



An emerging typology of IT governance structural mechanisms in smart cities



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ARTICLE INFO

Keywords:

IT governance
Structural governance mechanisms
Public sector
Smart cities
Adaptive governance

ABSTRACT

The institutionalisation of Smart City Functions (SCF) within local authorities creates significant IT Governance (ITG) challenges, including the need to foster a triadic alignment between the overall organization, the IT function and the SCF. Building on existing literature on ITG, smart cities, and the emerging conversation on Adaptive Governance in the public sector, the following exploratory question has been formulated for this study: *How are ITG structural mechanisms implemented in city authorities to oversee and govern smart cities?* To address this question, a qualitative multiple case study was carried out across three city authorities in Ireland characterised by diversity in their ITG structural arrangements to govern portfolios of smart city initiatives. From this analysis three types of ITG structural implementation are proposed named: Detached, Integrated, and Traditional. These are compared and discussed in relation to: (1) orientation of each approach; (2) decision-making authority; (3) alignment with the IT function and the overall municipal organization; and (4) the challenge perceived by the SCFs under each ITG arrangement. This research contributes to the academic conversation on adaptive governance, smart cities as well as to the broader ongoing debate on ITG in the public sector.

1. Introduction

There is growing concern that implementing effective governance arrangements constitutes a major obstacle for cities becoming ‘smart’ (Scholl & Alawadhi, 2016; Ruhlandt, 2018; Praharaj, Han, & Hawken, 2018; Silva, Khan, & Han, 2018; Rana et al., 2018; Kar, Ilavarasan, Gupta, Janssen, & Kothari, 2019). To help address these concerns, this study explores how city authorities implement structural IT Governance (ITG) mechanisms to oversee and govern smart city initiatives, thus contributing to the ongoing debate on ITG in the public sector, and specifically to emerging academic conversations advocating more adaptive approaches to ITG.

Over the last decade, there is a growing trend for information technology (IT) in the public sector to be seen, not as a cost centre (e.g. Campbell, McDonald, & Sethibe, 2010), but as a source for innovation (Feller, Finnegan, & Nilsson, 2011; Gil-Garcia, Chengalur-Smith, & Duchessi, 2007; Janssen & Van Der Voort, 2016). City councils are among those public bodies fostering IT-enabled innovation driving the complex, sometimes controversial notion of smart cities (Corbett & Mellouli, 2017; Hollands, 2008). While the lack of a consistent

definition of the term smart city is well acknowledged (Ismagilova, Hughes, Dwivedi, & Raman, 2019; Yigitcanlar et al., 2019; Yigitcanlar, Hoon, Kamruzzaman, Ioppolo, & Sabatini-Marques, 2019), with differing smart cities implementations evident (Fietkiewicz, Mainka, & Stock, 2017), our focus corresponds with many smart city definitions (e.g. Caragliu, Del Bo, & Nijkamp, 2011), in asserting that cities developing smart agendas strive to manage the implementation of a collection of IT-dependent strategic initiatives (according to Piccoli and Ives (2005)’s definition) to realise public value.

In this context, as a response to the need of public bodies to cope with the rapidly changing IT environment, extant IS literature advocates for more adaptive approaches to governance, e.g. (Hong & Lee, 2018; Janssen & Van Der Voort, 2016; Wang, Medaglia, & Zheng, 2018). This means moving from established governance mechanisms based on stability and accountability, towards governance arrangements enabling adaptation in the context of “policies, legislations, systems and even internal structures” (Janssen & Van Der Voort, 2016, p.1). This study specifically focuses on the structural aspect of governance within city authorities.

In the context of smart cities, from a structural perspective, city

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<https://doi.org/10.1016/j.giq.2020.101499>

Received 20 September 2019; Received in revised form 13 March 2020; Accepted 20 June 2020

Available online 16 July 2020

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councils have created separate functions to manage these IT-dependent strategic initiatives. This represents an evolution from early stage smart city implementations, in which temporary committees and groups were established within city councils' organisations for specific tasks, to a situation in which Smart City Functions (SCF) are increasingly being institutionalised as an additional/overlay structure within city authorities (Connolly, Maccani, & Donnellan, 2017; Ojo, Curry, & Janowski, 2014). These SCFs are emerging governance structures, working across city silos, overseeing the implementation of new and emerging technology. They are in effect change agents, put in place to focus on exploiting emerging technology, without the burden of ongoing day-to-day IT service provision responsibilities within the city authority. Such responsibilities are retained by the "traditional" IT function. The establishment of SCFs are clear examples of ITG structural changes where cities strive to implement more adaptive approaches to governance, as these are argued to require "balancing stability [from 'traditional' IT functions] and adaptability [from SCFs] and requires building so-called ambidextrous organizations" (Janssen & Van Der Voort, 2016, p.2). With this new structure, we argue that SCFs pose important ITG challenges which reflect important gaps in the mainstream IS literature, namely:

First, ITG has traditionally been viewed as a framework to achieve alignment between organization and IT functions (Weill & Ross, 2004). In the context of adaptive governance and with the advent of the SCF, ITG of smart city initiatives now must foster alignment between the overall organization, the IT function, and the SCFs.

Second, IS research on ITG in the public sector is argued to be immature, where "researchers are far from establishing a consensus on the effects of ITG mechanisms in public organizations" (Tonelli, de Souza Bermejo, dos Santos, Zuppo, & Zambalde, 2017, p. 595).

Third, in the public sector realm, a significant academic conversation has emerged in the last decade in terms of e-governance (Valdés et al., 2011); Dawes, 2009; Twinomurinzhi, Phahlamohlaka, & Byrne, 2012; Ojo, Janowski, & Awotwi, 2013), where, unlike ITG, the focus is on "the use of ICT to improve governance processes" (Estevez & Janowski, 2013: p. 94). These studies typically focus on eGovernment implementation (sometimes included in smart city portfolios) but don't necessarily fit the wider scope of smart city visions. The breadth of smart initiatives is exemplified by cities such as Amsterdam who has been driving a variety of IT/IS projects for a number years including the development of an IoT infrastructure, open data initiatives, citizen-centric crowdsourcing, smart districts and buildings, and the development of innovation ecosystems (Amsterdam City, 2019). Clearly, these initiatives span beyond traditional IT-enabled innovation in the public sector, e.g. e-government (Cordella & Iannacci, 2010). They are very often data-driven, address city services external to the city authority, involve an ecosystem of external service providers, and are often characterised by an increased level of scale and complexity (Corbett & Mellouli, 2017).

Fourth, while smart city literature widely acknowledges governance as a key barrier for cities to become "smart" (Scholl & Alawadhi, 2016; Rana et al., 2018; Kar et al., 2019), "research on Smart City Governance appears to be even more ambiguous and disintegrated than that carried out on Smart Cities, more broadly" (Ruhlandt, 2018; p. 11).

Finally, in the public sector realm, drawing on the concept of adaptive governance (Janssen & Van Der Voort, 2016), a few studies have investigated how it has been operationalized only at a project level – e.g. in the context of social media and open data contests (Wang et al., 2018) – or in specific domains – e.g. in sharing economy scenarios (Hong & Lee, 2018). Therefore, we identify a significant research gap concerning how adaptive governance mechanisms are implemented by city authorities to govern complex portfolios of IT-enabled strategic initiatives, i.e. beyond the project level.

The identification of these gaps leads us to formulate the following exploratory research question for this study: *How are ITG structural mechanisms implemented in city authorities to oversee and govern smart*

cities?

We address this question by selecting, empirically exploring and comparing three in-depth case studies carried out in the period from January 2016 to December 2018. They reveal how smart cities are being implemented in three Irish cities from an ITG structural perspective. The three cities developed smart city visions in 2015, when SCFs were established within the authority's structures and have been in operation ever since. From the analysis of these three cases, we discuss an emerging typology of ITG structural implementation. Specifically, we outline three identified approaches to smart city structural ITG at a city authority level, named: *Integrated*, *Detached*, and *Traditional* structures. Differences in these ITG structures and related implications are further discussed and compared in terms of the: (1) orientation of each approach; (2) authority of the SCFs under each ITG arrangement; (3) alignment with the IT function and the overall organization; and (4) perceived challenges. In addition to contributing to the gaps highlighted above, we attempt to uncover how different ITG choices lead to different conceptualisations of what the scope of a smart city is, therefore questioning the value of various attempts to provide smart city definitions valid across contexts.

