Living Apart Together? Discussing the Different Digital Worlds in City Government

Evert-Jan Mulder

Abstract The concept of the smart city is growing in popularity and is receiving a lot of interest worldwide. An important characteristic of the smart city is the deployment and use of ICTs. Although the interest from research and practice for the new "smart cities" is understandable and justifiable, it is important that the broader context of the use of ICTs by city governments is taken into account.

Namely, three different ICT landscapes develop within city governments: information systems (IS) for the back office, the front office, and the smart city. Each of these landscapes has its own dynamic, organizational setting, and added value for the organization.

For the efficiency and effectiveness of the innovation strategy of city governments, it is important to develop an overarching vision and approach to the use of ICTs. In this way, integration of the different landscapes will be guaranteed in the future.

In this chapter, we describe various models that are used to characterize the use of ICTs within city governments, and we present an overarching model for the use of ICTs within the back office, the front office, and the smart city.

We then discuss the added value and the application of an integrated approach from different perspectives.

Keywords City government · Digital world · ICT landscape · Innovation strategy · ICT use by city government

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Introduction

Digital technology is an important driver of the concept of smart city. A smart city is in many definitions a city that uses new digital technology, next to other non-digital technologies, to face urban challenges (Chourabi et al., 2012; Cocchia, 2014; Granath, 2016). In particular, new cyber-physical systems are eye catcher in the implementation of new smart city technologies. This is about heterogeneous and distributed systems, implemented in sector-specific domains (transport, waste, energy, health, housing, etc), collecting real-time data. This way urban processes get datafied and the city becomes a *datapolis*, the modern version of the *polis*—the old Greek word for city (Meijer, 2015).

The emerging smart city or datapolis is a phenomenon that is a part of the digital revolution that is taking place. The current wave of new information and communication technologies (ICTs) like big data, artificial intelligence, blockchain, robotification, augmented reality, and others will cause disruptive change in society and economy (Brynjolfsson & McAfee, 2014; Floridi, 2015; Tegmark, 2017). Smart cities are part of this wider transformation. This phenomenon is already happening in business domains, where ICT driven models disrupt the existing order. Some anticipate that the same will happen in cities. According to Pereira (2018, p. 27): "The interesting aspect of the emerging technologies is that besides challenging existing governance models, they make it possible for new governance models to emerge. The interdisciplinary nature of smart cities and the changes on the complexity of contemporary urban problems make flexible institutional arrangements necessary which are able to deal with context-specific solutions and multi-stakeholders' environment."

The emerging smart city systems are implemented on top of other information systems (IS)[1] that are already in use in the back office and front office of city government. These IS have been implemented in city governments since the 1970s. Back-office IT—without the C of communication, since networking abilities were limited in the beginning—is often associated with silos and IT legacy. Front-office IS are a result of the implementation of the egovernment concept, since the rise of the internet in the 1990s.

The aim of this chapter is to draw attention to the different IS landscapes in city government and discuss an integrated approach, for the sake of an effective and efficient innovation strategy of city government. In this chapter, we will explore the different IS landscapes in city government and their specific characteristics. We want to highlight the different organizational dynamics at work in every landscape, discuss the need for an integrated city operating model and the challenges involved.

[1] In the definition of Boell & Cecez-Kecmanovic (2015, p. 4959): "Of general interest to the field of IS are therefore all aspects of the development, deployment, implementation, use and impact of IS in organizations and society. However, the IS field is not primarily concerned with the technical and computational aspects of IT. What matters to IS instead is how technology is appropriated and instantiated in order to enable the realization of IS that fulfill various actors'—such as individuals, groups or organizations—information needs and requirements in regards to specific goals and practices".

The motivation for this chapter is rooted in our consultancy practice for the Dutch government. During the last three decades, we have been witnessing the rise—and sometimes fall—of digital technologies at different levels of government in the Netherlands, to many known as a frontrunner in digital innovation. As a consultant, we have been involved in back-office IT projects, egovernment programs, and, more recently, smart city programs. Although our argument is inspired by the context of Dutch city government, other city governments face similar challenges.

We continue this chapter as follows:

In the next section, we will explore the various IS landscapes in city government. We will discuss several stage models that have been introduced in the literature on egovernment and smart city. Building on these models, we will present an overarching model, covering all the different IS landscapes in city government.

Then we will discuss an integrated approach. We will present a stylized model of the fragmented IS landscape of city government and will elaborate on the challenges involved in developing an integrated approach.

