of foreignness that is associated with locating firm activities in global cities (Mehlsen and Wernicke, 2016). This allows firms to deploy non-location-bound FSAs more efficiently throughout the MNE network, and in multiple cities at the same time. Yet, it remains important for firms to simultaneously develop location-bound FSAs in each local context in the MNE network. While these FSAs are limited to the context in which they are embedded, insights in local market conditions, customer needs and expectations, and government regulations are still important in each local situation (Rugman and Verbeke, 1992). To assess how MNEs can potentially develop non-location-bound FSAs from their activities in multiple urban contexts, a firm's ability to efficiently manage this interplay between location-bound and non-location-bound FSAs is a key factor.

In addition, the efficient transfer and integration of knowledge throughout the MNE's international network of subsidiaries facilitates firms in developing and exploiting non-location-bound FSAs. McCann and Mudambi (2004, 2005) identify that subsidiaries have two broad paths for sharing knowledge beyond local contexts: transferring the accessed knowledge to other subsidiaries and units throughout the MNE network, or integrating the accessed knowledge with existing knowledge bases. Both forms of intra-MNE knowledge sharing can potentially provide MNEs with the opportunity to build their resources and capabilities in any particular market or industry. Mudambi (2002) states that such flows of knowledge from subsidiary to parent form the basis for an MNE's network leverage, and enables MNEs to exploit local resources and capabilities by acting as an intermediary, integrator, and facilitator of intra-MNE knowledge sharing. In order for knowledge sharing to happen between subsidiaries in the MNE network, it is important to have organizational procedures in place. Persson (2006) mentions in this regard that an operational structure which facilitates intra-MNE knowledge sharing, as well as the presence of incentives to share knowledge, positively influence outbound knowledge transfer from subsidiaries to the broader MNE network. Hence, the transfer and integration of knowledge from multiple urban contexts can potentially enable ICT MNEs in developing non-location-bound FSAs as international smart city technology suppliers.

To explore the strategic approaches of ICT MNEs to the emergence and spread of smart city technologies, this study focuses on whether and how firms can leverage resources and capabilities which are developed through their smart city engagements in multiple cities. Specifically, it examines how these firms use local contexts to build FSAs related to smart cities, and assesses how locally developed resources and capabilities are transferred throughout the MNE network, facilitated by a lower amount of liability of foreignness experienced from locating firm activities in global cities (Goerzen et al., 2013; Mehlsen and Wernicke, 2016). Section 3 elaborates on the methodology, and introduces the focal firms in the sample.

3. Materials and method

This study adopts a multiple case study design, and focuses on the strategic approaches of three MNEs from the ICT industry (IBM, Cisco, and Accenture), which have established leading positions as global smart city suppliers (Navigant, 2013, 2014). These firms were selected based on the initiatives that they have developed for their smart city technologies (IBM Smarter Cities, Cisco Smart + Connected Communities, and Accenture Intelligent Cities), and their international presence in prime cities for the spread of smart city solutions. The Globalization and World Cities (GaWC) inventory (Beaverstock et al., 1999; Beaverstock et al., 2000) was used to establish insight into the city-level presence of each MNE, given that firm reporting on key figures (revenues, assets, employees) is not available at this specific level. The GaWC inventory provides a relevant roster to account for firm presence at the subnational level, as it categorizes cities in terms of their centrality in economic globalization (Beaverstock et al., 1999; Beaverstock et al., 2000; Derudder et al., 2003; Derudder and Witlox, 2004; Taylor et al., 2014). Table 1 shows the firms' presence in cities for the three globalization arenas in the GaWC (North America, Western Europe, and Asia-Pacific), which are considered to be prime cities for the spread of smart city technologies, based on their inclusion in three comparative rankings related to smart cities. They cover the 20 highest ranking cities in the Sustainable Cities Index for 2015 (Arcadis, 2015); the 20 highest ranking cities in Innovation Cities Index for 2014 (2thinknow, 2014); and the highest ranking cities in the Siemens Green City ranking for 2012 (Economist, 2009, 2011, 2012), including the European (10 highest ranking cities), North American (10 highest ranking cities), and Asia-Pacific ('above average' ranking cities) indices.

An exploratory analysis was conducted for each firm, based on data from documentation and semi-structured interviews. Firm-specific documentation came from annual reports, CSR and sustainability reports, and industry-specific publications on smart city technologies. All available documentation from web-based sources on the programmes of these MNEs for smart cities was collected and scrutinized. For IBM, the publications which were selected include: 'A vision for smarter cities' (IBM, 2009); 'Smarter city solutions: leadership and innovation for building smarter cities' (IBM, 2011a); 'Actionable business architecture for smarter cities' (IBM, 2011b); 'A foundation for understanding IBM smarter cities' (IBM, 2011c); 'Intelligent operations center for smarter cities' (IBM, 2012); and 'Smarter cities: creating opportunities through leadership and innovation' (IBM, 2014). For Cisco, they consist of 'Connecting cities: achieving sustainability through innovation' (Cisco, 2010); 'Smart + Connected city services' (Cisco, 2011); 'Smart city framework: a systematic process for enabling Smart + Connected Communities' (Cisco, 2012); 'Smart cities and the Internet-of-Everything' (Cisco, 2013a); 'The Internet-of-Everything for cities' (Cisco, 2013b); and 'Smart + Connected Communities: envisioning the future of cities now' (Cisco, 2014). For Accenture, the analysis is based on 'Building and managing an intelligent city' (Accenture, 2011); 'Intelligent urban infrastructure' (Accenture, 2012); 'Accenture sustainability services' (Accenture, 2013); 'Open energy data: a prerequisite for cities to become low-carbon' (Accenture, 2015); and 'Capabilities for tomorrow's digital city hall' (Accenture, 2017). Key statements from these publications for each MNE and their activities in smart city technologies are summarized in Appendix A. To complement firm-specific documentation, publications of leading consultancy and accountancy firms with expert industry knowledge were also collected and analysed, including reports by Navigant, Frost & Sullivan, McKinsey, KPMG, PWC, Arup, and Deloitte. This helped to gain a broader perspective on the economic, technological, environmental, and social aspects of smart cities. A list of this 'grey literature' is provided in Appendix B.