This paper's structure adheres to the recommendations provided for in-depth qualitative multiple case studies (Eisenhardt & Graebner, 2007; Walsham, 1995). The next section is dedicated to an overview of the relevant literature. This is followed by a description of the methodology designed for this study. Section four presents the findings in terms of the rich descriptions emerging from the individual case studies. Section five positions our findings within the existing literature, whereby we compare the three different ITG structural mechanisms. The discussion leads to section six where we outline this study's implications for practice and research before conclusion, limitations and future research.

2. Theoretical background

In this section, we first provide an overview of the concept IT Governance (ITG). We then focus on structural mechanisms for ITG implementation followed by a reflection on how these concepts apply to smart city scenarios.

2.1. IT governance

IT governance (ITG) is traditionally defined as "the capacity of top management to control the formulation and implementation of the IT strategy via organizational structures and processes that produce desirable behaviours, which will ensure that IT initiatives sustain and extend the organization's strategy and objectives" (Bradley et al., 2012, p. 157). A rigorous summary of ITG can be found in the work of Wu, Straub, and Liang (2015) who reviewed constructs and their impact over the previous fifteen years. In this review we find one important fundamental constant, i.e., the role of ITG to support business strategy (De Haes & Van Grembergen, 2009; Huang, Zmud, & Price, 2010; Prasad, Heales, & Green, 2010). However, while early research on ITG focused on vertical coordination and integration (e.g. through SLAs), this focus is acknowledged as only providing limited ability to govern IT effectively (Peterson, O'Callaghan, & Ribbers, 2000; Tiwana & Kim, 2015; Tiwana, Konsynski, & Venkatraman, 2013). This limitation suggests a new focus on lateral structures that enable processes and relational abilities to direct and coordinate the multifaceted activities associated with the planning, organization and control of IT (Peterson, 2004).

With respect to ITG implementation, Van Grembergen and De Haes (2009) define ITG as an integral part of corporate governance, which addresses the definition and implementation of processes, structures and relational mechanisms in the organization that enable both business and IT people to execute their responsibilities in support of business/IT alignment and the creation of business value from IT-enabled

business investments. In the literature, many studies have operationalized ITG implementation as elements consisting of structure, process, and relational mechanisms (Boonstra, Yeliz Eseryel, & van Offenbeek, 2018; De Haes & Van Grembergen, 2005, 2009; Peterson, 2004; Peterson et al., 2000; Weill & Woodham, 2002). This structure-process-relational framework has been used widely to explore ITG implementation across a variety of organizational and industry contexts (Kuruzovich, Bassellier, & Sambamurthy, 2012; Schlosser & Wagner, 2011), and the public sector (Kaur & Bahri, 2014; Nfuka & Rusu, 2010). This research focuses on the structural element of this framework.

2.2. Structural mechanisms for ITG implementation

According to Peterson (2004), the structural component of ITG implementation focuses on the formal mechanisms for connecting and enabling horizontal, or liaison, contacts between business and IT management functions. These include formal positions and roles, structure, and decision rights. Extant literature has extensively focused on these mechanisms in the private sector (e.g. De Haes & Van Grembergen, 2005, 2009; Peterson, 2004; Tiwana, 2009; Winkler & Brown, 2013). ITG structural choices are argued to have three fundamental implications: the orientation of IT in the organization; the decision rights and authority of the IT function; and the resulting IT-organization alignment.

In terms of orientation, in the context of ITG structural choices, centralised versus decentralised configurations of ITG have taken most attention within IS research. In Sambamurthy and Zmud (1999)'s seminal work, they argue that centralised structures positively influence results related to IT infrastructure and architecture, while decentralised structures generate better decisions associated with business applications. Following this, Weill and Ross (2004) found that structural configurations influence results for decisions related to IT principles, IT architecture, IT infrastructure, business applications, and prioritization. In the smart city context, work on ITG needs to expand to take into account the new emerging structure of the SCF and the subsequent need to foster triadic alignment.

Decision rights or decision-making authority are acknowledged as being another crucial element within the context of ITG structural implementation (Anand & Mendelson, 1997; Nault, 1998; Tiwana, 2009; Winkler & Brown, 2013). While Tiwana et al. (2013) argue that decision rights are underexplored in the extant ITG literature in IS, establishing an accountability framework for IT decisions has been advocated as a crucial element for effective ITG implementation (Brown & Grant, 2005; Ross & Weill, 2002). The main argument to date with respect to decision rights focuses on the need for strong participation of business and IT managers in IT decision making (Bassellier, Benbasat, & Reich, 2003; Sambamurthy & Zmud, 1999, 2012; Weill & Ross, 2004). The difficulty is that the IT function has mainly been viewed as the unit responsible for IT decision making, ignoring the part played by business (Lacity, Solomon, Yan, & Willcocks, 2011), which is especially true in the public sector (Campbell et al., 2010; Tonelli et al., 2017).

As the third element, alignment can be described as the ultimate goal of ITG to be achieved through structural, process, and relational mechanisms (Boonstra et al., 2018; De Haes & Van Grembergen, 2005, 2009; Peterson, 2004). Therefore, alignment raises a third broader set

of implications relating to specific ITG structural choices, i.e. how does structure facilitate alignment, and therefore decision-making integration between IT and the organization? Teo and King (1999) propose a framework (Table 1) consisting of four different integration levels to qualitatively assess alignment through investigating the degree to which business and IT decisions are integrated because of ITG implementation efforts.

In conclusion, structural ITG mechanisms tend to be mandatory, tangible, and often implemented in a top-down manner (Peterson, 2004). This is the case of SCFs in local authorities (Connolly et al., 2017; Maccani, Connolly, & Donnellan, 2019), i.e. the unit of analysis for this study.

2.3. Smart City structural mechanisms for ITG implementation

Recent literature argues for the need of smart cities practices “to be embedded in all aspects of city governance” as opposed to “something that is added next to existing initiatives” (Kar et al., 2019; p. 495) emphasising the subsequent “amount of planning and strategic execution required” (p. 498). Silva et al. (2018) acknowledge governance as one of the pillars of smart city, advocating for the development of an institutional infrastructure integrating “public, private, civil, and national organizations when necessary to provide interoperation between services” (p. 699). In this context, governance is identified as one critical barrier for cities transitioning to “smart” (Ruhlandt, 2018; Rana et al., 2018). In a similar fashion, in their extensive literature review, Yigitcanlar et al. (2018) identify the need for smart city researchers and practitioners to explore “new and innovative forms of governance” (p. 5) as a potential solution to existing challenges, thus supporting the need for exploratory studies to better understand how ITG is implemented in these contexts.

With respect to structural ITG, in their systematic literature review, Ruhlandt (2018) describes smart city structural governance as “the structural or organizational formations that facilitate the interaction among stakeholders or allow for certain processes” (p. 6) requiring the dismantling of old departmental silos (Scholl & Alawadhi, 2016) (i.e. aligned with the concept of institutionalisation of SCFs). However, Ruhlandt (2018)'s findings show that “most of the structural and organizational considerations are quite general” (p.6) and that “research on Smart City Governance appears to be even more ambiguous and disintegrated than that carried out on Smart Cities, more broadly” (p. 11). Overall, reviewing the extant literature, we argue that ITG structural mechanisms in smart city scenarios are currently underexplored. Consistent with the ITG literature presented above, different structural arrangements have important implications in relation to: orientation of the SCF; its decision making authority; and the resulting alignment with both the IT function and the overall municipal organization. These are contextualised in the paragraphs below.

With respect to orientation, beyond the traditional IS debate between centralisation and decentralisation, public sector literature calls for more adaptive approaches to governance in smart city scenarios (Hong & Lee, 2018; Soe & Drechsler, 2018; Wang et al., 2018). From an ITG perspective, as presented above, this shift is problematic and requires structural changes, considered in this study through the institutionalisation of SCFs. Consistent with the IS literature on ITG, we argue that different ITG structural choices underpin different approaches to adaptiveness. This argument fits with the work of Janssen and Van Der Voort (2016) who propose and outline a range of different approaches to adaptive governance (Table 2).

