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A Leadership Role Framework

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Smart Leadership for Smart Cities: A Leadership Role Framework

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Abstract

A Smart City takes advantage of new technologies; Internet-of-Things; Machine Learning and Artificial Intelligence; Data Analytics; Robots; just to mention some. But being smart in 2018 is also about sustainability. Becoming a Sustainable Smart City (SSC) is all about Organizational Change. That requires leadership, timely decision making, and effective execution of decisions. In this paper we present a comparative study where we investigate smart cities in Denmark, Holland, USA, Australia and New Zealand. Our paper focus on how City Managers make decisions surrounding the application of smart city technologies and the data arising. We derive a framework of six barriers to overcome and five leadership roles that needs to be enacted to realize the future sustainable smart city.

1. Introduction

From Barcelona to Wellington, and Reykjavik to Rio de Janeiro, an increasing number of cities worldwide are embarking on the quest to become smart cities. Over a thousand smart city pilot projects have reportedly been launched, five-hundred in China alone (Lin, 2018), and multiple tracts of land have been set aside around the world to build smart cities from the ground up (including a US$80 commitment by a Bill Gates subsidiary in the Arizona desert). This global 'smartrush' of cities and nations has created a burgeoning multi-billion dollar industry of consultants and suppliers of technology, services and infrastructure. The global smart cities market was valued at US $529.55 billion in 2017, and is forecast to reach US $1944.67 billion by the end of 2023 (Reuters, 2018). `

The smart city movement is fundamentally motivated by a desire to help address critical issues relating to urban growth and global and local sustainability: Two-thirds of the world's population (an estimated 6.5 billion people) are expected to be living in cities by 2050 (United Nations Development Programme, 2017). For individual cities, becoming a smart city requires 'smartness' in the application of technologies and 'smartness' in the use of the data that arises to drive improvements. The delivery of smart cities has taken on a competitive dimension, akin to a digital-age urban performance. We see regular news reports about which cities are leading and following in the smart cities stakes, and measurement indices, such as the City in Motion Index (IESE Business School, 2018a) are used to generate global rankings. In 2018, the world's top ten smart cities in 2018 were variously reported to include Singapore, Dubai, New York, Paris, London, Tokyo, Reykjavik (an outlier in terms of size), Seoul, and Los Angeles, Shanghai, Beijing, Toronto, Hong Kong and Amsterdam (IESE Business School,

2018b; Smart Cities World, 2018). Some countries, such as India, have their own smart city indices and ranking systems (Mohan & Shukla, 2018).

In such a pressured environment, with a backdrop of increasing urgency in the global sustainability dialogue, the leadership of smart cities can be seen as an important phenomenon to study, particularly in relationship to the challenge of delivering sustainability-related outcomes from IT-related investment, and leading sustainable change from city business-as-usual. Unless a smart city is itself sustainable as a working system, it cannot achieve its larger sustainability goals and objectives. Our exploratory study set out to examine leadership practice in the sustainable smart city, with a focus on the sustainable smart city change process that follows the initial showcasing stage. We asked, *What barriers do smart cities face?* and *How do you leaders smart city change?*

In the remainder of this paper, we review the literature of relevance, then outline the study method, before reporting on the findings and their implications.

2. Smart City state-of-the-art

Scholars are in agreement there is no single agreed definition of a smart city (Albino, Berardi, & Dangelico, 2015; Nam & Pardo, 2011). There is considerable variation in how the term smart city has been appropriated by different cities in their development and marketing endeavours, and in how the concept is used in studies.

Hollands (2008) notes that although the adjective smart "clearly implies some kind of positive urban-based technological innovation and change via ICTs", it has also been used in relationship to e-governance, communities and social learning, as well as addressing issues of urban growth and social and environmental sustainability (p.303). In some cases the term smart is employed in an instrumental way, to imply the use of smart means in relationship to the city, while in others smartness is seen as normative, an outcome to be aimed for (Höjer & Wangel, 2015). Perhaps unsurprisingly, smart city has been described as a buzzword (Höjer & Wangel, 2015), a vague or fuzzy concept (Albino et al., 2015; Bibri & Krogstie, 2017c; Nam & Pardo, 2011) and an urban labelling phenomenon that has a self-congratulatory tendency (Hollands, 2008). Despite these criticisms, it is clear that the recent emergence of the smart city as a global phenomenon is reflected in significant growing research interest. A search on google scholar in October 2018 using the term "smart city" returned 65.500 results, with only 1.630 articles predating 2010, and 10.500 results for the year 2018 to date.