In addition, semi-structured interviews were conducted with representatives of all firms in the sample who have expert knowledge of firm-specific activities in smart city technologies and addressing urban

Table 1
Firm presence in selected cities part of the GaWC inventory.

Geographic location	Included in comparative ranking	IBM	Cisco	Accenture
Arena 1: Western Europe				
Amsterdam, Netherlands	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Berlin, Germany	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Brussels, Belgium	Sustainable Cities; Green Cities	X	X	X
Copenhagen, Denmark	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Frankfurt, Germany	Sustainable Cities	X	X	X
Hamburg, Germany	Innovation Cities	X	X	X
Helsinki, Finland	Green Cities	X	X	X
London, United Kingdom	Sustainable Cities; Innovation Cities	X	X	X
Madrid, Spain	Sustainable Cities	X	X	X
Munich, Germany	Innovation Cities	X	X	X
Oslo, Norway	Green Cities	X	X	X
Paris, France	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Stockholm, Sweden	Innovation Cities; Green Cities	X	X	X
Vienna, Austria	Innovation Cities; Green Cities	X	X	X
Zurich, Swiss	Green Cities	X	X	X
Arena 2: North America				
Boston, United States	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Chicago, United States	Sustainable Cities	X	X	X
Denver, United States	Green Cities	X	X	X
Los Angeles, United States	Innovation Cities; Green Cities	X	X	X
Minneapolis, United States	Green Cities	X	X	X
New York, United States	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
San Francisco, United States	Innovation Cities; Green Cities	X	X	X
Seattle, United States	Innovation Cities; Green Cities	X	X	X
Toronto, Canada	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Vancouver, Canada	Green Cities	X	X	X
Washington D.C., United States	Green Cities	X	X	X
Arena 3: Asia-Pacific				
Hong Kong, China	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Melbourne, Australia	Sustainable Cities	X	X	X
Seoul, South Korea	Sustainable Cities; Innovation Cities; Green Cities	X	X	X
Singapore, Singapore	Sustainable Cities; Green Cities	X	X	X
Sydney, Australia	Sustainable Cities; Innovation Cities	X	X	X
Taipei, Taiwan	Green Cities	X	X	X
Tokyo, Japan	Innovation Cities; Green Cities	X	X	X

Note: This table refers to overall firm presence in each city based on available information on the office locations of each firm. Firm presence in a particular city was assessed based on available information from corporate websites, annual reports, and other available online sources.

energy efficiency issues through technology-enabled solutions. In addition to these interviews with the focal firms, interviews with Amsterdam-based representatives of other public and private stakeholders in smart cities were held, to gain insight into the specificities of this market as illustrative example, and the nature of the resources and capabilities that MNEs can potentially access in relation to smart cities. They included interviews with firms from other industries, members of the Amsterdam Smart City strategic team, and representatives of the City of Amsterdam with expert knowledge on smart cities on urban energy consumption. A total of 15 interviews was held, with each interview lasting between 45 and 120 min. Combined with the data collected from documentation, a narrative account on the strategic approach of each ICT MNE to the international emergence and spread of smart cities was constructed. An overview of interviews can be found in [Appendix C](#).

4. Presentation of findings for the ICT firms

4.1. IBM

IBM Smarter Cities has been IBM's main programme for its smart city technologies and city-oriented consultancy services since 2009, and focuses on the deployment of ICT-based innovations in cities to address a broad range of urban sustainability challenges. It is part of the broader IBM Smarter Planet strategy, which was launched in 2008 as IBM's novel corporate strategy, aimed to develop intelligent and interconnected systems and infrastructures for different actors (firms, governments, city authorities) and sectors (energy, transportation,

banking, healthcare, education). Big data and analytics, cloud computing, and 'cognitive technology' (e.g. artificial intelligence, machine learning) have been central drivers in the firm's strategic reorientation in recent years, whereby [IBM \(2015, 22\)](#) states that it is "transforming into a cognitive solutions and cloud platform company". In the firm's approach to smart cities, it emphasizes the importance of developing a holistic approach to managing a city's core systems, which is in line with this strategic reorientation. [IBM \(2009, 1–2\)](#) identifies in this respect that "cities are based on six core systems composed of different networks, infrastructures and environments related to their key functions: people, business, transport, communication, water and energy", which together form a "system of systems" that should be addressed in an integral way.

An important part of IBM's activities in smart cities comes from consulting activities coupled with city management technologies, such as IBM's 'Actionable Business Architecture for Smarter Cities' and 'Smarter City Assessment Tool'. These smart city technologies build on efficient management of core elements of urban systems, and enable [IBM \(2011b, 4\)](#) in "defining a city through 185 business components and identifying transformation initiatives". Through these city management technologies, platforms, and applications, as well as city-centric consultancy services to city governments, IBM's positions itself as a long-term partner for cities. This includes defining a city's strategy strategic approach to addressing sustainability issues in multiple urban systems related to city-specific goals and aspirations, improving a city's performance and identifying performance indicators in line with this approach, and the deployment of ICT-based technological solutions ([IBM, 2011a](#)). These components are reflected in the IBM's Smarter City

Challenge as part of the Smarter Cities programme, which provides pro bono consultancy services and technological solutions to selected cities globally, to address a specific urban sustainability issue related to energy efficiency, urban mobility, water and waste management, and digitalization of urban services. IBM (2017) states that it has deployed 800 IBM employees to 130 cities globally for the Smarter Cities Challenge since 2008, with consulting activities worth US\$500.000 per city, with a total value of approximately US\$65 million since the start of the programme.¹

Strategically, the IBM Smarter Cities programme and Smarter Cities Challenge have been important for the international spread of smart city technologies in three distinct ways. First, it has been instrumental in developing in-depth knowledge of urban sustainability issues in different cities globally, and provided opportunities for organizational learning on addressing these issues through smart city technology deployment in heterogeneous contexts. Second, it has enabled IBM to build relationships with city governments, which fits the broader positioning of the firm in their smart city technologies as a strategic partner for city governments, in addition to being a smart city technology supplier. And third, the Smarter Cities programme has enabled IBM to position itself as a leading firm for ICT-based solutions in urban development, which could potentially be a strategic growth market for the firm.