These approaches to adaptive governance offer good insights from a strategic perspective. However, what ITG structural implementation mechanisms underpin these adaptive governance strategies (Janssen & Van Der Voort, 2016) remain unexplored.

With respect to decision making authority and accountability in smart cities, as exemplified in the introduction, SCFs are often responsible for governing IT enabled systems provided by third parties in

Table 1
Levels of IT decision making process integration (Teo & King, 1999).

Integration Level	Description
Administrative	Budgets and schedules are amalgamated between business and IT
Sequential	Business decisions provide directions for IT decisions
Reciprocal	Business and IT decisions are mutually influential
Full	IT and business decisions are concurrently part of the same process

Table 2
Adaptive Governance Strategies (Janssen & Van Der Voort, 2016).

Name	Main focus
Know the Stakeholders and their capabilities	Identify patterns of participants, their interests and goals, and look at how their capabilities can be used (De Bruijn & Ten Heuvelhof, 2018).
Mobilize stakeholders and cooperate	Mobilize stakeholders to form coalitions that can have all the capabilities and resources needed or might have already developed useful solutions (De Bruijn & Ten Heuvelhof, 2018).
Public-private strategies	As a specification of the previous strategy, public and private parties can be involved, but attention should be given to the differences in objectives (Klievink, Bharosa, & Tan, 2016).
Self-organization	Self-organization with teams and actor groups that draw on various knowledge systems and experiences for the development of a common understanding and policies (Folke, Hahn, Olsson, & Norberg, 2005).
Decompose complexity	Decompose a complex challenge into smaller, tangible problems that can be solved (Sutherland, van Solingen, & Rustenburg, 2011).
Keep options open	Make decision that cannot be easily alternated as late as possible to keep the options open and if needed choose another direction (Dym & Little, 2009).
Flexible infrastructure	Providing infrastructure that is flexible and adaptive and can facilitate various directions over time (Janssen, Chun, & Gil-Garcia, 2009).
Shortening decision making times	Inform higher-level decisions from the bottom-up and ensure short decision times. Once innovations are spotted, there is a need for decision-making within a short time. Procedures allowing this should be in place (Janssen & Van Der Voort, 2016).
Education and training	Education and training are the key concepts to provide more leniency towards improvement and adaptation and provide more ability to react (Janssen & Van Der Voort, 2016).

multiple configurations, such as in the provision of infrastructure and services (Pereira, Macadar, Luciano, & Testa, 2017). In these scenarios the city authority is the focal point of coordination (Dameri & Rosenthal-Sabroux, 2014; Maccani et al., 2019; Popescu, 2015) and SCFs, represent an effort to cope with this uncertain and complex world, i.e. to develop adaptive ITG structural arrangements (Nelson, Howden, & Smith, 2008). However, the notion of smart cities as a whole is argued to be ambiguous (Yigitcanlar, Hoon, et al., 2019), whereby most researchers and practitioners rely on “ad-hoc conceptualisation of smart cities” (Yigitcanlar, Kamruzzaman, et al., 2019; p. 359). This in turn is reflected in a current lack in the understanding of what SCFs should be accountable for, i.e. what their authority is. Existing public sector and smart city literature has focused on addressing decision making authority and accountability issues in complex and multi-stakeholders IS contexts only at a project level (e.g. Chatfield & Reddick, 2018; Hong & Lee, 2018; Wang et al., 2018). Wang et al. (2018), for example, propose three types of adaptive governance based on an inductive analysis of the distribution of decision-making power and accountability across four different IS projects. Thus, research that considers the overall governing of portfolio of projects and initiatives also requires attention.

Regarding alignment, in the context of smart cities, Chatterjee, Kar, and Gupta (2018) demonstrate that alignment of knowledge, expertise and engagement is a cornerstone for addressing privacy and security concerns for citizens, which is alignment between the “IT authority” and citizens. In this study, we argued that the institutionalisation of SCFs within local authority dictates a new triadic relationship between the SCF, the IT function and the overall municipal organization, thus creating a novel ITG challenge. This relates to what Janssen and Van Der Voort (2016) highlight as a “major challenge” in adaptive governance arrangements, i.e. “to ensure stability and adaptability” by deciding which parts of an organization are accountable for IT-enabled change and which parts should remain stable for a longer time (p.3). In IS, this academic conversation is still in its infancy.

As a summary of this section, a review of the existing IS and smart city literature on structural mechanisms for ITG implementation leads us to the formulation of three focus dimensions for addressing our research question. Accordingly, we aim to understand: (1) the orientation of the SCF, by exploring the relationship between ITG structural choices and adaptive governance strategies (see Table 2) (Janssen & Van Der Voort, 2016), extending the ongoing debate on centralised versus decentralised approaches to ITG; (2) the decision making authority and accountability of SCFs, which currently remain underexplored beyond the project level; and (3) the consequences of ITG structural choices in terms of decision-making integration (see Table 1) (Teo & King, 1999),

given the emerging need for a triadic alignment between the SCF, the IT function, and the overall municipal organization, to understand how city authorities can coordinate the choice, the co-creation, and the value delivery of multiple IT-enabled services while continuing to deliver on their traditional expertise.

3. Research methodology

3.1. Qualitative multiple case study

City authorities represent complex settings in which cultural, social, and institutional contexts play a great influential role on ITG (Dawes, 2009; Janowski, 2016; Janssen & Van Der Voort, 2016). In order to take this into account, and given the exploratory nature of this study, we have adopted a qualitative multiple case study methodology, which can generate rich data, thereby thick descriptions (Geertz, 1973). A multiple case study methodology enables the exploration of complex situations allowing for the gathering of multiple perspectives, from a range of sources, including contextual information (Flyvbjerg, 2006; Lauckner, Paterson, & Krupa, 2012; Stake, 2013). Such studies have shown to result in an understanding of an issue problem, or phenomenon using the case as a specific illustration (Stake, 2013; Stewart, 2012).

3.2. Case studies selection

Three case studies were chosen as this is seen as an ideal number to investigate differences within the cases while not losing the idiosyncrasies of individual cases (Creswell, 2015; Lauckner et al., 2012). The cases are three Irish cities, with populations of between 100,000 and 500,000 inhabitants. In Europe, such cities are considered to be medium sized cities, home to nearly half of all European urban inhabitants (Giffinger, Fertner, Kramar, & Meijers, 2007). The three cities will be referred to as City A, City B and City C. By anonymizing the names and identities of cities and participants, the authors were able to secure access to a richer data set for analysis that would have been inaccessible otherwise. The choice of the case studies is in adherence to Stake's (2013) selection criterion – relevance (to the phenomenon of interest), diversity (in the structure and context) and accessibility (to the researchers). The three case are relevant as they represent typical SCFs, following a model implemented in many cities worldwide; they are diverse as their implementation was highly influenced by their context; and, due to the cities relationship with the authors, they were willing to provide appropriate accessibility to the case data and people. With respect to the selection process, through a preliminary

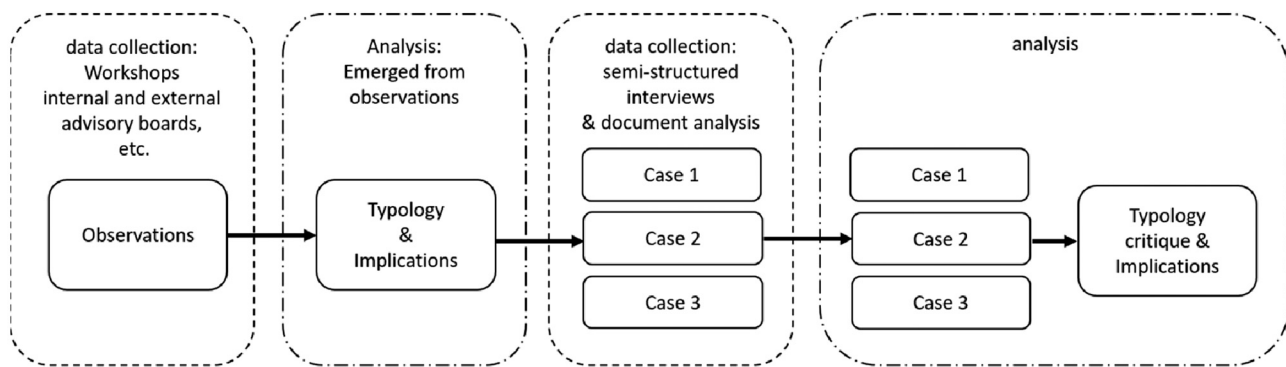


Fig. 1. Data Collection and Analysis Process.