We conclude this chapter with some conclusions, both for practice in city governments and for further academic research.

Different Technologies and Different Worlds

The digital revolution, including the introduction of smart technologies within cities, is part of a development that has been going on for a quite some time and which here is called the "digital industrial revolution." The introduction of back-office technology and the rise of the internet are also part of this digital industrial revolution. The digital industrial revolution is the fifth, and for now the final, industrial revolution of the last 250 years. According to Perez (2009) and others (Brynjolfsson & McAfee, 2014) this revolution started in the 1970s with the introduction of the computer, followed by the internet and artificial intelligence. It is impossible to tell when this revolution will end and what will be the next revolution. Some speculate it will be about nano and biotechnology, possibly in combination with digital technology (Drechsler, 2010).

In academics, research into techno-economic paradigm shifts is aimed at analyzing this kind of revolutions. According to Perez (2009, p. 6) a technological revolution is defined as follows: "What distinguishes a technology revolution from a random collection of technology systems and justifies conceptualizing it as a revolution are two basic features. (1) The strong interconnectedness and interdependence of the participating systems in their technologies and markets. (2) The capacity to transform profoundly the rest of the economy (and eventually society)."[2]

[2] Perez further explains (Perez, 2009, p. 6) "Thus, a technological revolution can more generally be defined as a major upheaval of the wealth-creating potential of the economy, opening a vast innovation opportunity space and providing a new set of associated generic technologies, infrastructures and organisational principles that can significantly increase the efficiency and effectiveness of all industries and activities."

The concept of technological revolution and techno-economic paradigm shifts is applied—according to our knowledge—only to a limited extent within the discipline of public administration and egovernment. As far as (historical) modeling of the use of digital technology in government is concerned, it is often within a specific generation of technology and the value models related to them. A well-known example is the—older—model of Layne and Lee (2001), which describes the different stages in the evolution of egovernment IS. Another example is the model on smart city stages, presented by the International Electronic Commission (IEC) (2014) (Table 1):

Some other models, like Vintar (2010), Janowski (2015), and Pereira et al. (2018), are more encompassing. Their models of the evolution of digital government address all the use of ICTs in government. Vintar focuses on the technology evolution in the back- and front-office IS, what we call here "digital city," or the use of ICTs both in front and back office. Janowski's model is also about the evolution of the digital city, but focusses on the impact of different technologies. Pereira's model is both about the digital city IS and the smart city IS.[3] All the stages in these models are not linear, but rather iterative.

Table 1 Stage models egovernment and smart city

Egovernment 4-stage model (Layne & Lee)		Smart City 5-stage model (IEC)	
Catalogue	Online presence. Catalogue presentation. Downloadable forms	Measured	Pervasive sensor networks throughout city
Transaction	Services and forms online Working database supporting online transactions	Networked	Node connections through low-cost communications
Horizontal integration	Lower level systems supporting higher level systems. Within similar functionalities	Managed	Real-time analysis and control of city systems
Vertical integration	Systems integrated around different functions. Real one stop shopping for citizens	Integrated	Integration of isolated systems and across cities
		Smart	SaaS-based citizen services, applications, and management tools

Source: Layne and Lee (2001) and IEC (2014)

[3] Adding to conceptual confusion is that some scholars define Smart City as a Digital City. See for example the definition of Toppeta in Chourabi et al. (2012, p. 2290): "A city combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability." Conceptual clarity is needed and will help to understand why there need to be newer concepts developed to understand the smart city dynamics instead of re-using the existing egovernment concepts. See also Meijer and Bolivar (2015) who touch upon the necessity of new conceptualization for the smart city.

Table 2 Stage models digital city and smart city

Evolution digital city		Evolution digital and smart city
Technology evolution (Vintar)	Impact evolution (Janowski)	Governance evolution (Pereira et al.)
Stage 1: Computerization	Stage 1: Digitization	Stage 1: Electronic government
Stage 2: Informatization	Stage 2: Transformation	Stage 2: Smart government
Stage 3: Egovernment	Stage 3: Engagement	Stage 3: Smart governance
Stage 4: Egovernment 2.0	Stage 4: Contextualization	Stage 4: Smart city governance

Source: Vintar (2010), Janowski (2015), Pereira et al. (2018)

Summarized (Table 2):

Building on these models and other literature (Lips, Bekkers, & Zuurmond, 2005; Yildiz, 2007), we have developed an overarching model, covering all phases of digital technology in government. This is a three-stage model: back-office IT systems, egovernment systems, smart city systems. This model aims to reflect all the different kinds of ICTs in use in city government, plus the organizational dynamics involved (Table 3).