While the total value of pro bono consulting activities as part of the Smarter Cities Challenge is relatively small in comparison to IBM's annual revenues during the 2008–2017 time period, it does provide opportunities to build expert knowledge on addressing urban sustainability issues and optimizing urban services with ICT-based solutions. Also, it facilitates the development of a portfolio of exemplary projects and best practices in the smart city realm. The IBM interviewee referred to the fact that the firm has developed expert knowledge in building complex systems and infrastructures for large public and private clients over decades, and thus has expert knowledge on integrating and optimizing processes within complex systems and infrastructures. In addition, the firm's recent strategic reorientation towards big data and analytics, cloud computing, and cognitive technology (IBM, 2015) can also be applied in the urban management domain. In this respect, IBM's smart city activities leverage existing resources and capabilities, and are complementary to this novel strategic direction. This underscores that the IBM Smarter Cities programme can be characterized as a 'framing device' to develop a strategic presence in this market (Söderström et al., 2014), which utilizes the firm's existing resources and capabilities in building and managing complex ICT systems and infrastructures (Paroutis et al., 2014).

In developing FSAs in the market for smart city technologies from embeddedness in multiple local contexts, these smart city engagements have enabled IBM to build non-location-bound FSAs which can be leveraged throughout the MNE network. The firm states that "IBM Smarter Cities solutions capitalize on insights gained through thousands of client implementations worldwide" (IBM, 2014, 4), which has allowed the development of global best practices in the deployment of smart city technologies based on common models, such as IBM's 'Actionable Business Architecture for Smarter Cities' model and its 'Smarter City Assessment Tool'. Smart city activities in heterogeneous local contexts are therefore claimed to have allowed IBM to develop "repeatable best practices that can be applied to cities of all sizes" (IBM, 2011b, 4), thus creating opportunities to achieve economies-of-scale from replication through the wider MNE network. In this vein, the firm's technological solutions for smart cities draw on communalities

between each urban system. The interview with IBM confirmed that presence in prime cities for the spread of smart city technologies is important as that provides insight into prevalent sustainability issues at the local level, and gives opportunities for developing resources and capabilities in managing urban systems and infrastructures. In view of the heterogeneity of each urban environment, such knowledge of local systems creates location-bound FSAs. Yet, the firm's ability to build location-bound FSAs through its embeddedness in a particular city, in combination with non-location-bound FSAs developed from smart city engagement throughout the MNE network, has contributed to the firm's ability to position itself as a leading international smart city technology supplier (Navigant, 2013, 2014).

Intra-MNE knowledge transfer is instrumental in the wider dissemination of non-location-bound FSA throughout the MNE network, and occurs in multiple ways. The first entails interdisciplinary collaboration between employees on a project basis. The IBM Smarter Cities Challenge sends an interdisciplinary project team to address a specific urban sustainability issue in a selected city, which is assembled from employees with different functional backgrounds, working in diverse geographic locations. This IBM team provides consulting services to a specific city governments, and identifies opportunities to address issues through the application of ICT-based solutions. As these temporary teams consist of employees from different locations and backgrounds, this facilitates post-project knowledge transfer throughout different subsidiaries in the MNE network, and allows IBM to create and integrate knowledge from these multiple city-specific activities in smart cities. Second, the interview with IBM identified several other forms of knowledge sharing which occur in relation to their smart city activities between locations, which includes sharing knowledge via internal information systems, video conferencing, and other forms of online and offline communication. Thus, the lack of geographic proximity between locations is not considered to be a barrier for intra-MNE knowledge sharing between subsidiaries.

4.2. Cisco

In Cisco's strategic approach to smart cities, the firm emphasizes that ICT-based solutions should improve urban infrastructure and create scalable systems for urban management which contribute to economic growth and environmental sustainability (Cisco, 2011). The Smart + Connected Communities programme is Cisco's leading programme for smart city activities, which has been developed based on earlier experiences with city-centric consulting activities in Cisco's Connected Urban Development programme, a joint collaboration with city governments in seven pilot cities (San Francisco, Amsterdam, Seoul, Birmingham, Hamburg, Lisbon, and Madrid) established in 2006. Underlying Cisco's activities related to smart cities is the assumption that energy-efficient ICT-based solutions can contribute to a reduction of energy consumption and GHG emissions in cities. Cisco (2010, 7) states that "building partnerships with these and many other cities in the Smart + Connected Communities programme to promote innovative practices using ICT to develop economic, environmental, and social sustainability". Both programmes have been initially developed as corporate social responsibility programmes to develop proof-of-concept projects in specific cities, and demonstrate how ICT-based solutions can help cities to address urban sustainability issues. These proof-of-concept projects have demonstrated "how to reduce carbon emissions by introducing fundamental improvements in the efficiency of urban infrastructures" (Cisco, 2012, 3), and contributed to the firm's ability to build specialized knowledge in this market.

In relation to smart cities, Cisco can build on existing resources and capabilities which are rooted in the development and marketing of ICT-based solutions for a wide range of industries (manufacturing, energy, transformation, banking, healthcare, education), which include building network architectures, performing data analytics, and creating Internet-of-Everything (IoE) and cloud-based solutions (Cisco, 2013a,

¹ For an overview of the approximately 130 cities which have been selected for the IBM Smarter Cities Challenge since 2008, see: <https://www.smartercitieschallenge.org/>. Amsterdam was selected for the IBM Smarter Cities Challenge in 2015, see: <https://www.smartercitieschallenge.org/cities/amsterdam-netherlands>.

2013b). The firm characterizes cities as complex systems that face fundamental sustainability issues, which can be “mitigated through the adoption of scalable solutions that take advantage of ICT” (Cisco, 2012, 2). Our interview with a smart city expert for Cisco’s European markets revealed that smart city technologies are not a stand-alone market for Cisco, but rather a domain in which ICT-based solutions are integrated to optimize the efficiency of urban systems. The Smart + Connected Communities programme bundles the firm’s portfolio of platforms, products, and services, to provide city governments with “vertical solutions built on the network as an open, integrated platform” (Cisco, 2010, 2). The interviewee characterized the firm’s strategy in smart cities as emergent rather than planned, given that it builds on insights and knowledge developed from local smart city engagements, in which the firm collaborates with city governments and other public and private partners (e.g. facilitated by collaborations within the Connected Urban Development and Smart + Connected Communities programme). Intra-MNE knowledge sharing between teams and technical experts in different locations occurs through information systems, webinars, and other forms of communication. This allows for the exchange of knowledge between subsidiaries in the MNE network, and provides the potential to leverage non-location-bound FSAs beyond a specific urban context.