investigation of the nine major cities on the island of Ireland, we could initially classify these based on the position of the SCF within the existing organizational structure. In particular: in two cities, SCF appeared to be an extension of the traditional IT function; the second cluster of four cities referred to those in which SCF are established as a cross-organizational function whereby the actual lead often emanates from Economic Development directorates. The third initial type related to one city where the SCF is institutionalised as a relatively independent unit reporting to the authority's CEO. To comply with the diversity criteria, the goal was translated into selecting one case study per type initially identified. Thus, the actual shortlisting of cases was conducted in relation to the former two. Here, one case per type was selected as these were found to be the most mature settings in terms of institutionalisation of smart city efforts, as opposed to early stage attempts to establish SCFs.

It is noted that, in terms of generalisability, Irish cities are managed similarly to the council-manager form in the United States. Elected councillors elect a mayor from within and are collectively responsible for the legislative function and establishing policy. The CEO of the council is a professional manager, with permanent staff, responsible for implementing policy. Unlike the US model, an Irish CEO is not appointed by the council; he or she is appointed by the central government.

3.3. Data collection

According to Stake (2013)'s recommendations, multiple case study research involves the investigation of "one case at a time" (p.1), and therefore, the three case studies were carried out independently. In particular, the individual cases were studied to learn about their self-centring, complexity, and situational uniqueness, consistent with the objectives for this research. Data collection came in two phases, with each followed by rounds of qualitative analysis (see Fig. 1).

The first stage was based on a series of interventions by the authors over a three-year period. These included digital readiness workshops, smart city readiness assessments, digital strategy support and participation on internal and external advisory boards. In each case, 10 to 20 senior managers and decision makers across departments actively participated. The embeddedness of the authors defines them as participants-as-observers (Gold, 1958), allowing them unequalled opportunity to observe the development of the SCFs and access to all relevant documentation, much of which they were given access to as they were drafted. These interactions and access provided a deep understanding of each city's context, i.e. the *situationality of the quintain* (Stake, 2013). Observational field notes and activity documents were stored and reviewed. From the analysis of these, a preliminary typology emerged based on structural differences, more granular than the one achieved during the case selection process, and the perceived effects of these structural decisions.

The second data collection phase was a series of semi-structured

interviews. These were based on a protocol developed from the core case study objectives (outlined at the end of section 2.3) and customised to each case depending on the preliminary findings achieved through the first phase. In-depth interviews were designed to fully explore the study's objectives, including gaining deeper understanding of key observations from the initial phase. To select "information-rich participants" (Miles & Huberman, 1994), we followed Purposive Sampling technique (Devers & Frankel, 2000) selecting interviewees based on their involvement in the SCFs, their experience and knowledge of its effects "so that it would be of most benefit to the study exercise" (Baccarini, Salm, & Love, 2004, p.289). As the SCFs in these cases are small, the interviews were sought from within the function and from stakeholders' groups. In total, 18 semi-structured interviews were conducted across the three cases. Interviewees comprised of the SCF lead ($n = 3$), SCF staff ($n = 2$), formally established internal digital champions ($n = 6$), and members of the external advisory group of their respective city ($n = 7$). These groups are explained more fully in the findings section. All interviews lasted between one and two hours. In parallel, we obtained data (descriptions) on project implementations from the SCFs, which provided invaluable insights on the effect of specific ITG choices.

3.4. Data analysis

The first phase of analysis was based on a literature review of concepts being observed in the SCFs over the three-year period. From observations, it was clear that the SCFs had different motivations, based on a single director who championed its creation. It was also clear that each city had their own pattern to the projects that emanated from the SCF. Lastly, as our chosen theoretical perspective is ITG, we were particularly interested in the relationship between SCF, the IT function, and the overall organization. These characteristics were studied from within literature (see section 2) and were integrated into the interview protocol.

The second analysis phase was based on in-depth interviews and documentation. We followed the open coding convention (e.g. Darke, Shanks, & Broadbent, 1998; Miles & Huberman, 1994; Stake, 2013; Walsham, 1995), which included: manually reviewing the data collected line-by-line to uncover key patterns/themes producing key words/phrases in relation to ITG structural mechanisms; looking for relationships among the codes; developing preliminary assertions for each case; and validating each case's findings. Therefore, the first objective was to extract codes and to categorize these in relation to the three main concepts in which the implications of ITG structural mechanisms can be unbundled: (1) codes that related to the orientation of the SCF; (2) those related to the authority of the SCF; and (3) those informing statements about alignment. In addition, while involved in this process, we identified significant statements related to existing challenges faced by each case study. These were initially coded as "perceived challenges" and were finally added as an additional set of

codes enriching the learning from each case. Next, the analysis proceeded separately across these four clusters. In this process, preliminary assertions were developed when sufficient evidence was found (i.e. supported by at least three sources of evidence). These were finally structured, presented to the city councils, and validated through further discussions with the smart city manager within each of three cases. This validation stage, together with (1) the authors' depth of knowledge of the cases, (2) the selection of all existing governance models in Ireland, and (3) an understanding of the interviewees, allow us state that theoretical saturation has been achieved within the context of ITG of SFCs in Ireland.

Given our objective of capturing the richness of these three cases, and to propose an emerging typology of structural ITG in smart cities, a cross-case analysis was not undertaken to avoid the risk of reducing complex cases to a few comparable variables, resulting in the loss of the idiosyncrasies of individual cases, or obscuring case knowledge including knowledge not pertinent to the cross-case analysis (Allport, 1962; Lauckner et al., 2012; Molenaar, 2004; Peattie, 2001; Walsham, 1995). Rather, the three different types are compared and discussed.

3.5. Validity and reliability of the study

To ensure trustworthiness of case study research, considerations must be given to construct validity, internal validity, external validity, and reliability (Stake, 2013; Yin, 2013).

Construct validity has traditionally been defined as the demonstration that a study is measuring the construct it claims to be measuring (Brown, 2000). In this way, in accordance with (Yin, 2013) and (Stake, 2013), validation efforts were conducted with smart city managers within each of the cases. Another suggestion to improve construct validity is to use multiple sources to provide evidences (Eisenhardt, 1989; Miles & Huberman, 1994). The range of data sources leveraged in this study is reflected in this principle.

Internal validity is concerned with the degree of the researcher inferences in the determination of causal relationships (Yin, 2013). Due to the embeddedness of the authors, coupled with a qualitative methodology, the question of bias arises. Gold (1958) refers to the risk of “going native” (p. 220) when playing the role of participant-as-observer. We are aware that critiquing a topic or context that we are familiar with means that bias does exist and that we need to be cautious. This means that we must be aware that the procedures and outcomes of our research are not the product of a heteronomous approach but the considered “best try” of a situated, autonomous team (Blair, 2015). To this end, the distribution of information sheet and consent forms prior to the data collection have ensured that our relationship with the city

employees is clear and understood.

External validity, instead, relates to the generalizability of the outcomes from the multiple cases (Yin, 2013). While the role of generalization in exploratory multiple case studies is controversial (Walsham, 1995), the specificities of the Irish context have been outlined (see section 2.3).

Ultimately, in relation to case study reliability, according to Yin (2013), we attempted to make our methods as transparent as possible, demonstrating a clear decision trail and ensuring interpretations of data are consistent. We also attempted to eliminate any potential individual biases, by separately analysing interviews and documentation, before convening to compare and consent on a list of codes-that were used for further analysis.

