

# Smartness and thinking infrastructure: an exploration of a city becoming smart

Emergence of  
smart city  
governance

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Tomas Träskman

*Department of Accounting, Åbo Akademi Ekonomisk-statsvetenskapliga fakulteten,  
Åbo, Finland and  
School of Engineering, Culture and Wellbeing, Arcada UAS, Helsinki, Finland*

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## Abstract

**Purpose** – The paper explores the emergence of smart city governance with a particular focus on the cognitive value of the new technologies and the different accountabilities emerging in the digital infrastructures attempting to visualize and rationalize urban dynamics.

**Design/methodology/approach** – Drawing on ethnographic, netnographic and interview data from an empirical case study of the Smart and Wise City Turku spearhead project, the study builds on the assumption that smart cities emerge from the interaction between the characteristics of technologies, constellations of actors and contextual conditions.

**Findings** – The results report smart city activities as an organizational process and a reconfiguration that incorporates new technology with old infrastructure. Through the lens of the empirical examples, we are able to show how smart city actors, boundaries and infrastructures are mobilized, become valuable and are rendered visible. The smart cities infrastructure traces, values and governs actors, identities, objects, ideas and relations to animate new desires and feats of imagination.

**Practical implications** – In terms of implications to practice, the situated descriptions echo recent calls to leaders and managers to ask how much traceability is enough (Power, 2019) and limits of accountability (Messner, 2009).

**Originality/value** – The central theoretical concept of “thinking infrastructure” highlights how new accounting practices operate by disclosing (Kornberger *et al.*, 2017) new worlds where the platforms and the users discover the nature of their responsibilities to the other. The contribution of this paper is that it examines what happens when smartness is understood as a thinking infrastructure. Different theorizations of infrastructure have implications for the study of smart cities. The lens helps us grasp possible tensions and consequences in terms of accountability that arise from new forms of participation in smart cities. It helps urban governance scholarship understand how smartness informs and shapes distributed and embodied cognition.

**Keywords** Accountability, Smart city governance, Thinking infrastructure

**Paper type** Case study

## Introduction

Understanding cities means understanding how they bring about communications, coordination and control. Governments and public agencies at all levels are increasingly beginning to embrace the notion of “smartness” to distinguish new policies, strategies and programs that target sustainable development, sound economic growth and a better quality of life for their citizens (Argento *et al.*, 2019; Brorström *et al.*, 2018; Chourabi *et al.*, 2012; Karppi and Vakkuri, 2020; Kitchin, 2015; Meijer *et al.*, 2015; Nam and Pardo, 2011).

Literature on smart cities (SC) refers to a “virtuous circle” in which technologies such as digital platforms are fueling acceleration in citizen engagement and innovation (Anttiroikko, 2016;



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Muñoz and Rodríguez, 2019). In the ideal scenario, technology enables citizens to create public services together, while smart cities citizens are collectively governed by “smart governance” (Johnston, 2010; William *et al.*, 2018). This study explores the emergence of smart city governance (SCG), focusing on not only the cognitive value of new technologies but also the new accountabilities emerging in the digital infrastructures. These new accountabilities distribute agency and responsibility more widely, in addition to visualizing and rationalizing urban dynamics more clearly.

This study addresses the emergence and design of smart cities governance. It has two main aims. The first is to expand on Shelton *et al.*'s (2015) concept of an “actually existing smart city.” In real life, smart cities contrast with the technocratic and idealized “but often unrealized vision that dominates the social imagination” (Madsen, 2018, p. 2). Smart cities as they really *are* also differ substantially from critical views of SCs, in which power is assumed to be concentrated in the hands of a few experts or elites (Grossi *et al.*, 2020).

This paper instead focuses on how smart city ideals are “situated and integrated into existing constellations of urban governance in specific cities” (Madsen, 2018), with a particular emphasis on the desire for new distributed accountabilities and accountability systems, as fueled by the rise of various platforms as a new form of organization.