We will elaborate on each IS landscape:

Back-Office IS

Back-office systems are about the administrative, management, and office systems in use in city government. They support the efficiency and effectiveness of the operations of city government. Often terms such as "silo" or "legacy" (Bannister, 2001) are used to characterize this technology landscape. These associations already indicate that the application of technology here is not particularly innovative or cross-sectoral. This is not to say no innovation takes place here. In recent years, important new technological concepts have been implemented, such as cloud computing and related models such as SaaS, PaaS, and IaaS.

eGovernment IS

Front-office systems have been implemented since the rise of the internet supporting the egovernment concept. This network technology enables digital interactions and services in the field of G2C, G2B, and G2G (Nixon & Koutrakou, 2017). It also supports open government and open data, mobile government, and when the web turned 2.0, it also allowed governments to go on social media. Implementation of

Table 3 Characteristics different IS landscapes in city government

Label	*Back-office IT*	*eGovernment*	*Smart City*
Time period	1970s plus	1990s plus	2010 plus
Process	Computerization and informatization	Digitalization and communication	Datafication and robotification
Technologies	Mainframes, PCs, client/server	Internet, mobile, platforms	Internet of things, AI, blockchain
Integration	Monolithic	Loosely coupled	Distributed
Domain	Back-office (internal departments)	Front-office (external G2C, G2B, G2G)	Out-of-office (various stakeholders in the city)
Architecture	Organizational level	Organizational + national level	Organizational + city level
Management focus	Business and IT alignment, vendor strategies, IT legacy	Front- and back-office integration, multichanneling, user-centric design	Multi-stakeholders, triple, and quadruple helix
Roles City government	Buyer, implementator, user	Buyer, (user centric) designer, implementator, user	Coordinator, investor, regulator, steward, strategist, connector
Governance	IT Department	Public Services Department	Smart City Department
Data	Structured, descriptive, static	Structured, descriptive, static	Unstructured, operational, real-time
Added value	"More" (efficiency and effectiveness)	"Better" (service and transparency)	"Different" (governance and policy)

Source: Author (2018)

egovernment IS is enabled by national digital infrastructures. In the EU, there is even a cross-border digital European infrastructure. Nonetheless, almost two decades of egovernment history have learned that the anticipated public reform did not happen (Fountain, 2014). In most Western European countries, the existing structures are more or less untouched. We might say that egovernment did not yet deliver, or just partially, on its promise of "one-stop-shopping" or "seamless" government for the citizen.

Smart City IS

The implementation of smart city systems will add another layer to the existing IS landscapes in city governments. In the beginning of the new millennium, ICTs developed by big tech firms like Cisco and IBM were promoted as a solution for the challenges cities are facing: the concept of the "smart city" was born. Since almost a decade now cities worldwide are developing smart city programs, mostly experimenting with these technologies.

Smart city IS are intended to be implemented in different vertical domains (mobility, waste, energy, etc.), creating a "system of systems" (Cavalcante, Cacho, Lopes, & Batista, 2017). That is also why interoperability and governance are so complex because of the open networks, the heterogeneity of the stakeholders, and the unpredictable behavior of actors and systems. City government also has different roles to play in these networks. Besides coordinator of the smart city program, they act as regulator, steward, strategist, connector, or investor (Deloitte, 2015).

The new dynamics involved with the introduction of smart city IS, although perhaps not immediately clear in the beginning stages, will impact the existing city policy and governance models. As a result, there will be disruptive impact on the organization of city government itself. New roles, processes, and jobs will appear and old roles, processes, and jobs will disappear. Without the organizational transformation of city government, it will be doubtful if the use of smart city IS will ever become a real success.

Summarized (Fig. 1):

Discussing an Integrated Approach

Overlooking these different IS landscapes in city governments, the call for a more integrated approach is not a surprise. "Integration" in a general sense, means "bringing together and uniting things" (Wikipedia). According to the British Standardization Institute (BSI) (2014, p. 14) in their view on smart cities: "Smart city leaders should ensure that their city vision includes the need to develop an integrated city operating model, which is focused around citizen and business needs, not just the city's organizational structure."