4. Findings

This section describes the findings from the three case studies. Findings from each case are presented separately. Quotes from interviews are written within quotation marks. Each subsection begins with a brief overview of the city followed by a figure depicting the ITG structure, illustrating both the roles, configuration and decision-making structure for each case studied. We then describe this structure in more detail.

4.1. City A

City A is the largest of the cities considered in this study. The smart city program was initiated by the current CEO in 2015. A program manager (PM) was appointed in early 2015, with a further one and half full-time equivalents over the next two years. In terms of ITG structure, the SCF reports directly to the CEO (see Fig. 2). This is detached from the IT function, which reports into the head of finance. Structurally, the relationship with IT and all other departments is through informal digital champions, identified through personal relations, and who are called upon only when initiatives affect their respective departments. While responsible for its own smart activities, City A's SCF contributes to a regional smart city effort, made up of four city authorities. The regional steering group is represented by the four SCFs of the respective cities in the region. In addition, the region has established an oversight group, consisting of over sixty external stakeholders from both the public and private sectors.

In terms of authority, City A's SCF has its own capital budget which allows it to seed exploratory projects. However, the primary funding comes from the relevant department, e.g. transport, waste or urban planning, on an ad-hoc basis depending on the project. The SCF

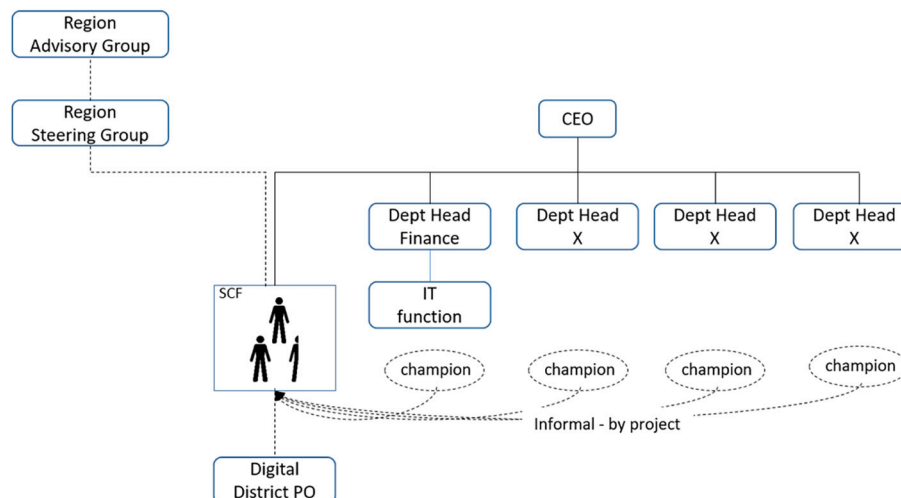


Fig. 2. City A ITG Structure.

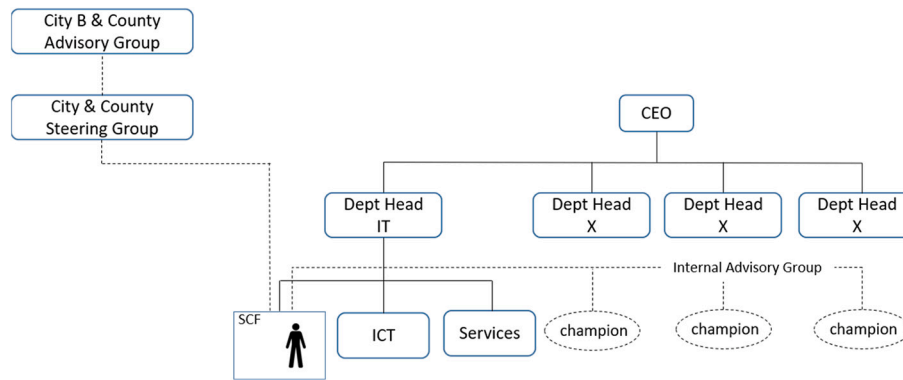


Fig. 3. City B ITG Structure.

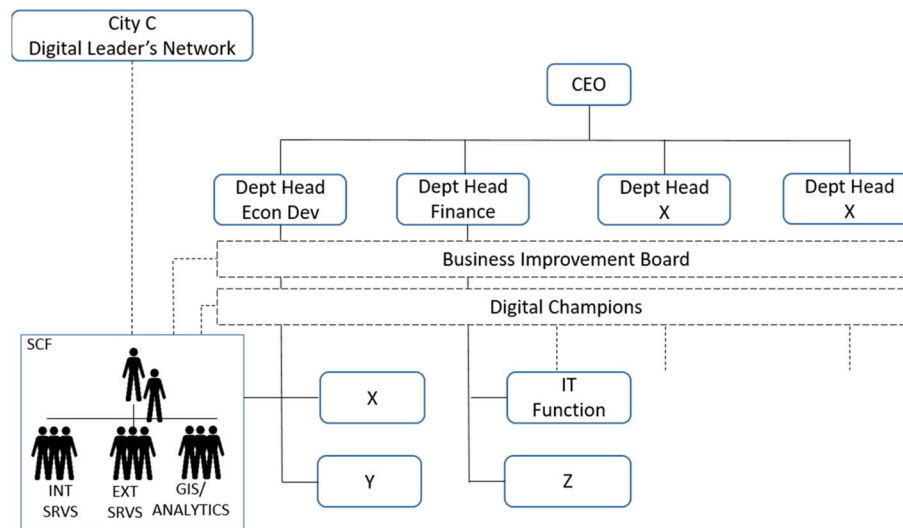


Fig. 4. City C ITG Structure.

perceives its purpose is to facilitate a cultural change within the city authority, to explore the possibilities that technology provides and to address barriers to its implementation. City A's SCF has tended to focus on exploratory projects involving new technology or new uses of technology. These explorations can be further subdivided into future infrastructure needs and "understanding the technology marketplace" (PM). The CEO expects the focus to be on practical problem solving allowing the SCF to develop its own agenda and the seeding investments it makes. It has an informal policy of only seeding projects which are co-funded with external service providers.

In summary, City A has institutionalised its SCF as an entity that is detached from the overall organization. This structural choice fits with the SCF's role, i.e. overseeing piloting and experimentation of innovative IT-enabled solutions in the city. We name this configuration as *Detached* structural ITG implementation.

4.2. City B

City B has a population over 100,000. Smart city activity in City B emanated from the authority's IT department when, in 2014, a project team from the city authority and the adjoining county council studied cities internationally and sought input from other experts on smart city programs. In the same year, City B successfully applied a European Union funded Smart City program. City B's PM for smart cities refers to their initiative as striving to create "a city where people would like to live, work and spend time." For 2015 and 2016 the city authority managed the smart agenda for both the city and the county. It appointed a non-technical PM and implemented an oversight steering group. In both the

city and the county, the members of this group come from economic development and IT. An external advisory group of public and private representative was also set up. In late 2017 the PM was appointed as a city PM, leaving the city-county organization. This role is positioned at the same level as the leads of IT and Services, reporting to the director of IT. Since then, the SCF is embedded within the IT function (see Fig. 3). It does not have its own capital budget as all funding must come on an ad-hoc basis from the relevant departments. Structurally, the relationship with IT and all other departments is through a digital advisory group represented by all departments. This advisory group only meets when requested by the PM.

The interviewees acknowledge that the SCF is risk averse and the focus so far has been on supporting small projects which have incrementally developed the profile and competency of the unit. These projects are intended to act as exemplars for all departments in the use of new technology. The profile of the office is such that all related queries to the city are directed to the office, and it has the expertise to make a call on whether an opportunity will be considered positively, or negatively, by the relevant service department. Positive opportunities will be forwarded through the champions in the internal advisory group, and then encouraged and supported as appropriate. If need-be, business plans are drafted and funding from the relevant department is sought. According to the PM, "originally it came out of IT budget but now I identify what is the problem and who owns it – I then convince them to get involved and cough up." Projects which have a wider appeal are brought to the Director of IT for sponsorship.