Smart cities scholarship has identified a need for more “sophisticated socio-technical analyses” (Meijer and Rodríguez, 2016) of smart cities to enhance the theoretical understanding of the panoply of smart city initiatives, new technologies and how they “work (or do not work) in concert” (Coletta *et al.*, 2019). Such analysis also includes discussion of the possible tensions and consequences that arise from new forms of participation in smart cities, as well as their enabling technologies (Grossi *et al.*, 2020). The empirical research found in this paper seeks to address this gap in the SC research.

Over the course of two and a half years of field study, the researcher investigated how multiple social and material entanglements were established during a smart cities project that led to new forms of accountability relationships. The methodological drawbacks of opportunistic case selection are partially counteracted by the second aim of this research, which was to provide a fresh perspective (Eisenhardt, 1989) on existing theory, in addition to augmenting (Cecez-Keckmanovic *et al.*, 2014) research on the relationship between the social and the material in the context of our increasingly digital society.

This fresh perspective is provided by examining the cognitive value of technology. Cognition is viewed through the lens of “thinking infrastructures,” or the apparatuses in which distributed agency and cognition are conjoined. The present analysis, therefore, extends the analytical focus of SC scholars by iterating between the idiosyncrasies of the case and key features of the emergence of novel socio-technical practices and their consequences.

In essence, previous analyses of smartness have focused on the use of information and communication technologies (ICT), but not on how they work. This paper, therefore, sets out to answer the following question: How does ICT cognitively configure smart city actors and how does this smartness redistribute accountability relationships?

This research begins by exploring the tendency in smart cities initiatives to invest in ICT as a means to “wire-up” and make technology “do political work” (Woolgar and Neyland, 2013, p. 17). This is followed by a presentation of the case study method and context, and after this, the findings. The paper finishes with a discussion in which thinking infrastructure (TI) is used to examine general issues regarding distributed agency, cognition and accountability in the smart city.

This research contributes to the literature on urban governance and the role of accounting in the city in two main ways. First, SCG is shown to be a complex process of institutional change, whereby research is needed to acknowledge that smartness has non-neutral performative implications with consequences in the definition of responsibilities and accountability. Interaction with SC infrastructure helps actors imagine what is possible to do

and become in the SC. Thus, smart cities infrastructure traces, values and governs actors, identities, objects, ideas and relations to animate new desires and feats of imagination.

Second, the central theoretical concept of “thinking infrastructure” highlights how new accounting practices (e.g. on digital platforms) operate by *disclosing* (Kornberger *et al.*, 2017) new worlds where the platforms and the users discover the nature of their responsibilities to the other. In addition to this, smartness understood through the lens of thinking infrastructure helps us understand how smartness informs and shapes embodied cognition, e.g. the love for or the smell of the SC. The present work thus contributes to the urban governance literature by highlighting the cognitive value of technology (Grossi *et al.*, 2020; Meijer, 2018), data as epistemology (Kitchin, 2014) or rather epistemologies – ways of sensing the world and ways of obtaining knowledge about the world.

### Literature review

The theoretical framework that underpins this research is drawn from the literature on urban governance and accounting. The literature on urban governance holds that the actors that construct smart cities hold great significance (Meijer, 2018). In this instance, the definition of actors includes both stakeholders (such as citizens and industry representatives) and material actors (such as new ICTs). In this paper, the key idea is that technology cognitively configures and reconfigures actors (Grossi *et al.*, 2020; Kitchin, 2014; Meijer, 2018).

In the words of Grossi *et al.* (2020, p. 638), the urban governance literature highlights “the cognitive value of new technologies” and the power dynamics between actors, which then work together to redistribute accountability relationships. The idea is that better information generates better urban governance, as smart technologies help manage visibilities, guide cognition and shape decision-making.

Accounting studies on the other hand focus on devices and practices through which quantifications, calculations and numerical information shape the ways organizations such as cities are represented, discussed and governed. However, little attention has been paid to date to the smart cities phenomenon in the accounting and accountability literature (Grossi *et al.*, 2020).