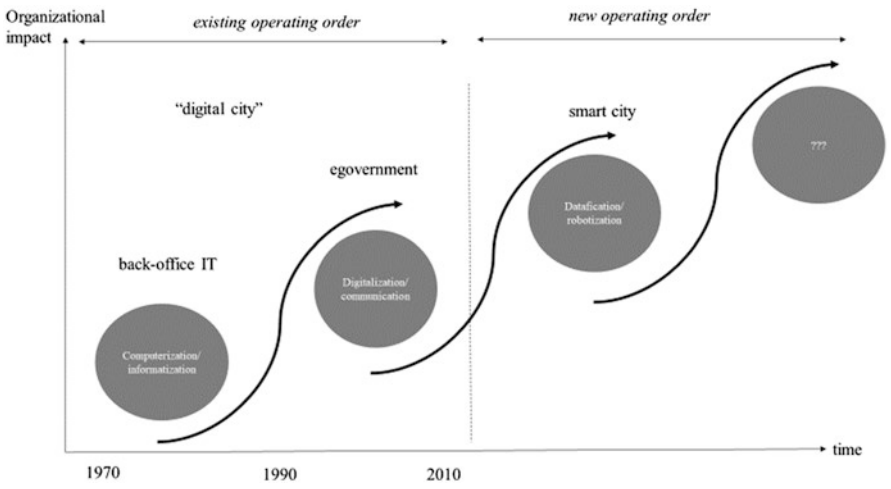

Fig. 1 IS landscapes in city government. (Source: Author 2018)

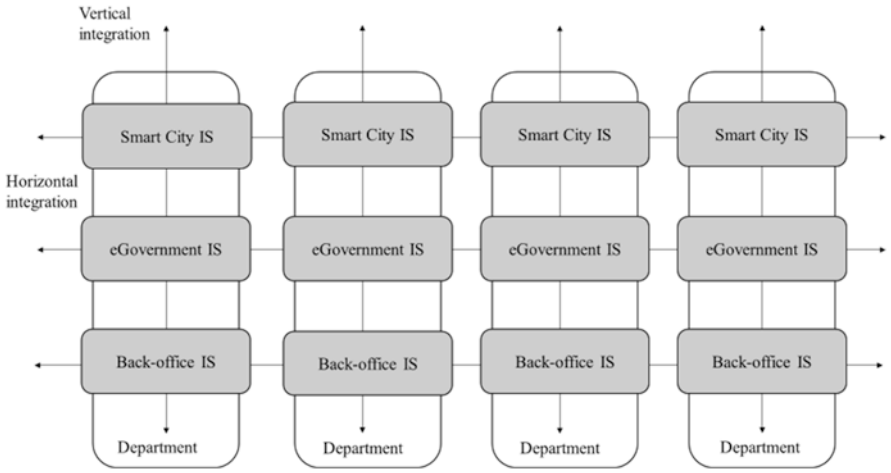

Fig. 2 IS integration in city government. (Source: Author, 2018)

Building on the current operating IS model, adding smart city IS on top, the image of the departmental siloed bureaucracy (Bannister, 2001) almost becomes a 3D-picture: departments having their own back-office IT, egovernment services, and in the near future their own smart city systems. This can be shown stylized as follows (Fig. 2):

IS integration has a vertical and a horizontal dimension. Vertical integration implicates integrating IS from a specific domain perspective (mobility, energy, waste, etc). Besides all the integration challenges in every specific IS domain (smart city, egovernment, back office), there is an overarching integration challenge. For example, how to combine traffic pollution data gathered by smart city IS with administrative data of car ownership and parking policies in the domain of mobility? In other domains, other challenges will exist.

The horizontal integration aims at combining data from the different domains to enable cross-sectoral policy-making and service delivery by city government. Here, every IS landscape also has its own challenges, see the following examples (Table 4):

Especially the introduction of open urban data platforms might be an impactful instrument for integration (Schieferdecker, Tcholtchev, & Lämmel, 2016), combining smart city data and open data as a basis for new models for policy-making and service delivery. For example, it will be interesting to see how predictive models will be implemented in current city policies.

In the remainder of this section, we will discuss IS integration from several perspectives: (1) business value, (2) phasing, (3) funding, (4) mindset, (5) reskilling, (6) standardization, and, last but not least, (7) ethics.