We argue City B follows a *Traditional* approach to structural ITG implementation as the IT function remains the locus of ITG overseeing

their smart city portfolio. In other words, City B's effort to implement adaptive governance was undertaken by extending the IT function's role from ensuring effective functioning of IT in the organization (i.e. towards exploitation), to also drive and steer IT-enabled innovation both internally and externally (i.e. towards exploration).

4.3. City C

City C has a similar population to City B. The CEO initiated a smart city program in 2014. A Head of Digital Strategy (HDS) was appointed within the Customer Service Directorate - "a smart city function was established to promote the idea of a digital strategy beyond the IT function. The IT function was internally focused and there was an opportunity to engage externally and even internally to look at digital from a strategic and not just technology point of view" (HDS). The HDS defined two main general objectives for the SCF, i.e. separating an internal and external focus. The former is aimed at enabling "digitization of the organization" across all the council's departments. The latter focuses on enabling and fostering service innovation, directed at citizen access, across several domains within the city (defined in their documents as economy, culture and entertainment, movement and transport, urban places and spaces, and environmental practices). The positioning of the SCF within the organizational structure evolved over time, and it is now positioned within the Economic Development (ED) function (i.e. HDS reports to the Head of ED) with a staff of ten people and its own budget. The group is sub-divided into three sub-groups: Internal Services; External Services; and GIS Analytics, (see Fig. 4).

Within these groups, managerial roles include: head of digital strategy, digital strategy program manager, internal user experience manager, external customer manager, and data analytics and GIS manager. These managers all have IT background, but this is more by coincidence than by design- "more into business analyst role for the two customer managers and into data manager for the GIS and analytics person." In addition, a new horizontal structure named The Digital Champions Forum was created to oversee the internal digital transformation. Its members are budget holders and decision makers from all departments. These champion roles are formally assigned with terms of reference, thus extending structurally the SCF into a cross-organizational division formally established. The digital champions operate in parallel with an existing project management layer called the "Business Improvement Board," (BIB) whose remit is to filter, prioritize and select all innovative projects and initiatives within the council. This function enables a "cohesive organizational view of projects ensuring: there are no overlaps; commitment to the projects; and a fit with the overall organization". Since "every project needs to go through the BIB", the SCF's project prioritization authority is still dependent on this additional layer, thereby ensuring strong alignment between the SCF and the overall council. External programs are overseen by a "liaison group" called the "Digital Leader's Network," which is made up of representatives of both the private and the public sector, within and outside the council organization.

In terms of authority and decision rights, the SCF is responsible for: "commissioning, design, architecture and / or procurement of specific systems to support internal transformation and external customers"; liaising with city partners and industry partners within and beyond the city (i.e. EU level); "some legacy responsibilities that came with the role because of it having evolved from the IT function" (e.g. "management of certain applications and databases"); and project selection. The IT function is responsible for operational tasks ("make sure internal systems are up and running"), and it is structurally positioned under the finance directorate (i.e. head of IT reports to the head of finance). Consistent with the approach taken, the head of IT is part of the Digital Champions Forum.

In summary, City C's approach ensures broad engagement across the local authority's departments including the IT function. Therefore, we name City C's ITG structural implementation as *Integrated*. The SCF is indeed integrated in the organizational structure as a cross-

departmental unit. All relevant departments have decision-making power and are accountable for City C's smart city agenda.

5. Discussion

The reason for completing the case studies was to understand how ITG is implemented in smart cities scenarios, so as to extend traditional ITG research into the complex and high scale portfolio of IT-enabled innovations in the public sector. City Councils increasingly institutionalise new functions devoted to overseeing and coordinating portfolios of IS projects. The three cases studied in this research identify different arrangements through which city authorities approach new forms of ITG to address the need of adaptiveness and ambidexterity (Janssen & Van Der Voort, 2016), which are argued to be required to cope with this rapidly changing and uncertain underlying environment (Hong & Lee, 2018; Wang et al., 2018). These three distinct structural approaches for overseeing and governing smart city initiatives are: (1) Detached Smart City Structural ITG (City A); (2) Traditional Smart City Structural ITG (City B); and (3) Integrated Structural Smart City ITG (City C).

This section discusses the differences with each approach by positioning the findings of this study within the literature. These approaches are discussed and compared in terms of: (1) their orientation, i.e. the range of prominent Adaptive Governance strategies (Janssen & Van Der Voort, 2016) following each case's ITG structural choice; (2) authority and accountability of the SCFs, i.e. the activities and processes that SCFs are responsible for and the projects that are prioritised under each ITG structural arrangement; (3) alignment with the IT function and the overall organization, i.e. given an ITG structural choice, the level of decision making integration between the SCF and these two entities; and (4) and perceived challenges.

5.1. Orientation

When discussing traditional structural implementation of ITG (i.e. debating centralisation and decentralisation of IT functions), Sambamurthy and Zmud (2012) argue that organizations deal with this issue by designing processes and structures to reflect preferences towards certain objectives of IT functions. These were traditionally described in a continuum between an orientation towards global (e.g. promoting a unified standard and architecture across an organization's business units) and local objectives (e.g. addressing specific business unit needs). In the context of SCFs, these preferences are reflected in the actual focus of the function itself. In this section we reflect on each case's orientation by relating the city's ITG approaches to the range of adaptive governance strategies proposed by Janssen and Van Der Voort (2016) (see Table 2).

In the case of City A, the SCF is, by design, not integrated into the organization as a whole. This is rationalized by the PM when asserting that they are comfortable operating in an apparent unstructured manner. Without the burden of adhering to any routine legacies or standard bureaucratic planning, the PM argues this structure allows them to understand and respond to the rapidly evolving market. This aligns with those scholars who underline the need for cities to create capacity for agility (Mergel, Gong, & Bertot, 2018) and experimentation (Gupta, Drave, Bag, & Luo, 2019; Soe & Drechsler, 2018), to respond to the dynamic market of IT enabled smart city solutions. In City A, capabilities and associated routines related to market sensing, developing relationship with potential service providers and marketing the municipality's openness have developed over time. We argue that City A has an orientation towards exploration and experimentation. In the spectrum of adaptive governance approaches (Janssen & Van Der Voort, 2016), City A leverages utilization of internal and external capabilities (from the point of view of the local authority), decentralised decision-making power, and seeking to inform high level decisions from bottom. Therefore, the findings inform us that the orientation of this Detached

Structural ITG implementation is more specifically towards: Self Organization (Folke et al., 2005); Flexible Infrastructure (Janssen et al., 2009); and Public-Private Strategies (Klievink et al., 2016).

With respect to City B, its Traditional approach to ITG implementation means the SCF represents an extension of the IT function rather than a governance disruption in the overall organization as in Cities A and C. This makes City B's SCF a dependent office without the latitude and will to self-organise observed in City A. As argued in more detail below, City B's SCF focus is, for the short term, on continuing to build an organization-wide culture and attitude to seizing opportunities that technology provides. Therefore, its orientation emerged as being towards: Mobilize Stakeholders and Cooperate (De Bruijn & Ten Heuvelhof, 2018); and Public-Private Strategies (Klievink et al., 2016).

In contrast, City C's structure entails a preference towards pursuing control and establishing of structures and clear accountabilities. The orientation towards Self-Organization and flexibility observed in City A is less prominent, in favour of more structured processes. Also, due to the establishment of the Business Improvement Board (BIB), the council's governance is well structured. When an idea emerges, the first step is to ensure that there is a potential contribution to (i.e. alignment with) the overall 2030 strategic plan. Subsequently, *“the approach is to work with the business unit to develop a requirements document, the business case from an enterprise architecture perspective, and to decide what are the dependent systems, what are the work flows etc.”* At this stage the project proposal goes through the BIB (chaired by the CEO) for approval. With respect to adaptive governance strategies (see Table 2 above), the presence of the Digital Champions Forum highlights an orientation towards engagement with the goal of leveraging capabilities coming from the relevant departments, which aligns with the adaptive governance approach named Know the Stakeholders and their Capabilities (De Bruijn & Ten Heuvelhof, 2018; Janssen & Van Der Voort, 2016). On the other hand, this structure ensures that higher level decisions (i.e. at the BIB level) are informed from the bottom up (i.e. from the representatives of the departments formally assigned within the Digital Champions Forum), which aligns with an orientation towards Shortening Decision Making (Janssen & Van Der Voort, 2016). Finally, the last orientation emerged is towards Education and Learning (Janssen & Van Der Voort, 2016), with all departments playing a role in the decision making across each project's lifecycle as well as in the monitoring processes.