Responsiveness to city-specific sustainability demands and requirements is particularly important in consultancy services. Cisco (2012, 3) asserts to build open data platforms for city governments, based on standardized platforms such as the ‘Smart + Connected Operations Center’, to “enable cities to establish a standard catalog system for recording, measuring, and collating city data, and for making it easily accessible for efficient, effective implementation and management of smart city solutions”. For individual cities, the specificities of such a system can vary, depending on local circumstances. Cisco’s smart city solutions thus combine proprietary ICT platforms and products based on best practices developed from multiple smart city engagements, with consultancy services that take city-specific characteristics into account in. This provides cities with “real-time, context-specific information intelligence and analytics to address specific local imperatives” (Cisco, 2013b, 1), and forms the basis for the firm’s positioning as a strategic partner for city governments (Cisco, 2010).

The firm’s aspiration to build long-term collaborations with city governments is consistently emphasized in the firm’s strategic approach to smart cities. Cisco (2013b, 19) states that “in order to realize the full potential of Smart + Connected Communities in the era of the Internet-of-Everything, a strong public-private partnership approach is necessary”. An illustrative example in this respect in one specific context of the GaWC inventory (Amsterdam, the Netherlands) is Cisco’s participation in the ‘Smart Light’ pilot project, developed as part of the Amsterdam Smart City network, in collaboration with Amsterdam’s city government and a consortium of other partners (Philips, KPN, and Alliander). The aim of this pilot project was to develop and test a ‘smart’ and energy-efficient public lighting system, with Wi-Fi and motion sensors integrated into the design, which could be managed based on real-time data on traffic and pedestrian flows.² Our interviews highlighted that this provided Cisco with an opportunity to build knowledge on this specific type of solution, as part of its broader portfolio of IoE solutions for cities, whereby the strategic aim was to develop a solution for public lighting that could be applied in other cities in the firm’s network as well. While the impact of this solution on urban energy consumption has remained rather limited to date, given that it has not been scaled up beyond the pilot project, it does illustrate how Cisco has the potential to access knowledge from local smart city engagements.

² A more extensive description and analysis of the Smart Light pilot project is available in the report ‘Organizing smart city projects: lessons from Amsterdam’, see: <https://amsterdamsmartcity.com/posts/organizing-smart-city-projects-lessons-learned-fr>.

4.3. Accenture

Accenture’s activities in the field of smart cities are embedded in the firm’s broader portfolio of sustainability-oriented services for public and private clients (Accenture, 2013), and primary build on the concept of ‘Intelligent Cities’. A key characteristic of the firm’s approach is the adoption of innovative ICT-based solutions by city governments to deliver urban services, which combines a “coherent and specific vision along with the right kind of technology platform to enable the optimal integration, delivery and management of city services over time” (Accenture, 2011, 10). The firm identifies several economic, technological, infrastructural, and regulatory factors which facilitate the development of ‘Intelligent Cities’, in line with this strategic approach. First, cities need a technological foundation able to embed intelligence in city operations, and provide city governments with an open, interoperable platform that facilitates the optimization of resource management in multiple domains. This urban management platform forms the basis for the deployment of smart city technologies to addressing urban sustainability issues. Accenture (2011, 14) notes that “innovations such as machine-to-machine communications, sensors, intelligent software and analytics, enable a range of critical capabilities such as improved efficiency of electricity, water and gas usage”. Accenture’s ‘Intelligent Infrastructure Platform’ can provide this such a foundation for cities, which the firm operates for city governments in an ‘Infrastructure as a Service’ mode (Accenture, 2012). Second, cities need strategic planning to develop a city-specific vision for urban development, which incorporates social, economic, cultural and resource-related components. This strategic vision should take context-specific variables of each individual city into account and be related to its prevalent urban sustainability issues. Third, Accenture identifies that cities should build efficient management and governance mechanisms in line with this strategic vision. They include regulatory and policy frameworks, financial incentives aligned with sustainable development goals, and new forms of partnerships between public and private stakeholders (Accenture, 2011).

Underlying Accenture’s sustainability-oriented consulting services are the firm’s existing resources and capabilities in strategy consulting and outsourcing services for corporate clients, governments, and international organizations, as well as expert knowledge in data analytics and the implementation, integration, and management of ICT-based solutions (Accenture, 2013). The concept of ‘Intelligent Cities’ is adopted to bundle the firm’s sustainability-oriented consultancy activities and technological solutions for efficient management of urban services, which are embedded in different departments and business units. Hence, it is not a stand-alone business unit, but a label to aggregate the firm’s activities related to sustainable urban development, which are distributed throughout the organization. Accenture positions itself as a strategic partner for city governments in the development strategic and long-term solutions for urban management, based on developing an intelligent urban infrastructure rather than implementing individual technology solutions. It states that “interdependent services can only be optimized if operators and planners in city administrations, transport services, public and private companies, have a holistic view of their operations and the environment in which they are embedded” (Accenture, 2012, 3). Thus, combining a city-specific vision for urban development with a technology platform that enables city governments to manage urban services in an efficient and integrative way (i.e. an intelligent infrastructure), is central in the firm’s concept of ‘Intelligent Cities’. In this regard, Accenture (2011, 4) mentions that the ‘Intelligent Cities’ concept is “garnered from our experience working with projects and programmes in this space around the world”, which reflects that their sustainability-oriented consultancy services to city governments build on knowledge which is developed across a multitude of urban contexts. In addition, the firm notes in relation to the ‘High Performing City Operating Model’, which is also part of its smart city offerings, that it “builds upon the experience gained

from working with more than 80 global cities”, and was “peer-reviewed by leading smart cities such as Amsterdam and Paris” (Accenture, 2017, 3).