#### *The urban governance literature*

Grossi and his colleagues (2020) identified a historical pattern in the urban governance literature in which a first wave of prescriptive papers is followed by a second wave of critical papers. This is then followed by a third wave of empirical studies that analyze the emerging patterns of technology-mediated urban governance.

This paper draws from the latter category (Coletta *et al.*, 2019; Dourish, 2016; Madsen, 2018; Meijer, 2018; Rose *et al.*, 2015) and builds on the assumption that smart cities emerge from the interaction between the attributes of technologies, the constellations of actors and the contextual conditions. New tools and technologies for smart cities governance do more than support interactions, they also “change the game” (Meijer, 2018, p. 199). Smart cities quite literally “become smart” (Karppi and Vakkuri, 2020) as they enact planning tools in specific environments. Studies on “actually existing smart cities” (Shelton *et al.*, 2015) depict spaces of fulfillment, cooperation, ambiguity, asymmetry and conflict.

This paper adopts Meijer and Rodríguez (2016) definition of the smartness of a city as “its ability to attract human capital and to mobilize this human capital in collaboration between the various (organized and individual) actors through the use of information and communication technologies” (2015, p. 398). Smart governance is defined as a new way of managing complex societal issues, based on a collaboration between government and nonpublic stakeholders (Bevir, 2013).

In smart cities, technology plays a critical role in supporting and mediating participation (William *et al.*, 2018). This study boils these takes on smartness down to three key components: human intelligence, participation and the accumulation of knowledge in ICT. Data infrastructures of smart cities are not neutral, however, as they “embody value judgments” (Meijer, 2018) that arise via the design of the interface and algorithms (van der Graaf and Ballon, 2019). For this reason, urban governance cannot be understood without studying the role and impact of new technologies on interactions between actors.

*Mobilizing and attracting human intelligence through technology*

Systems for “horizontal” and “lateral” accountability (Almqvist *et al.*, 2011; Klijn and Koppenjan, 2012) have been discussed as a means of managing complexity and linking power and accountability. The proliferation of such flexible and distributed accountability mechanisms and systems is problematic, as those who provide and implement them are not necessarily held accountable (Cardullo and Kitchin, 2019). Failures in smart cities governance have been explained by the inability to design and perform such ideals.

In addition, unsuccessful SC initiatives have been attributed to a lack of lateral accountability and an unwillingness to collaborate and adopt smart cities infrastructures and services (Argento *et al.*, 2019; Castelnovo, 2016). More research is, therefore, needed in order to empirically embrace a more dynamic view of socio-material relations (Meijer and Rodríguez, 2016). The relationship between the social and the material in smart cities is increasingly understood in terms of a relational ontology in which the two are in fact inseparable.

Literature on urban governance often highlights smart cities as a way of heeding calls for a more transparent form of accountability. Concepts that resonate with democratic ideals, such as openness (Bătăgan, 2011), transparency (Nam and Pardo, 2011), participation (Bătăgan, 2011; Castelnovo *et al.*, 2016), collaboration (Pereira *et al.*, 2017), efficiency (Caragliu and Del Bo, 2019), responsiveness (Kitchin, 2015) and responsibility (Chourabi *et al.*, 2012), recur throughout the literature.

According to Bovens (2007), these distinct concepts have a close affinity to accountability. Accountability “in this very broad sense is basically an evaluative, not an analytical, concept” (Bovens, 2007, p. 450). By way of problematization (Alvesson and Sandberg, 2011), this paper identifies these seemingly positive effects of smart cities and the technologies that underpin them as a common assumption in the urban governance literature. At the same time, accountability is widely used to positively describe a state of affairs or “the performance of an actor” (Bovens, 2007).