5.2. Authority of the SCFs

The next point we reflect upon is on the actual authority of each ITG type. In other words, based on the orientation described above, we further discuss and compare these cases with respect to the types of IT-enabled innovation projects and programs that constitute the remit of each smart city strategy, i.e. what each SCF is accountable for.

Consistent with its objectives of pursuing Self-Organization and Flexible Infrastructure, City A's focus is on experimenting new solutions. Following what are known in the smart city literature as agile (Mergel et al., 2018) and experimentation-based (Gupta et al., 2019; Soe & Drechsler, 2018) approaches, relationships with external service providers are continuously being developed, but implementations are limited to prototypes, as public procurement regulations restrict full implementations without long bureaucratic tendering processes. With some exceptions, these pilots do not interact or affect departments other than the SCF. These projects are a reflection of the initial governance decisions with respect to a detached structure, agility and externally directed relations. The approach is to use external success to show benefit to those inside the organization – *“my role it's a facilitator, a collaborator, how to pick quick wins and as we are moving so fast on that and the world is changing so quickly. Bringing in collaboration with the big tech innovators and the research side, internal people are beginning to be amazed that we can think this way. It's about building awareness”* (PM). The largest program coordinated by the City A's SCF is the development of a

Digital District. In practice, this program provides a real-world environment where companies, government and academics can jointly experiment new solutions with the objective of scaling successful ones across the city, and/or learn from real world piloting.

Interestingly, in City B a second mover strategy is the preferred approach. The remit of its SCF is categorised in three ways: (1) IT-led projects which are an extension of the existing IT activity, where control is held within the IT Function which vie for IT capital and resources; (2) Smart capability projects which build the authorities knowledge and social capital, such as the development of a City Dashboard from the available open data, and a citizen survey which engaged residents on their understanding and aspirations for a Smart City; and (3) Leveraging funding opportunities from Horizon 2020 or the central government, such as in the piloting of an energy storage system at a local fire station. Ideal projects involve a collaboration between the city-county, research centres and service providers, consistent with its orientation towards Mobilize Stakeholders and Cooperate (De Bruijn & Ten Heuvelhof, 2018); and Public-Private Strategies (Klievink et al., 2016). However, rather than having a long-term strategy, City B's SCF operates in an “ad-hoc” manner based on specific projects, grants, and partnerships.

In City C, the fact that the SCF emanated from the Economic Development department led to it having a wider scope, or, in other words, the management of a bigger variety of projects in which IT can play both a marginal or central role depending on the specific situation. We believe this could potentially create confusion in relation to being able to distinguish what belongs to the SCF and what does not. However, the presence of the Business Improvement Board within the council (and hierarchically above the SCF) mitigates this risk. The key types of decisions taken at the SCF level involve generation, selection and prioritization of projects. As described above, City C pursues both internal and external objectives. As an example of an internal program, the decision was made to implement a customer relationship management (CRM) system, more akin to an eGovernment project. Activities for the second, external, goal focus on facilitating collaboration and integration between multiple stakeholders, and providing *“strategy, tools, insights, and guidance”* for innovative projects. One example is a public safety project, which resulted in the implementation of 44 CCTV cameras in 24 locations in the city. The implementation is a collaboration between public servants from various departments within the local authority, public representatives, members of local communities, the police force, civil engineers, business and technology specialists from multiple companies. Contracts based on approved business cases govern these relationships. Overall, we argue that these outcomes reflect the initial governance decisions and the related orientation explained above with respect to an integrated structure, due to the high levels of process and significant effort put into building internal and external relations.

Reflecting on the authority of the SCFs lead us to conclude that the lack of consensus on the definition of smart cities (Ismailova et al., 2019; Yigitcanlar, Hoon, et al., 2019; Yigitcanlar, Kamruzzaman, et al., 2019) is reflected in a different conceptualization by each of the three cities here, driven by their ITG choice and context. In other words, our findings suggest that there is a direct relationship between ITG choices and the scope of a smart city agenda. For example, whilst City C's integrated CRM solution appears a flagship smart city program, it would not fall within the scope of City A's SCF strategy. It is noted that the investigation of the relationships between actual programs and ITG choices goes beyond the scope of this paper. However, these insights emerged from the data collected and this is proposed as a future research avenue.

5.3. Decision making integration

With respect to consideration of alignment, we reflect on the level of IT decision-making integration suggested by Teo and King (1999) who

assert that organizations differ in the degree to which business and IT decisions are integrated and subsequently aligned (see Table 1 above). Consistent with the objective of this study to investigate the emerging need for triadic alignment resulting from the institutionalisation of SCFs, we reflect on the level of decision-making integration across two different relationships: the SCF and the IT function; and the SCF and the city authority's organization.

By design, City A is independent of all other departments including the IT function. Thus, there is little evidence of internal communication, related employee training and knowledge codification. Furthermore, there is not necessarily a budget interdependence as the SCF has tended to promote projects independently. These observations suggest that City A's IT decision making process integration, both between the SCF and IT, and the SCF and the rest of the city authority would be characterised as Administrative (Teo & King, 1999), i.e. when budget and decisions are amalgamated between the organization, the IT function, and the SCF.

Concerning City B, the embedded position of the SCF in the IT function results in Full Integration with IT, where the SCF and IT decisions are concurrently part of the same process. With respect to the other departments the integration can be classified as Sequential (Teo & King, 1999), i.e. the overall council's decisions provide direction for SCF decisions. As stated above, we argue that the establishment of the SCF had its major ITG implications within the IT function, as opposed to the overall organizational level.

In City C, the presence of the BIB ensures strong alignment between all departments. With respect to smart city initiatives, the Digital Champions Forum makes this integration even stronger. This structure ensures participation and collaboration from every department across the city council. However, when asked about the level of decision-making integration with the IT function, one interviewee stated: *“well, yes and no; other departments were more engaged through the BIB – IT was the facilitation of everything else, for example for the provision of systems for operations”*. According to the PM, the IT function is seen as a cost centre (also demonstrated by its position in the council's structure under the Finance Department). Therefore, the findings suggest that there is Sequential Integration (Teo & King, 1999) between the SCF and the IT function, i.e. the SCF provides direction for IT function decisions.

5.4. Perceived challenges

Those involved in City A's smart city initiative identify several challenges. First, as acknowledged by the existing smart city literature (Gil-Garcia, Helbig, & Ojo, 2014), public procurement is viewed as a significant barrier to co-creation with external service providers. Cities are limited in the types of collaboration they are allowed enter into with these providers. Second, the realisation that the SCF should only be a catalyst for change is not understood by the organization at large. It is felt that there should be a formal plan to integrate the SCF into the business - *“a challenge in the next couple of years is how to bring these two back together and integrate different mind sets.”* Other challenges identified concern: a lack of systemic alignment; and the lack of effective criteria for evaluation and monitoring. Consistently, existing literature on adaptive governance in the public sector identifies related challenges as decreased alignment (Wang et al., 2018) and accountability (Janssen & Van Der Voort, 2016).

In City B, the existing challenges emerged could once again be considered as typical in an IT function scenario in the public sector realm (Campbell et al., 2010; Tonelli et al., 2017). The main perceived issue revolves around the limited authority of the SCF. SCF in City B is a dependent function where engagement with other departments (i.e. the level of active participation of and collaborative relationships among executives, IT management, and business management (Peterson, 2004)) is another perceived challenge. We argue that this is a typical ITG challenge in the public sector. According to the extant IS research on ITG in the public sector, the positive relationship between

engagement and ITG effectiveness is well acknowledged (Ali & Green, 2012; Scholl, Kubicek, Cimander, & Klischewski, 2012; Tonelli et al., 2017). Examples of identified relational mechanisms in the public sector include: top management involvement with IT and enterprise communication systems (Ali & Green, 2007), understanding of business objectives by IT teams, partnership and communication between business and IT, key stakeholders engagement, governance training, and IT training (Nfuka & Rusu, 2011).