Interviews with smart experts at Accenture, Amsterdam's city government, and the Amsterdam Smart City network provided a particularly illustrative example of how MNEs have the potential to develop non-location-bound FSAs from local smart city engagements. As part of the EU-funded TRANSFORM project, Accenture developed an open data platform which visualizes energy flows in Amsterdam in a highly detailed way (the ‘Energy Atlas’), in collaboration with the city government, utilities, and other data holders (Accenture, 2015; Van Warmerdam and Brinkman, 2015). Complementary to this open data platform, a decision support environment for urban management was developed, to enable the city government to simulate interventions in the energy system, supported by the deployment of smart city technologies, in order to lower urban energy consumption (Van Winden and Van den Buuse, 2017). The potential for building FSAs as an international supplier of smart city technologies are both location-bound and non-location-bound in this example. Context-specific factors of the urban context in which this solution was developed, such as the characteristics of the local urban infrastructure, the energy system, access to data from local stakeholders, and relationship-building with the city government, provide the potential to develop location-bound FSAs within this specific context. These are difficult to integrate and leverage throughout the MNE network, due to their level of specificity and subnational spatial heterogeneity in urban contexts. However, the knowledge which is created in the development and realization of this smart city solution in Amsterdam can be leveraged beyond this specific context as well. The open data platform for managing urban energy flows (i.e. the technological solution itself), as well as insight into the organizational process of accessing data in a standardized format from multiple data holders, can be transferred beyond this specific urban context. It can be integrated with FSAs in firm's sustainability-oriented consulting activities and outsourcing services in other localities, and thus be leveraged through the global MNE network to offer similar smart city solutions to other city governments. Our interviewees underlined that Accenture is exploring opportunities to develop similar solutions in other cities, based on the knowledge developed from their activities in Amsterdam.

5. Discussion and conclusions

In the internationalization strategies of firms, locating activities in centres of economic agglomeration rather than in peripheral areas is associated with a lower degree of liability of foreignness (Mehlsen and Wernicke, 2016), leading to the propensity of firms to focus on global cities (Goerzen et al., 2013). The lower degree of liability of foreignness enables firms in leveraging FSAs which have been developed in different urban contexts efficiently throughout the MNE network (Rugman and Verbeke, 2007). Given the global presence of all firms in the sample in prime cities for the spread of smart city technologies, as reflected in Table 1 based on the GaWC Inventory (Beaverstock et al., 1999, 2000), this creates the potential for ICT MNEs to build and sustain a position as international smart city technology suppliers. Section 4 reflected that the firms in the sample seem to be able to tap into resources and capabilities from smart city engagements in a large number of urban contexts, through their network of subsidiaries. Illustrative in this respect is that IBM (2011a) states that its design model for smart city solutions is based on insights from ‘over 2000 smart city engagements worldwide’. Firm-specific programmes, including IBM's Smarter Cities, Cisco's Smart + Connected Communities, and Accenture's Intelligent Cities, have facilitated this process, and have provided a basis for

building specialized knowledge in technological solutions for urban management. Related to exploring different types of actors in transitions towards more sustainable modes of energy consumption (Farla et al., 2012; Markard et al., 2012), this provides insight into the strategic approaches of ICT MNEs in addressing energy efficiency in cities, as suppliers of smart city technologies.

Section 4 highlighted how both non-location-bound FSAs (which can be exploited globally, potentially leading to benefits of scale or scope) and location-bound FSAs (which benefit the firm in a specific location) are important in the strategic approaches of IBM, Cisco, and Accenture to smart cities. On the one hand, the deployment of non-location-bound FSA throughout the MNE network draws on firm-specific smart city engagements in a wide range of cities. This locally developed knowledge can be accessed by other subsidiaries and business units in the MNE network (McCann and Mudambi, 2005), and thus be applied to develop and market solutions to urban sustainability challenges in other localities. Mechanisms for intra-MNE knowledge transfer, which facilitate the inflow and outflow of knowledge between subsidiaries in different local contexts in the MNE's network (Mudambi, 2002), are an important factor. Interviews with all focal firms confirmed that formal mechanisms for knowledge sharing between locations are in place, which allows subsidiaries in the MNE network to transfer explicit knowledge and leverage capabilities beyond the local context. This includes knowledge sharing through information systems, virtual meetings, and conference calls between locations (which occurred in all firms), as well as more integrative forms of project-based collaboration between employees from different locations. A noteworthy example here is IBM's Smarter City Challenge, for which IBM has deployed hundreds of employees in major cities globally since its commencement in 2008. Teams consist of employees with interdisciplinary backgrounds from different office locations, and are commissioned to work collaboratively on a specific sustainability issue in a city for multiple weeks. The interview with IBM reflected that this facilitates post-project knowledge dissemination throughout locations in the MNE network, and may allow MNEs to leverage FSAs throughout different locations, which can potentially lead to the development of non-location-bound FSAs in this market.

On the other hand, several location-bound FSAs remain important for responsiveness to local sustainability requirements, despite being limited in their deployment to the geographic context in which they are embedded. For smart city technologies in particular, pre-existing collaborations, partnerships, or contractual arrangements between MNEs and city governments within a specific urban environment are important. As section 4 showed, all three ICT MNEs in the sample aim to position themselves as a strategic partner for city governments, and advocate the development of a holistic and long-term smart city vision, which moves beyond technological fixes for isolated sustainability issues. Cisco (2010) claims in this respect that their strategic aim is to build partnerships with cities as part of its Smart + Connected Communities programme, which promotes innovative practices using ICT to develop economic, environmental, and social sustainability. Similarly, IBM (2011a, 2011b) refers to the extensive knowledge and experience in collaborating with city governments, positioning itself as a strategic partner for technology-driven innovation and urban management. Given that city governments are the primary customers for urban management solutions based on smart city technologies, existing relationships are important location-bound FSAs for these firms.

However, the interviews with public actors in Amsterdam highlighted that while these firms play active roles in several smart city pilot projects, the scope of their activities has remained relatively small and experimental to date. The involvement of these firms in Amsterdam Smart City projects, as discussed for two energy efficiency projects in

Table 2
Assessment of strategic approaches of smart city technology suppliers.