The smart city concept was originally focused around the diffusion of ICT, then became more inclusive of people and community needs (Albino et al., 2015). Nonetheless, a common element of the smart city development approach remains "the idea that ICT is, and will be for many years to come, central to urban operations, functions, services, and designs" (Bibri & Krogstie, 2017c, p. 191). Associated with this theme is an emphasis on the use of the internet of things (IoT) to generate data that can in future be analysed to improve efficiency and guide decision-making (Khan, Anjum, Soomro, & Tahir, 2015). For example, cameras and sensors may be integrated into city infrastructure to gather diverse data, while streetlight connectivity may become the basis for a WAN. Data generated may be aggregated and analysed in combination with other data, such as that held by the city and agencies such as police, fire and emergency departments. The smart city is therefore seen by some as becoming an application for future big data analytics (Khan et al., 2015), to help guide and/or automate decision-making, increase efficiency and achieve goals. As a Gartner writer Kasey Panetta puts it, "Most citizens might view a streetlamp as just a streetlamp, but to a city planner in a smart city, a light post is an opportunity to build a framework for optimizing city operations such as environment,

transportation, and safety and security" (Panetta, 2017). Potential applications of city data include transport and CO2 emission, energy efficiency, security and emergency services, waste and water management, city management and economic development, public health, and informed people and public participation (Khan et al., 2015).

2.1 What are the components of a smart city?

Researchers agree that the smart city is a multi-faceted concept. Various researchers have conducted reviews to identify trends in smart city studies, and have proposed sets of smart city dimensions or frameworks. For example, Choubari et al. (Chourabi et al., 2012) propose a framework of eight critical factors of smart city initiatives: management and organization, technology, governance, policy, people and communities, the economy, built infrastructure, and the natural environment. Nam and Pardo (2011) identify a set of strategic principles aligned to three main dimensions (technology, people, and institutions) of the smart city. These are the integration of infrastructures and technology-mediated services, social learning for strengthening human infrastructure, and governance for institutional improvement and citizen engagement (p. 282). Bătăgan (2011) identifies four core systems of the smart city: transport, health, education and government, and three 'spheres': quality of life, limits of the environment, and technological changes. A report by Vienna University's Centre of Regional Science (2007) identifies six characteristics of the smart city: smart economy (competitiveness), smart people (social and human capital), smart governance (participation), smart mobility (transport and ICT), smart environment (natural resources), and smart living (quality of life), each of which comprises a set of factors. The categories in this framework have been drawn on by a number of other researchers (Höjer & Wangel, 2015).

2.2 The smart sustainable city

The amorphous smart city concept is often centred on a drive for efficiency (Bibri & Krogstie, 2017c, p. 191), but this does not necessarily signify a sustainability imperative. Conversely, as part of the Sustainability Development Goals (SDGs), the United Nations has prescribed a specific and comprehensive set of sustainability development goals (SDGs) for cities (Goal 11), while leaving it to nations and cities how to deliver on these goals. A subset of work has therefore focused on how to incorporate sustainability in smart city approaches (Bibri & Krogstie, 2017a, 2017b, 2017c; Höjer & Wangel, 2015).(Bibri & Krogstie, 2017c, p. 191).

The term *smart sustainable city*, denotes "a city that is supported by a pervasive presence and massive use of advanced ICT, which, in connection with various urban domains and systems and how these intricately interrelate, enables cities to become more sustainable and to provide citizens with a better quality of life" (Bibri & Krogstie, 2017c, p. 193). Höjer and Wangel (2015) argue for a deductively crafted, normative definition of Smart Sustainable Cities, "with the purpose of pointing out a desired state or trajectory of development" (p. 338). Drawing on the concept of sustainable development as outlined in the Brundtland report of 1987, they define the smart sustainable city as "a city that meets the needs of its present inhabitants without compromising the ability for other people or future generations to meet their needs, and thus, does not exceed local or planetary environmental limitations, and where this is supported by ICT" (p. 342).

However, in terms of implementation, the smart and sustainable city landscape is at a very early stage has been described as "extremely fragmented both on the policy and the technical levels" (Angelidou et al., 2018, p. 146). It is therefore also important to consider how to build the sustainability of the smart city as a phenomenon. Not only do smart cities set out to address

a number of significant global challenges (outlined above), but studies indicate that smart cities face a number of challenges, barriers and critical success factors (e.g. Chourabi e al. 2012) in meeting their objectives. Unless a smart city is sustainable as a working system, it cannot achieve its sustainability goals and objectives. This can be seen as a valid contemporary concern given the early stage of the smart city as a global phenomenon on the adoption curve, and the ambitious goals that smart cities are charged with.