Table 4 Examples horizontal IS integration challenges

IS landscape	*Horizontal integration challenge*
Back-office IT	Enterprise architecture
Egovernment	Portals for one-stop-shopping
Smart city	Urban data platforms

Source: Author (2018)

Business Value

What is there to gain by an integrated IS approach? In the current practice, back-office IT, egovernment services, and smart city programs differ in ICTs at use and their organizational settings. This practice has grown over the last 50 years and has become more or less institutionalized. Nowadays, there is a separate IT department, public services department, and smart city department at work in city government. The lack of an integrated approach leads to the current operating modus, characterized by BSI (2014, p. 14) as: "unconnected, not customer focused, inefficient use of resources (staff, systems), not open to externally led-innovation. no ability to drive cross-system innovation, no ability to drive city scale change at speed."

It is obvious an integrated approach will help to overcome the imperfections of the existing operating order. BSI (2014) has depicted the different elements in such an approach, also summarizing the potential benefits (Fig. 3):

Phasing

Taking into account the challenges modern cities are facing, an integrated IS approach must address these issues for the next phase of IS evolution that cities will enter. In the current phase, smart city initiatives (Chourabi et al., 2012) are mostly about setting up experiments with smart technologies and using the city as a "living lab." Also egovernment and back-office IT are embedded in their own specific dynamics. Egovernment is now witnessing the next step to a more personalized and fulfilling service model for citizens (European Commission, 2017), while back-office IT is tangled up in implementation of cloud computing and other instruments for further rationalization.

In the next phase of smart cities, when it comes to implementation, an integrated approach needs to be applicable. Based on theory of disruptive innovations (Christensen, 1997), we might anticipate two different scenarios. First, a radical scenario, where the existing operating order will be "cannibalized" by the new operating order. This will happen when, for example, the implementation of smart city solutions will make existing back-office processes obsolete. Second, an incremental scenario, including a step-by-step implementation of integration between the different IS.

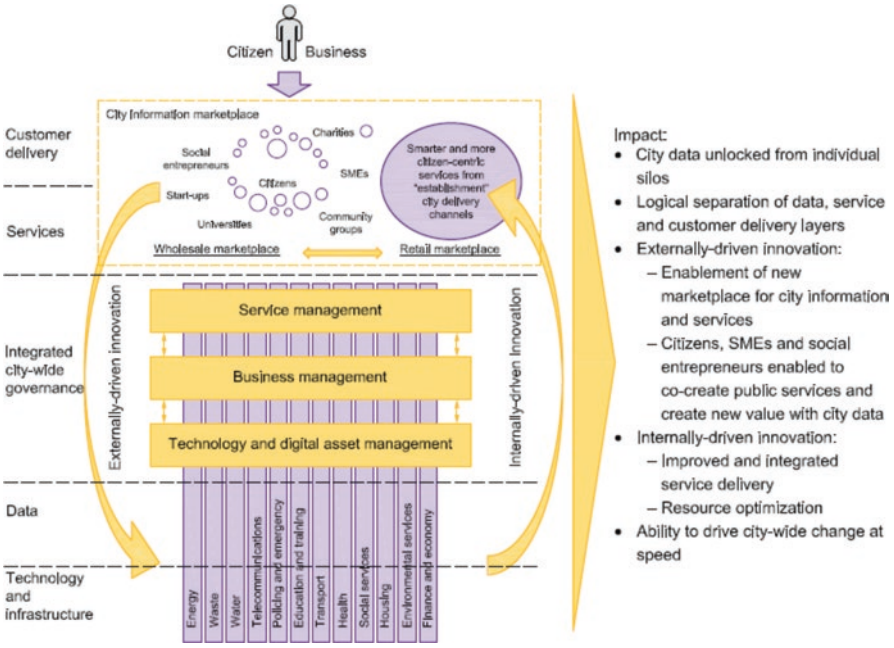

Fig. 3 An integrated IS approach for city government. (Adapted from: British Standardization Institute (2014). Smart city framework—Guide to establishing strategies for smart cities and communities. Department for Business and Skills, UK. p. 15. Copyright 2014 by BSI)

Funding

In the existing order, city government is funding IS in front and back office. With smart city IS, alternative models will evolve, open for (co-)funding by other stakeholders. Since these models are pretty recent, little is known about their actual financial impact and support of smart city IS. The opposite applies, as stated, for the funding models of the current IS in front and back office. As a thumb of rule, ICT budgets are usually spent in a general estimated proportion of 70:20:10. This means 70% budget spending on existing IT legacy, 20% innovations to sustain the existing legacy, and 10% for "new" innovation.