	IBM	Cisco	Accenture
Smart city strategy or programme	IBM Smarter Planet; Smarter Cities	Cisco Smart + Connected Communities; Connected Urban Development	Accenture Intelligent Cities
Urban management platforms	'Actionable Business Architectures for Smarter Cities'; 'IBM Intelligent Operations Center'	'Cisco Smart + Connected Operations Center'; 'Cisco Kinetic for Cities'	'Accenture Intelligent Infrastructure Platform'; 'Accenture High Performing City Operating Model'
Main foci	Complex systems and digital infrastructures; Big data and analytics; Optimization/automation of digital services; Hardware and software orientation	Connectivity and Internet-of-Everything solutions; Network and cloud solutions; Optimization and automation of digital services; Hardware and software orientation	Strategy consulting; Outsourcing services; Optimization and automation of digital services; Software orientation
Partner in Amsterdam Smart City network	Yes	Yes	Yes
Creation of potential non-location-bound FSAs			
Building resources and capabilities in management from heterogeneous urban contexts	X	X	X
Building a position as international smart city technology supplier in a potential growth market	X	X	
Building a portfolio of exemplary projects and best practices in smart city solutions	X	X	X
Building expert knowledge of persistent sustainability issues in cities	X	X	X
Exploiting complementarities between existing resources and capabilities in ICT and urban domains	X	X	
Optimizing proprietary solutions (products and services) from multitude of smart city engagements	X	X	X
Creation of potential location-bound FSAs			
Building relationships with city governments in prime cities for the spread of smart city technologies	X	X	X
Building expert knowledge of specific urban system and infrastructures in a local context	X	X	X
Gaining access to local knowledge clusters and urban stakeholders in a local context	X	X	X

Note: Assessment in the table was based on interviews as well as firm-specific documentation, as outlined in the method section.

Section 4 (i.e. Cisco in the 'Smart Light' project and Accenture in the 'Energy Atlas' project), are illustrative in this regard. Both examples showed that these pilot projects can provide opportunities for firms to build knowledge in developing and deploying smart city solutions, as part of their broader international portfolio of smart city engagements. At the same time, it reflected that the broader environmental and social impact from these projects on sustainable urban development has remained rather limited to date, given that the process of scaling up these solutions beyond a pilot project proved to be challenging. It should also be noted that the ambition to be 'a (key) strategic partner' will be rather difficult for all three firms concurrently in the same city, so a certain level of competition can be expected, especially when the stakes become higher than they currently are. Moreover, if the amounts involved in smart city projects increase considerably, there will be a requirement for public tenders in quite some countries, at least in Europe, so obtaining a privileged position may not be that easy.

The analysis of the strategic responses of MNEs to smart cities has provided a firm-centric perspective to existing studies in this field,

rooted in the international business literature, which reflects key factors that shape the strategic approaches of international smart city technology suppliers. Table 2 provides an overview of location-bound and non-location-bound FSAs that can potentially be developed by ICT firms in relation to smart cities, as described for each focal firm in Section 4. These factors were identified based on the empirical exploration of their smart city engagements, as well as the interviews conducted in Amsterdam with public and private actors. It shows that there are differences in the labels that these firms use, and to some extent in approaches, but that they also share quite some similarities, predominantly in the nature of the urban management solutions that this firms offer to city governments.

The creation of non-location-bound FSAs from local smart city engagements provides firms with the opportunity to address persistent urban sustainability challenges on a global scale. Interviews with smart city experts within each focal firm underlined that their technological solutions for urban management primarily focus on the common characteristics of urban systems. In the development and spread of

smart city solutions, firms are able to exploit these communalities by building standardized urban management platforms, products, and services, which can be customized to fit the local sustainability demands and requirements of each individual city. This is reflected in the proprietary urban management platforms offered by each firm (i.e. IBM's 'Actionable Business Architectures for Smarter Cities', Cisco's 'Smart + Connected Operations Center', and Accenture's 'Intelligent Infrastructure Platform'). Interviewees from each firm confirmed that these urban management platforms are largely based on existing their resources and capabilities, rooted in the development of ICT solutions for public and private clients, applied to the smart cities domain. While this standardization in technological solutions contributes to the ability of MNEs to position themselves as international smart city technology suppliers, researchers have also been critical in this respect (Söderström et al., 2014; Townsend, 2014). As the review of studies on smart cities in Section 2.1 showed, most scholars in the field of geography/regional studies emphasize the importance of including a much broader set of societal dimensions into the conceptualization of smart cities, related to the overall liveability of cities.

6. Limitations and further research

Several limitations can be identified for this study. First, the industry-specificity and relatively small sample of ICT MNEs limits the generalizability of the findings presented in Section 4 for a broader set of 'firms-in-industries' (Geels, 2014) in response to the emergence of smart cities. Second, the lack of specific firm-level data on revenues and sales for their activities in smart cities makes it difficult to determine the extent of firm-specific investments in this market, and assess its strategic importance for the firm. Similarly, the lack of firm reporting on key figures at the level of specificity of cities is a limitation to explore firm strategies at the subnational level. While the GaWC inventory, which was adopted instead, provides insight into the presence of a firm in a particular city, it does not give an accurate picture of the scope of firm activities at that level. A third limitation stems from the use of documentation published by the focal firms, which is inherently a form of self-representation, often meant for reputational purposes. By triangulating firm information with other sources, including semi-structured interviews and publications from reputable third parties where possible, an attempt was made to redress this limitation. However, lack of possibilities to check company statements is an issue.

For future research, it would be fruitful to explore which intra-MNE knowledge sharing mechanisms are most effective in leveraging non-location-bound FSAs throughout the MNE network. The interviews with IBM, Cisco, and Accenture all confirmed that the transfer of explicit

knowledge between locations occurred between subsidiaries, and enabled them to draw on resources and capabilities developed from multiple smart city engagements globally. The transfer of tacit knowledge is far more complex, however, given that it is embedded in the routines of individuals, and therefore difficult to transfer through information systems. Hence, gaining insight into effective mechanisms for knowledge transfer between subsidiaries with the MNE network would be worthwhile. This is intertwined with the capacity of MNEs to leverage non-location-bound FSAs beyond a specific local context, as emerged from the analysis of these MNEs. The spatial heterogeneity of each urban environment (Beugelsdijk et al., 2010; Beugelsdijk and Mudambi, 2013), and the need for local responsiveness on the part of the MNE in relation to environmental and social issues (Kolk, 2010; Kolk and Margineantu, 2009), has made ICT firms and smart city technologies an interesting initial research context at the subnational level. Nevertheless, there are many questions, related to the actual importance and relevance as well as the implementation, beyond that what is stated by companies verbally and in writing.