3. Leadership state-of-the-art

In 1971 Henry Mintzberg studied leaders and managers. He found that managers perform "ten basic roles which fall into three groupings" (Mintzberg, 1971, B-97). He called these roles; interpersonal roles, information processing roles and decision-making roles. Further, Mintzberg argued that these three main and 10 basic leadership roles can be used to categorize a manager's different functions. In a later study (Mintzberg, 2009) of 10 managers he derived a theory of management and confirmed the leadership roles he had found 40 years before. Some years later John P. Kotter (2012) studied organizational change and found that change needs a guiding coalition where both leadership and management are represented.

Based on many years of research in management teams at Henley Management College, Meredith Belbin (Belbin, 2010, 2012) found three main roles each with three sub-roles that is necessary in a team. The first group of three 9 roles are Action-oriented. The sub-roles are called Shaper, Implementer and Completer-Finisher. The second group of three roles is called people-oriented roles. Here the three sub-roles are Coordinator, Team Worker and resource Investigator. Finally, the third group called Thought-oriented roles consist of Plant, Monitor-Evaluator and Specialist.

A Smart Sustainable City project or program deliver something new. A new process, a new product or at least something that the citizens user experiences as new. Therefore, it makes sense to take a look at a study of innovation roles by Tom Kelley (2005). Kelley was one of the founders of IDEO, a successful California design, concept development and innovation company. His book is based on what he has found through 100's of projects and innovations in IDEO. He says, that in order to succeed in innovation, three leadership roles must be enacted: (1) A learning role, (2) An organizing role and (3) a constructive role. Each of these three roles can be enacted in different ways. E.g. the learning role can be enacted as anthropologist, experimenter and cross-pollinator.

Finally, we found a four part leadership typology used by Contractor et al. (Contractor, DeChurch, Carson, Carter, & Keegan, 2012), adapted from Carson and Teluk's (2007) analysis of convergence in leadership studies around the role dimensions the Navigator, Engineer, Social Integrator, and/or Liaison.

3.1 Leadership challenges to making smart cities sustainable

The innovative nature of smart city initiatives are seen as requiring a different management approach than the traditional business as usual of the city (Van den Bergh & Viaene, 2015) yet there is a surprising lack of empirical research into leadership of the smart city. One notable exception is coming from Birmingham university in UK (Nicholds, Gibney, Mabey, & Hart, 2017) using the lens of place leadership that involves, "complex, large-scale social and economic co-production of activity comprising a range of power and resource-related, community and personal agendas and negotiations across organizations, disciplines and professions" (Nicholds et al. 2017, p. 251). In such an environment, leaders may require more

relational and technical leadership skills than are required in traditional city operational management settings (Gibey et al. 2009; Nichols et al., 2017).

This stream of work considers strategic leadership of place-shaping to include not only political leaders and appointed officials, but also a much wider range of individuals in senior roles in public, private, para-public and third sector institutions (Gibney, 2009). Focusing more narrowly, Van den Berg and Viaene (2015) identified a number of challenges that the smart city poses for city administration. These include allocating the locus for leadership, establishing co-ordination mechanisms, managing IT-business alignment, shaping organisational culture, and going beyond the experimental phase. Our study follows this line of concern by considering the nature of leadership that is performed by those within the city administration, with a focus on going beyond the experimental phase.

4. Research Method

We set out to explore the practical work done by smart city leaders in driving and embedding change in the context of the smart sustainable city, focusing on how to move beyond the experimental (piloting or showcasing) stage. Our goal was not to study any specific leadership role, but rather to explore and understand the barriers to embedding of the smart city phenomenon, and emergent practices that leaders are using to build sustainability of the smart city in practice. It is unlikely that any one leadership role could result in effective smart city leadership: smart city projects are complex and leadership research evidences a shift away from a focus on the individual leader towards a view of leadership in practice as being distributed, collective, or pluralised leadership (White, Currie, & Lockett, 2016). We therefore aimed to conduct exploratory interviews with individuals employed by cities whose roles involved a strong focus on smart city leadership, aiming to capture complementary perspectives on the nature of smart city leadership, and the nature of challenges, involved. We aimed to include participants from a range of global regions and city sizes/densities, with the goal of identifying common themes and concerns. To identify potential candidates we combined an online search of publicly available Linked In profiles (looking for the term "smart city" in job titles) in tandem with online searches of smart city programmes. We identified leaders of smart city programmes that were orientated towards generating value for citizens using IT and data, and were at least three years into the smart city programme. Participants were approached by email and invited to participate. Six of these were able to be interviewed within the timeframe of this exploratory study. Five were city employees charged with a leadership role in smart city delivery. We included the smart city adviser in order to gain understanding of issues and trends from the perspective of smart city partners, but also in order to access broader trends across smart cities. (The smart city is a new and highly contextual phenomenon, and the CIOs and programme managers interviewed had smart city experience in only one setting). In total, we interviewed two CIOs charged with leading smart city initiatives, three smart city programme managers, and one independent consultant who had extensive experience in working with smart cities as a smart city adviser and private sector partner. Two participants were from cities in the European Union, two were from different states in USA, and two were from Oceania (Asia/Pacific). Three were female and three were male. The table below shows the participant and city breakdown.