In City C, a major challenge concerns external engagement in procurement processes. Often service providers are not inclined to follow the strict procurement procedures. Second, the perception from those in the SCF is that greater integration and collaboration with the IT function is needed to add IT skillsets that are currently lacking within the SCF. As argued by the program manager, *“a lot of skills from IT function could be very useful to drive smart cities here”*. Lastly, internally, the intentional preference on accountability and control leads to challenges related to the strict and highly monitored innovation processes enforced.

5.5. Proposed typology

In this section we have reflected on the emerging ITG structural typology in relation to the orientation of the SCF (due to each ITG structural choice) and the subsequent effects on decision making authority, and decision-making integration (i.e. one qualitative measure of alignment). We also reflected on currently perceived challenges in governing portfolio of IT-enabled strategic initiatives under each specific ITG structural arrangement. This inductively emerging typology is summarised across these four points in Table 3.

6. Summary of contributions and implications

Building on the findings and their positioning within the existing literature, this section summarises the research contributions of this study as well as its implications for practitioners.

6.1. Implications for research

First, our study advances research into the emerging context of adaptive governance, which thus far has mainly focused on its implementation at a project level. Our case studies identify three types of ITG structural arrangements for pursuing adaptiveness for overseeing a portfolio of smart city initiatives at the local government level (Hong & Lee, 2018; Soe & Drechsler, 2018; Wang et al., 2018). By reflecting on the orientation of each ITG arrangement, our research augments the current understanding of the spectrum of adaptive governance approaches (Janssen & Van Der Voort, 2016) by identifying relevant ITG structural mechanisms underpinning those strategies.

Second, we outlined an emerging typology from empirical data on actual ITG structural arrangements to address the emerging need for triadic alignment given the institutionalisation of SCFs, a topic so far underexplored in the existing literature. We propose this initial typology as a structured way to differentiate smart city efforts. By doing so, we addressed the strongly advocated need to research and explore new governance structures in the context of smart cities (Kar et al., 2019; Rana et al., 2018; Ruhlandt, 2018; Yigitcanlar et al., 2018) We hope this typology will be leveraged as a tool for enabling more relevant comparisons of both smart city and adaptive governance efforts in public authorities.

Third, the reflection on the authority of the SCFs leads us to conclude that, while the literature acknowledges the lack of an agreed definition of smart cities, these can be conceptualised differently depending on the context and ITG choices. This research provides important insights in the scattered academic conversation on smart cities that is currently relying on ad-hoc conceptualisations (Yigitcanlar, Kamruzzaman, et al., 2019). Our analysis questions the value of seeking

Table 3
An emerging typology of ITG structural mechanisms in smart cities.

	Detached SCF – City A	Traditional SCF – City B	Integrated SCF – City C
Orientation	<i>Self-Organization</i> <i>Flexible Infrastructure</i> <i>Public-Private Strategies</i>	<i>Mobilize Stakeholders and Cooperate</i> <i>Public-Private Strategies</i>	<i>Know the Stakeholders and their Capabilities</i> <i>Shortening Decision Making</i> <i>Education and Learning</i>
Authority	Experimentation Piloting Pre-procurement	Incremental capability building project Innovation broker – facilitators	End to end system design and implementation – generation, prioritization, selection, and implementation of IT-enabled initiatives. Business case-based projects.
Decision Making Integration	SCF – IT: none SCF – Organization: Administrative	SCF – IT: Full SCF – Organization: Sequential	SCF – IT: reciprocal SCF – Organization: Full
Perceived Challenges	Lack of systemic alignment Scaling Knowledge Sharing	Dependent office Limited authority	Bureaucracy External engagement Lack of IT skills

a definition that is valid across contexts given that different ITG structural configurations correspond to different conceptualisation of what the vision and scope of a smart city actually are.

Finally, by investigating and analysing three ITG structural mechanisms in complex and uncertain scenarios, this research contributes to the overall discussion of ITG in the public sector. Furthermore, the qualitative approach adopted in this study and the richness of our findings complement the existing quantitative dominant view on ITG in the literature to-date.

6.2. Implications to practice

First, our observations lead us to conclude that the creation of SCFs was a conscious decision in change management. We might expect IT functions to have a large say in the use of new technology, but this suggests that, within the councils, IT is perceived as not having the bandwidth or the attitude to explore, seek, and potentially implement technologies that are not yet mature. By making SCFs discrete and treating them as vehicles for adaptive governance, councils are building organizational competencies needed to understand the technology market and manage access to external resources. The potential downside of this for practice is that, emphasis could tip overwhelmingly towards building exploration over exploitation competencies if not carefully managed. In practical terms, exploiting should be the role of IT department, whereby they ensure the long-term sustainability of technology. This suggests that a strong SCF and IT relationship needs to be in place from the start, and that an imbalance in this relation will affect exploitation, namely scaling.

Second, the case studies also show that there is no optimal ITG structural choice in this context. Rather, different ITG arrangements may suit different purposes and motivations. Our observations suggest that these structural decisions will however affect the speed at which full integration, or alignment, takes place moderated by the level of authority given to an SCF. City's C authority with respect to internal, external and GIS service provision is a clear example of the positive affect of authority in alignment, while, conversely, it is clear that City B's lack of authority is resulting in a slower path to alignment. From a practical point of view, embedding the SCF in everyday activity strengthens its position, improving its chances of achieving its goals, but might limit its ability to experiment in an agile manner.

7. Conclusion, limitations and future research

This study explored ITG structural implementation across three city authorities in Ireland in the context of smart cities. Building on existing literature on ITG, smart cities, and the emerging conversation on Adaptive Governance in the public sector, a qualitative multiple case study was carried out across three city authorities. From this analysis, an emerging typology of ITG structural implementation is proposed, compared and discussed in relation to: (1) orientation of each approach;

(2) the authority of the SCFs; (3) alignment with the IT function and the overall council; and (4) the challenge perceived under each ITG arrangement.

The trade-off between contextual richness of a small number of case studies and generalizability of a larger sample of cases points towards a potential limitation of our work. The choice of the method of enquiry was primarily motivated by achieving in-depth, thick, and rich understanding of ITG structural implementations. However, as a downside, we cannot claim that the ITG structural arrangements that we investigated are exhaustive. In fact, as argued in the methodology section, three cases studies were seen as an ideal number to investigate differences within the cases, yet preserving the idiosyncrasies of individual cases (Creswell, 2015; Lauckner et al., 2012). Furthermore, all the three case studies carried out in this research are local authorities of Irish cities. While the diversity in structural configuration of each of these case studies lends to the richness of our study, we acknowledge that there could be other socio, economic and political variables that may not be diverse enough across these three cases. For example, all three cases operate under the same national legislative landscape. Thus, as part of our future research, we encourage integrating additional case studies governed under different administrative systems (e.g. mayor-council forms) and characterised by context-related diversities – not only in terms of the position of the SCF within the organization, but also in relation to other exogenous variables.

Furthermore, we encourage future research to focus in-depth on governance capabilities. We argued that SCFs are adaptive governance capability building catalysts. The main capability building appears to be in relation to ecosystem coordination and pre-procurement / co-creation. These are classic dynamic capabilities in a smart city scenario - necessary to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Eisenhardt & Martin, 2000; Piening, 2013; Teece, 2007). An important subset of dynamic capability, which we believe is relevant in smart city scenarios, is government agility (Mergel et al., 2018). This refers to those processes relevant for sensing and responding to environmental change (Overby, Bharadwaj, & Sambamurthy, 2006), thus in alignment with those scenarios within which adaptive governance is advocated (Janssen & Van Der Voort, 2016).

Acknowledgments

This work was supported, in part, by Science Foundation Ireland grant 13/RC/2094 and co-funded under the European Regional Development Fund through the Southern & Eastern Regional Operational Programme to Lero - the Irish Software Research Centre (www.lero.ie).

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