In addition, further research should also explore the complexities and dynamics of collaboration between MNEs and other stakeholders within urban contexts, most notably city governments. Collaboration between public and private actors is an integrative part of addressing urban sustainability issues through the spread of smart city technologies (EU, 2014). This firm-centric analysis primarily showed how MNEs (state to be) involved as suppliers of technological solutions for cities. Given that such city-level collaborations have proliferated in capital cities in recent years, further research on collaboration between city governments and MNEs, also from other sectors than ICT, might help to shed more light on the actual involvement of international business in smart cities. This could also contribute to a more fine-grained analysis of how different types of actors approach transition processes towards more sustainable modes of production and consumption in society (Farla et al., 2012; Markard et al., 2012), and complement insights on the approaches of ICT MNEs at the city-level presented in this study.

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Appendix A. Smart city statements of the ICT firms

Firm	Smart city strategy or programme	Exemplary statements and quotes on strategic approach to smart cities
IBM	IBM Smarter Planet; IBM Smarter Cities	<p>“Cities are based on six core systems composed of different networks, infrastructures and environments related to their key functions: people, business, transport, communication, water and energy (...) the six core systems become a ‘system of systems’ (...) each element of this ‘system of systems’ faces significant sustainability challenges” (IBM, 2009, 1–2).</p> <p>“Smarter cities make their systems instrumented, interconnected and intelligent (...) pervasive information and communication technology means that there is much greater scope for leveraging technology for the benefit of cities” (IBM, 2009, 9).</p> <p>“Administrations - at city level and elsewhere - are recognizing the importance of ‘perpetual collaboration’ (...) city administrations will need to work seamlessly across their own organizational boundaries and partner effectively with other levels of government, as well as with the private and non-profit sectors” (IBM, 2009, 12).</p> <p>“Actionable Business Architecture for Smarter Cities consists of a set of operating models, including a model for the city ecosystem (city ecosystem model), models for individual systems of cities, and models for shared functions” (IBM, 2011a, 3).</p> <p>“IBM has developed Actionable Business Architecture for Smarter Cities, leveraging decades of experience in partnering with cities and local governments across various domains” (IBM, 2011a, 8).</p> <p>“IBM Smarter City Solutions are based on insights drawn from more than 2.000 Smarter City engagements worldwide. By working with inspiring leaders to solve difficult challenges, IBM has developed repeatable best practices that can be applied to cities of all sizes” (IBM, 2011b, 4).</p> <p>“IBM intends to expand its Smarter City solution portfolio to fulfill the Smarter Planet vision. By making cities more instrumented, integrated and intelligent, IBM Smarter City Solutions can help city leaders meet and exceed citizen expectations through innovation” (IBM, 2011b, 19).</p>
Cisco	Cisco Smart + Connected Communities; Cisco Connected Urban Development	<p>“The internet is making cities more essential than ever through a networked urban infrastructure (...) the Cisco Smart + Connected Communities programme seeks to find visionary and practical approaches regarding technology innovation, and for what an urban services platform means for the build-out of sustainable urban infrastructures” (Cisco, 2010, 2).</p> <p>“Cisco proof-of-concept projects fit into the wider urban blueprint whereby Cisco ultimately envisions a global urban services platform approach for - and among - cities (...) an urban services platform approach is based on an ecosystem that encompasses an eco-centric set of technologies and standards that allows for interoperability of applications and devices” (Cisco, 2010, 16).</p> <p>“Greenhouse Gas emissions are forcing cities to develop sustainability strategies for energy generation and distribution, transportation, water management, urban planning, and eco-friendly (green) buildings (...) These issues, and others, can be mitigated through the adoption of scalable solutions that take advantage of ICT to increase efficiencies, reduce costs, and enhance quality of life” (Cisco, 2012, 2).</p> <p>“A Smart City Framework will enable cities to establish a standard ‘catalog’ system for recording, measuring, and collating city data, and for making it easily accessible for efficient, effective implementation and management of Smart City solutions for economic, social, and environmental gain” (Cisco, 2012, 3).</p> <p>“The complexity of cities (multiple parties, stakeholders, and processes) remains the most significant barrier to adopting smart city solutions (...) complexity manifests itself across many areas of local government - regulatory, governance, economic, systemic, policy, and organizational” (Cisco, 2012, 4).</p> <p>“In order to realize the full potential of Smart + Connected Communities in the era of the Internet-of-Everything, a strong public-private partnership approach is necessary” (Cisco, 2013b, 19).</p>
Accenture	Accenture Intelligent cities	<p>“A city capable of becoming both environmentally sustainable and attractive to citizens and businesses requires a new kind of intelligent infrastructure— an innovative, open platform based on smart technologies that can help forward-looking cities more predictably integrate a complex suite of services cost-effectively, at pace and at scale” (Accenture, 2011, 9).</p> <p>“Important characteristic that distinguishes an Intelligent City is the manner in which it delivers services using advanced technologies: an integration of a number of innovations including machine-to-machine communication enabled by telematics, sensors and RFID technologies; smart grid technologies to enable better energy production and delivery; intelligent software and services; and high-speed communications technologies” (Accenture, 2011, 10).</p> <p>“The technological foundation of an Intelligent City is an intelligent infrastructure: the ability to embed intelligence in city operations, making the drive towards sustainability” (Accenture, 2011, 14).</p> <p>“Accenture Intelligent Infrastructure Platform is operated in Infrastructure as a Service mode” (Accenture 2012, 4).</p> <p>“Accenture can help cities thrive in the emerging low-carbon economy by tailoring solutions that take advantage of innovations in key infrastructure areas including smart grid services, smart metering, transportation, water conservation, waste and pollution” (Accenture 2013, 4).</p> <p>“Accenture can help cities define, develop and implement technology and communications infrastructure based on interoperable and scalable platforms, which leverage open technologies and architectures. These are vital enablers of smart cities” (Accenture, 2013, 4).</p> <p>“Accenture's High Performing City Operating Model builds upon the experience gained from working with more than 80 global cities (...) the model defines the key building blocks of a modern city government's capability framework. The model was peer-reviewed by leading smart cities such as Amsterdam and Paris” (Accenture, 2017, 3).</p>