#	Global Region	Pseudonym	Role	City Classification (using OECD definitions)
1	EU	Nina (F)	CIO	Large town (15,000-20,000)

2	EU	Carl (M)	Programme manager	Metropolitan area (500,000 – 1.5 M) contiguous within a large metropolitan area (2.7 M)
3.	USA	Kris (M)	CIO	Small city/urban area (50-200,000) within a metropolitan area (1.7M)
4.	USA	Fiona (F)	Programme manager	USA metropolitan area (500,000 – 1.5 M) contiguous with large metropolitan area (2.5 M)
5.	Oceania	Valerie (F)	Programme Manager	NZ city (medium sized urban area population 200, 000- 500, 000
6.	Oceania	Luke (M)	Consultant	Various, includes a large metropolitan areas (0ver 1.5 M)

Figure 1: Study participants[1]

Following the interpretivist tradition, we sought to understand the smart city leadership experiences of participants from their personal perspectives. We conducted semi structured interviews lasting between 30-45 minutes, asking about their leadership experience, what was distinctive about smart city leadership, challenges to the sustaining their city's smart city vision, and the work they did to address barriers and help achieve benefits, such as using smart city data to generate insights and decisions. In the course of interviews we asked them to share stories about specific events. The recorded interviews were transcribed and sent back to participants for checking.

We imported these transcripts into the qualitative analysis programme NVivo and iteratively coded them. Using an inductive, or grounded, process we firstly created 29 initial codes relating to barriers and 42 codes for leadership activities. We then created codes for families of barriers and merged the codes into larger categories identifying the main types of barriers reported below.

In the second round of coding, in order to determine suitable higher level categories for leadership practice, we re-engaged with the literature in a reflexive analytical process. Our data clearly showed that the smart city leaders were simultaneously involved in playing multiple role, or role dimensions. The final set of five leadership role dimensions that are outlined in the findings draws on several of the leadership role typologies reported above

5. Findings

We identified six key barriers and five distinct role dimensions of smart city leadership. We report on these in turn.

5.1 Barriers to sustainability

Six key barriers to the sustainability of the smart city were identified: (a) lack of scalability arising from a focus on showcasing of quick wins, (b) misalignment of municipal structures and processes with smart city needs, (c) Legal, regulatory and security challenges, (d) lack of

[1] OECD definitions: large metropolitan areas have a population of 1.5 million or more; metropolitan areas have a population of 500 000 -1.5 million; medium-size urban areas have a population of 200 000-500 000; and, small urban areas have a population between 50 000 and 200 000.

an innovation culture in city administration, (f) caution and risk aversion surrounding advances in data use., and (e) gaps in capability and knowledge.