If disruptive innovation becomes more important in cities, these proportions might be challenged and adjusted. Keeping on spending 70% of the ICT budget on existing legacy is not a sustainable model for financing future innovations.

Mindset

The greatest danger of turbulence is not turbulence itself, but to act with yesterdays logic—quote Peter Drucker on "turbulence". Yesterday's logic is omnipresent in the operating model of cities because this model has evolved during the past decades when ICTs were mainly *enabling technologies*. The new smart ICTs are *transformative* technologies (Lips et al., 2005) and will create a double challenge for current leadership, management, finance, and HR. First of all, these functions itself will be disrupted by new technology, and second, these functions have to guide the transformation city governments will face in the future. This will demand a whole new mindset and supporting instruments. For example, the function of financial auditing will be disrupted by technologies like "daily auditing." At the same time, auditors have to develop new frameworks to assess the innovative projects in the name of smart city. These projects do not fit into the traditional business case frameworks applied to "normal" projects because these new projects are more about exploring new models instead of better exploiting existing models.

Reskilling

The coming episode of implementing new ICTs in city government will impact the workforce at least in two ways. First of all, change must be anticipated in the quantity of the workforce. New jobs, like data scientist, will appear, while some jobs, especially administrative ones, will disappear. In the last decade, for example, a lot of administrative jobs have disappeared in banking and insurance. The same jobs are in danger in city government the coming years. Second, the essence of work will change. The World Economic Forum (WEF)/Boston Consulting Group (2018) predicts intensive man–technology collaboration in almost every job, which calls for a *reskilling* revolution as part of the digital revolution. This reskilling revolution will also require new learning models, to deliver on the fast pace of technology change. For city government, an integrated approach is essential on this perspective, to see how staff resources can be optimized and used cross-departmental.

Standardization

Standards, especially open standards, are crucial to guarantee interoperability between the various IS of city government and to avoid vendor lock-in. In the field of back-office IT and egovernment systems over the time of the years, a whole range of standards has been developed, and an adequate governance structure is in place. In the field of smart cities, standards are still under development, over the whole array of vertical domains and all the heterogeneous systems involved, plus the

horizontal functions, like, for example, IoT security (Mulder, 2016). These dynamics in standardization are part of the innovative character of the technologies involved. To deal with the uncertainties about technical standards, while at the same time making progress in experimentation and implementation, procurement can be a valuable instrument to address future proof open standards in contracting smart city systems. To prepare for interoperability among all the IS at use in the city government, open standards must be part of citywide IS architecture.

Ethics

Ethics will become a major issue in discussing the use of future ICTs in city government. These concerns include not only privacy and security matters but also concerns about the power of big tech platforms, the transparency of algorithms, or system's autonomy in decision-making. These concerns are much more impactful than the ICTs ethics discussion until now. Computer ethics used to be about matters as intellectual property, privacy, liability, etc. (Moor, 1985). With egovernment, the ethics discussion circled mainly about inclusion (EU, 2017). The introduction of new smart technologies has induced an intense debate about digital ethics, at least in Europe, facilitated by the General Data Protection Regulation (GDPR). Future innovation strategies of cities cannot do without an ethical framework. This is illustrated by the growing need for ethical principles and codes of conduct (Nemitz, 2018). These ethical frameworks need to be included in the IS integration approach.

For example, the cities of Amsterdam en Eindhoven (City Council of Amsterdam and Eindhoven, 2017) in the Netherlands have developed an IoT Charter with principles for data collection and use in the public domain of the city. This charter is uploaded to the national and EU-level.

Conclusions

For the future innovation strategy of city government, it is important to understand the different dynamics in the IS landscapes of back-office IT, egovernment, and smart city. The fragmentation caused by these landscapes does not only hinder efficiency but also cross domain innovation, more citizen focus and citywide change. An integrated IS approach is needed to address these issues to ensure a solid innovation strategy for cities.

For practitioners, including city executives and politicians, and their consultants, it is crucial to acknowledge the importance of an integrated approach of the different IS landscapes in the near future, at the same time allowing room for the current innovations taking place in the different IS landscapes, such as the experiments in smart cities or the implementation of the next-generation egovernment technology.

For academic scholars, there is a new chapter to write about IS integration. Especially scholars from public administration and egovernment, interested in the concept of smart city, should take an integrated approach, since the innovations of the smart city will not take place in splendid isolation. To understand and analyze the future dynamics at work, it is also necessary to develop new concepts.

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