Appendix B. Overview of smart city ‘grey literature’ scrutinized

	Year	Publication/document
Focal firm		
Accenture	2011	“Building and managing an Intelligent City.”
	2012	“Intelligent urban infrastructure.”
	2013	“Accenture sustainability services.”
	2015	“Open Energy Data: A Prerequisite for Cities to Become Low-Carbon.”
	2015	“Transforming Amsterdam’s smart energy mix.”
	2017	“Capabilities for tomorrow’s digital city hall.”
	2017	“Smart cities: how 5G can help municipalities become vibrant smart cities.”
Cisco	2010	“Connecting cities - achieving sustainability through innovation.”
	2011	“Smart + Connected City services.”
	2012	“Smart city framework: a systematic process for enabling Smart + Connected Communities.”
	2013	“Smart cities and the Internet of Everything.”
	2013	“The Internet of Everything for cities.”
	2014	“Cisco Smart + Connected Communities: envisioning the future of cities now.”
	2014	“Smart city readiness: understand the issues to accelerate the journey.”
IBM	2009	“A vision for smarter cities.”
	2010	“Smarter cities for smarter growth.”
	2011	“IBM Smarter City Solutions – leadership and innovation for building smarter cities.”
	2011	“IBM Smarter City solutions on cloud.”
	2011	“Actionable business architecture for smarter cities.”
	2011	“Smarter Cities Series: a foundation for understanding IBM Smarter Cities.”
	2012	“IBM intelligent operations center for smarter cities.”
	2014	“IBM Smarter Cities – creating opportunities through leadership and innovation.”
2014	“The future of energy and utilities – An IBM point of view.”	
Consultancy & Accountancy firms		
Arup	2010	“Smart cities: transforming the 21st century city via the creative use of technology.”
	2013	“Global innovators: international case studies on smart cities.”
	2013	“The smart city market: opportunities for the UK.”
	2014	“Delivering the smart city: governing cities in the digital age.”
Deloitte	2015	“Smart cities: how rapid advances in technology are reshaping our economy and society.”
	2015	“Smart Cities... not just the sum of its parts.”
	2015	“Smart Cities: Big Data.”
	2017	“Funding and financing smart cities.”
	2017	“Smart cities and smart mobility.”
	2017	“Smart cities and the journey to the cloud.”
Frost & Sullivan	2017	“Making cities smarter: how citizens’ collective intelligence can guide better decision making.”
	2014	“2014 Global best-in-class smart city integrator – visionary Innovation Leadership award.”
	n.d.	“City as a customer strategy: growth opportunities from the cities of tomorrow.”
KPMG	n.d.	“The technology behind tomorrow’s smart cities.”
	2012	“Infrastructure 100: world cities edition.”
	2012	“Cities infrastructure: a report on sustainability.”
	2014	“Emerging trends in 2014: trends that will change the world of infrastructure over the next 5 years.”
McKinsey	2016	“Creating connections: IoT foundations for smart cities.”
	2016	“The future of cities: creating a vision.”
	2017	“Harnessing the smart city opportunity: laying the foundations.”
	2012	“Urban world: cities and the rise of the consuming class.”
	2013	“Urban world: the shifting global business landscape.”
Navigant	2017	“Smart cities: turning opportunity into reality.”
	2013	“Navigant Research Leaderboard report: smart city suppliers.”
PWC	2014	“Navigant Research Leaderboard report: smart city suppliers.”
	2005	“Cities of the future: global competition, local leadership.”
	2011	“Making it happen: a roadmap for cities and local public services to achieve outcomes.”
	2011	“Cities of opportunity.”
	2013	“Cities of opportunity: building the future.”
	2014	“Amsterdam: a city of opportunity.”
	2014	“Getting smarter about cities: why creating tomorrow’s smart city is about much more than just technology.”
	2015	“Connecting the dots: smart and sustainable cities.”
2016	“Data-driven cities.”	

Appendix C. Overview of semi-structured interviews

Actor type	Organization represented	Function of interviewee	Interview date and length
Private	Accenture	Smart City and Sustainability Services Consultant	28 June 2017; 80 min
Private	Cisco	Smart City and Internet-of-Everything Consultant	2 March 2017; 120 min
Private	IBM	Sustainability and Corporate Affairs Manager	20 April 2017; 80 min
Private	KPN	Business Services Consultant	15 June 2017; 60 min
Private	Philips	CSR and Government Affairs Manager	7 June 2017; 45 min
Public	Amsterdam Smart City	Communication Manager	13 April 2015; 60 min
Public	Amsterdam Smart City	Project Manager Internationalization	6 May 2015; 50 min
Public	Amsterdam Smart City	Project Manager Energy Innovation	11 May 2015; 45 min
Public	Amsterdam Smart City	Business Development Manager	29 April 2015; 80 min
Public	City of Amsterdam Municipality Physical Planning Department	Smart City Expert/Programme Manager	24 November 2014; 60 min
Public	City of Amsterdam Municipality Physical Planning Department	Urban Energy Expert/Urban Planner	24 December 2014; 70 min
Public	City of Amsterdam Municipality Physical Planning Department	Urban Energy Expert/Urban Planner	18 November 2014; 60 min
Public	City of Amsterdam Municipality Climate and Energy Office	Urban Energy Expert/Policy Advisor	20 January 2015; 50 min
Public	City of Amsterdam Municipality Climate and Energy Office	Urban Energy Expert/Policy Advisor	26 November 2014; 60 min
Public	City of Amsterdam Municipality AEB Amsterdam	Urban Energy Expert/Programme Manager	19 November 2014; 90 min

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