In Figure 1 we have shown the six barriers

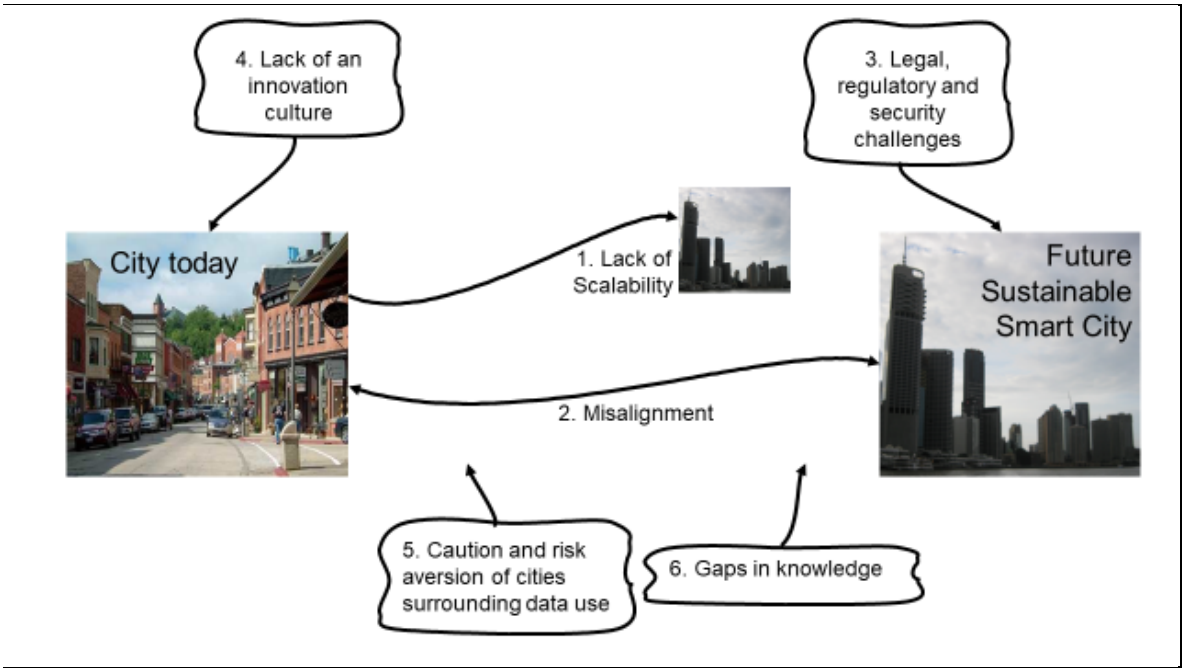

Figure 1: The six barriers identified

a. Lack of scalability arising from a focus on showcasing quick wins

The desire for quick wins during the early stages of smart city development had resulted in some outcomes that were seen as unsustainable: Several cases, participants reported that data for pilot projects was held in provider clouds and delivered to cities, but was not integrated with city data. This was seen as limiting scalability, preventing integration, and preventing capability development within cities' IT and business units. As Nina explained:

"We've been in a long phase now where [we] have been working with small pilot projects and they've been focused on making showcases, making it possible to show this is a smart thing to do. So we've been working with some sort of provider that has the whole ecosystem of data themselves. They split up the centres, they get the data into their own cloud somewhere, and maybe show them in an app or on the web or something. But it's an ecosystem that lives parallel to the municipality… It doesn't really grow the organization and it's often very difficult to scale."

b. Misalignment of municipal structures and processes with smart city needs

Participants outlined a range of aspects of city business as usual being misaligned with the embedding and scaling up smart city initiatives. Key amongst these barriers were the budgeting system and the allocation of benefits to siloed business divisions that had been formed in an era predating integrated services. These things created powerful disincentives, making it difficult for leaders who were charged with 'flying the airplane while building it (Fiona). Carl explained that:

"The municipality isn't organised to facilitate innovation, and definitely not organised to facilitate smart cities .. You don't have a light post anymore, you have a charging station,

you have camera points, you have 5G on camera point, and you have light, because that is smart. You have one object in public space that can have different functions. However .. we have a department that's responsible for public safety. If one [department] is responsible for light, if one is responsible for electric charging for cars, and those are different organisations, when you want to make a decision on an object in public space which is integral, nobody owns it because there's no owner for integration functions. And the same goes for funding"

For example, one smart city was considering installing food grinders to reduce waste. Under the current system, this would require the housing department to bear the costs of installing grinders, while the benefit would fall to the waste management department. In this siloed environment, s Fiona explained, leaders constantly face the challenge of "how to add value to what we're doing without slowing down the project." Further, even within divisions, there may be no incentive for efficiency. Carl noted that,

"In general when we talk about smart cities, you're talking about your city services and [these services] don't compete against the market, so there's no natural drive to improve. There's no adapt or die. It's just you know, you get your money, if you're not more efficient. But if you are efficient, you don't want to do it because you're going lose your budget, so there's no incentive to be better at what you're doing" (Carl)

For smart city leaders, the above challenges created a constant imperative "to figure out how to add value to what we're doing without slowing down the project" (Nina).

c. Legal, regulatory and security challenges

In order to gain quick wins, pilot projects had typically benefitted from being ringfenced as a proof of concepts that were exempted from business-as-usual policy requirements. Moving smart city initiatives beyond piloting and scaling up was seen as involving diverse legal, regulatory, security and privacy challenges which were complex and potentially expensive to work through. Kris noted that, *"A lot of the smart city technology collects information now, and while it certainly can be largely benign, there's the perception potentially that you're collecting information, personal information and using it for nefarious means or reasons".*

d. Lack of an innovation culture in city administration

Linked with the above challenges, participants reported the barrier of organisational culture that was risk averse and resistant to innovation. Luke (the consultant) noted that, "public servants typically don't want to be seen to make decisions. They'd rather a consultant make the recommendation and they'd sign off on a recommendation perhaps, or [and then they can say] 'no it's the consultant.'" As Carl explained, the impact of culture as a barrier is significant:

"At the end of the day technology will work, it will function. … if there's enough societal use for something, you will find the money…. .But it's the culture that is by far the most difficult to create. And that's the thing everybody underestimates… Everybody starts with the problem, you [aim to] solve a problem. But we never view our organization as a problem and it's almost as difficult to tackle as translating a challenge to technology solution" (Carl)

Further the innovation undertaken as smart city initiatives was not necessarily valued by colleagues. Valerie noted that, *" I don't think people in my own organization would call on*

me to speak freely about what I'm doing and what I do. Whereas people from other councils and other cities and other countries would like me to speak about it…"

e. Caution and risk aversion of cities surrounding data use

The smart sustainable city concept is strongly associated with rhetoric about the use of data derived from sensors and the IoT to drive city and citizen-level improvements. However, a number of those interviewed revealed that their cities took a piecemeal approach to data use, were uncertain about how to move forward with data use, and had caution surrounding the application of data relating to citizens into service-related decisions. Carl noted that, "we have loads of data flowing in, but the question for [this city and] all municipalities is what do you actually do with the data?". Although his city was applying world-edge automated decision models drawing on data in relationship to transport and water management, the majority of gathered data was not used to drive decisions, and was in demand by divisions of the municipality, even if there was an identified revenue or savings opportunity. (He gave the example of the city not using collected data to determine the optimum location to send a scanning car that identified parking offences). Likewise, Nina spoke of her city's focus on 'safe' areas of data use, and avoidance of using 'people' data:

"We usually put data together because we want to help a citizen, but do they want to be helped in that way and who should decide whether it should be smart or whether it's smart to do or not? … Some other municipalities that have done a lot of work in putting together data and people. And it's been questioned whether that's ethical or not. So… we're trying to stay on the safe side, working with safe data, like building data or, you know, non-person data."

Further, Carl saw politicians as a key barrier to the expansion of the use of data driven decision-making. He noted that, "Politics are about emotion… you can analyse everything, but for politicians it wouldn't be beneficial if everything would be transparent based on our data, because then they won't have a function anymore".

f. Gaps in capability and knowledge

Smart city programmes had created a high demand for new knowledge and exposed capability and knowledge gaps, notably relating to technology decisions, integration, and integration of data from city WANs with municipal data sets. On the part of leaders, lack of knowledge was not seen as a disincentive, but rather an a stimulating aspect of the change environment. Nonetheless, this issue led large time demands on leaders, and had exposed a gap between the capabilities and understandings of municipal governments and external providers and partners. This was more of an issue for smaller cities, where resources to develop new knowledge were constrained. Nina noted that, "We're all looking for somebody bigger than us to learn from… You have to spend a lot of time in meetings …And I've been in some meetings where it seems like everybody… want[s] to lean on somebody else and if there's nobody who really stands there to lean on then everybody's just leaning."

Perhaps the most significant barrier faced by leaders was that the norms and frames of reference held by colleagues responsible for delivery of city services often made it hard for these people to see smart city technologies as an enabler of service delivery. This created a demand for leaders to be knowledgeable about city services. Nina noted, "The people who actually know something about the core service that we deliver do not know anything about the technical

possibilities, and I don't really know much about what they really do out there with the citizens. So bridging that things is always [an issue]".

5.2 The five faces of smart city leadership: role dimensions and practices

Our analysis of the data revealed that the smart city leaders performed five distinct role dimensions, with associated enabling practices, so as to foster and embed change that contributed to smart city sustainability. We found that smart city leaders enacted five distinct role dimensions: ***the navigator*** (establishing, maintaining and defending a clear vision and direction, while enacting strategic moves to achieve specific ends that fostered progress), ***the engineer*** (structuring the smart city collective and tasks), ***the storyteller*** (telling stories and customising information to make it relevant to specific groups), ***the learner / knowledge builder*** (learning and modelling learning); and ***the relationship builder*** (building and enriching internal and external relationships). and was described by one participant as "having to fly the airplane while we're building it".

In Figure 2 we have shown a whole picture of the five roles. The big arrow in the middle symbolizes the project or program to derive a sustainable smart city in the future.

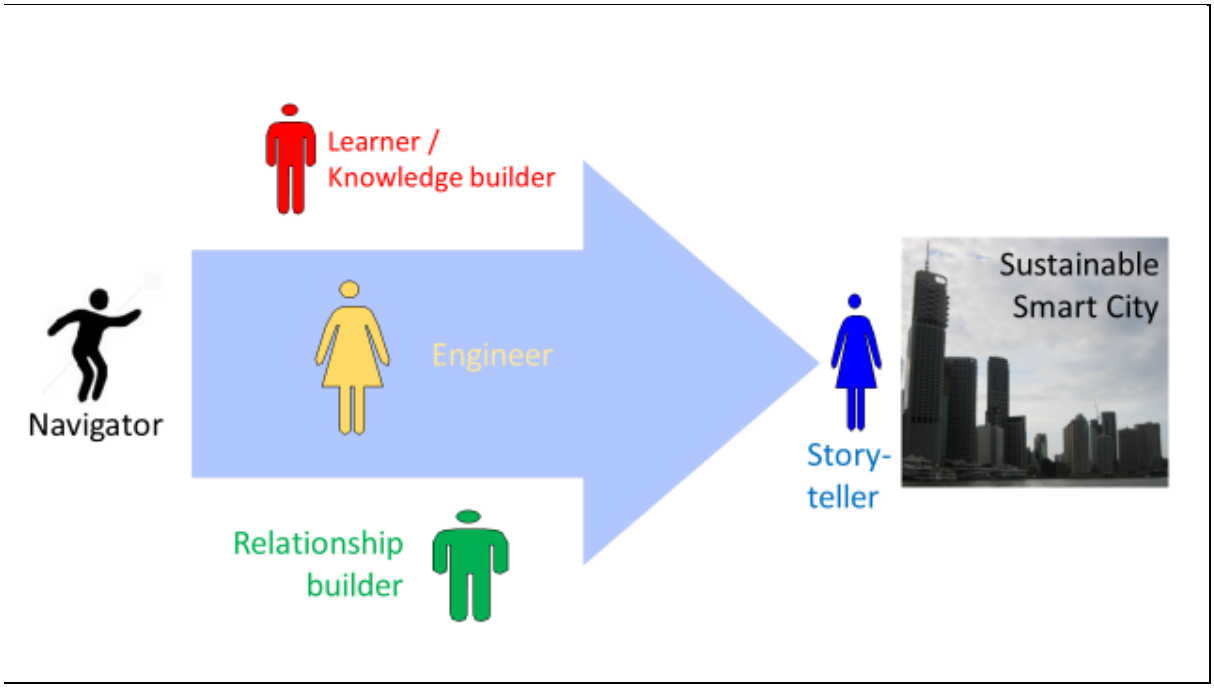

Figure 2: The five roles that needs to be engaged

a. The navigator

The Navigator-strategist role was about providing a clear sense of purpose and direction to help guide and support those implementing the smart city programme, while enacting strategic moves to move ahead, stay on track, achieve timely outcomes, and bring resistant parties on board with the smart city journey. It involved establishing, maintaining and defending the smart city vision, bringing others on the journey by helping them develop aligned visions and goals, and designing moves to address barriers progress. The leaders interviewed acknowledge that they played key leadership roles in smart city programmes, but also emphasised that distributed leadership was required across the organisation for the smart city to become embedded in the city's business as usual:

"You need leadership on all levels, you need it on a political level because if you want to change you need that, but you also need it within your organisation, on a director's level and then when you go lower in the manager level, so you need leadership. If you want to be a good smart city, you need to have geographically spread leadership within your organisation. (Carl).

It was therefore an important part of their job to find ways to bring others on board and foster ownership. This included strategic moves in addition to relationship building. There was a strong component of change management involved in strategic navigation:

You're trying to bring people to change their notions about how they've always done things… [change] is a strong component and it's not really a stated component of the role. So if you think about what I'm measured on it is really creating output that brings innovation into the city. However that output will never be made operational unless I can manage the change (V)

Leaders also reported on personal characteristics and values that were conductive to the navigator-strategist role:

"[It requires] an enormous amount of drive, you have to be an absolute advocate in what you believe, because basically, you have to do a lot of pulling, you have to pull a lot in the organisation. You have to drag people along. … It helps if you can create a vision and inspire people to move. (Carl)

b. The engineer

The Engineer role involved structuring the smart city collective and tasks, and coordinating the work of diverse members to meet the smart city goals Fiona stated, "*My job is, day to day, it's kind of ensuring that the pieces and parts all keep on working toward the same outcome"(*F).

In many project´s and programs the engineer will have the title of project manager. The engineer is responsible for designing optimal delivery paths, brokering supply and demand and orchestrating the deal(s) with suppliers and contractors.

In the process of deriving the SSC the engineer needs to improvise solutions and balance innovation with reuse, *"We have a culture of innovation in small and big steps… which our mayor set up and it really helped with fixing the other practices. And then because of the challenges that we see, but also our directive to get things done… we definitely still follow that enterprise architecture practice of reuse*."

Finally, the engineer coordinates internal and external resources and is responsible for combining data to make progress visible, "*We put together a program metrics and set up a dashboard, I'll say that they weren't really utilised by the executives. And then I realised that what I needed …was to have more ties to existing programs that pull data in terms of spend and invoices. (F)*"

c. The storyteller

The Storyteller role is about creating a common understanding for the vision of the smart sustainable city. To do that the storyteller tells stories about the future in the sustainable smart city, "*I think of myself as kind of a storyteller, or translator of the different technical community executives, the technical teams to other technical teams that are outside of our team outside of the city. I'm communicating that to the executives, to other organisations, partner organisations, other cities (F)"*

The storyteller is also responsible for customising stories for the audience – translating the story so to say, "I see it as my role to try and give her some idea of, "you could do this, you could do this, you can do this, you could do this". So, "What would fit into your picture of the ideal way forward for your area?", and so if I don't, so if we don't work together, we don't go anywhere. I can't do it alone. She can't do it alone (N)"

In addition the storyteller should be fostering structured and aligned thinking and support others in telling stories, "*We let them present once a month. They can present their innovation. I have a copywriter who writes a little piece about people, infuse people so we promote it and we do it on different levels.*"

Finally, the storyteller should support the building of artefacts – so-called "pillars of support".

d. The relationship builder

The relationship builder has contact with all the stakeholders; citizens, politicians, city employees etceteras. The relationship builder builds networks with all the stakeholders and helps bring about ideas in the networks, "I*t's my job to try and open up perspectives and see new possibilities that would else not come to the table. And I think of course that's also very relation bound in a way. So for the other heads that I work closely with, it's easier to bring about those thoughts…It's very important to have good relationships (N)*".

The relationship builder also builds shared ownership and bring others on board, "*Smart city-related work is an all hands on deck type activity. So it starts with having the leadership support right from the elected officials. Then you've got to make sure you're budgeting through the administrative services. Clearly IT needs to be on board. You need support from your legal department. A lot of the back office administrative functions have to be engaged. And then you think about something like the different departments, libraries. Well, our library department is one of the most sophisticated users of tech in the city and so they are pushing a whole range of smart city-related activities. And I look at public works or I look at our, even our police and fire [service], the degree to which they're using new technology for apprehending criminals or processing data, storing data.*"

Finally, the relationship builder creates and rewards internal champions, "*I've tried to create champions on different levels, on product level, people that do something, we brand them as a champion, we put them on a pedestal. We let them present once a month. They can present their innovation. I have a copywriter who writes a little piece about people, infuse people so we promote it and we do it on different levels.*"

e. The learner – knowledge builder

The learner / knowledge builder is responsible for bringing in knowledge and learning from outside. He or she takes responsibility for own learning and will be 'leaning' on others who have expertise.

The learner / knowledge builder is engaging with communities of practice, "*There are innovators in various organisations around the country, in my city obviously a lot, but also around the country who you see as kindred spirits, and you network with those people, and those are the people that you tend to tack on to make things happen as well. Because they have a similar attitude, it's almost like you can speak shorthand with each other. (V)* "

Furthermore, the learner / knowledge builder needs to creatively be challenging norms and prejudices to find and learn new solutions, "*There are two organisations that I should be creating a lot of headaches for. First are the security people, cyber security and the second are the attorneys, the legal people. Because if I'm pushing on both of those, it means we're out of our comfort zone and we're doing something new, we're doing something that no one's done before, or has a little bit of uncertainty to it. It definitely has elevated risk. The attorneys … they're really smart and they do their job exactly right, but it causes them headache, and I have to get creative with them and say, "Well, what if we do it this way or.." and sometimes you know, they'll help me. They'll say, "well, you know what.. here's the way you can do it because the law or the ordinance allows this." (K)*"

Finally, the learner / knowledge builder' knowledge needs were described by [K] as follows: *"I've got to be really clued in to what's going on, what the vendor space is doing, really aware of like stuff that's working around the world. Like what are people doing for proving, finding parking spaces or monitoring air quality or supporting self-driving vehicles, all the movement towards solar and non-carbon energy. You've got to be in the topics in the weeds, so a leader in this space needs to be knowledgeable of the technology, the global phenomena, and then of course [I need] to be really aware of the needs of our community."*

8. Conclusion

We have now presented the results of a comparative and exploratory study where we have investigated smart cities in Denmark, Holland, USA, Australia and New Zealand. Our paper have focused on how City Managers lead and make decisions surrounding the application of smart city technologies and the data arising. We have derived a framework of six barriers to overcome and five leadership roles that needs to be enacted to realize the future sustainable smart city.

The utility of our framework lies partly in using the six barriers to assess the readiness of a given city to undertake a project or program in order to realise a future sustainable smart city. In addition the five leadership roles can be used to plan a smart city project or program; filling the roles and ensuring they are enacted will increase the changes of a successful implementation we conclude.

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