In contrast to evaluative and normative perspectives on smart cities governance, this paper examines accountability as transparency, in line with Flyverbom *et al.* (2015), Messner (2009) and Roberts (2009). Here, accountability is a productive force that is both “conditioned upon and conditions a host of relations, actions, and norms for conduct” (Flyverbom *et al.*, 2015, p. 349). Furthermore, this paper draws from accounting studies (presented in the next subsection) in offering a foundation upon which to examine digital infrastructures and the aforementioned assumptions.

*New perspectives on accounting and the smart city: the emergence of smart infrastructures*

In this paper, recent explorations of nontraditional forms of accounting, such as rankings, ratings and reviews and so-called “evaluative” or “thinking” infrastructures (Bowker *et al.*, 2019; Jeacle, 2017; Kornberger *et al.*, 2017; Orlikowski and Scott, 2014; Pollock & D’Adderio, 2012) are relevant, as they focus on valuation processes, distributed agency and cognition. On the matter of accountability, Scott and Orlikowski (2012) show that ranking mechanisms perform a substantial redistribution of accountability, whereas technologies such as algorithms are not held accountable.

While these authors do not focus explicitly on SCs, they hint at dimensions that are missing from urban governance studies. For example, when explaining the role of accounting in smart cities, [Argento et al. \(2019\)](#) built on [Miller and Power's \(2013\)](#) concept of the "accounting complex" and its productive force. According to these authors, performance measurement systems in the city of Helsinki, for example, promote transparency and accountability. However, studies on new forms of accounting suggest that the relationship between accounting devices and the world should be theorized differently. [Kornberger et al. \(2017\)](#) proposed a shift from mediating accounting devices to overlapping and interacting devices that form a dynamic network of control technologies that the authors describe as "infrastructure."

The notion of infrastructure pops up often in the SC literature, but is rarely defined. Here, the literature on infrastructure ([Larkin, 2013](#); [Star, 1999](#); [Bowker and Star, 1999](#)) and accounting as a social and institutional practice ([Arena et al., 2017](#); [Kornberger et al., 2017](#)) is helpful. According to [Kornberger et al. \(2017\)](#), infrastructures are "assemblages of technical artefacts, institutional arrangements, cultural habits and social conventions" (p. 6).

The research on infrastructure draws our attention to the centrality of representation in organizational practice. Infrastructures are "a mixture of political rationality, administrative techniques, and material systems" ([Larkin, 2013](#)). For this reason, the paper uses smart cities governance and SCG infrastructure interchangeably. Infrastructure is a relational concept with relational properties and infrastructures are "the physical networks through which goods, ideas, waste, power, people, and finance are trafficked" ([Larkin, 2013](#), p. 237).

[Bowker et al.'s \(2019\)](#) concept of "thinking infrastructure" can illuminate the cognitive value of smart cities technologies. According to [Pflueger et al. \(2019, p. 250\)](#), thinking infrastructure emphasizes "the capacity of accounting to produce tentative knowledge, questions, and possibilities for innovation and action." The three elements of valuing, tracing and governing also shed light on what happens in smart cities infrastructure. [Power's \(2019\)](#) reflections on new visibility enabled by traceability are helpful, as the author critically reflects on the same dilemmas as [Roberts \(2009\)](#): transparency and tracing "works back upon those subjects in ways that are often counterproductive." [Power \(2019\)](#) also argued that tracing infrastructures are "agency distributing" in nature, as they create new accountability relations.

[Pflueger et al. \(2019\)](#) present a distinction between knowledge devices such as SC devices that allow central authorities to gather data, and thinking infrastructures that allow them to understand how actors think about opportunities and possibilities. Research suggests that TIs require continued attention to mundane background activities that, due to the efforts of a variety of actors, help sustain and shape organizational and institutional contexts ([Mazmanian et al., 2014](#); [Pollock and D'Adderio, 2012](#)).

Platforms "render visible, knowable and thinkable complex patterns of human interaction in and out of the market, in feedback loops of learning, reformatting and redoing" ([Bowker et al., 2019](#)). According to these authors, platforms produce paradoxes of power as they distribute control while centralizing power. Finally, it is important to note that the (in) visibility of infrastructure is mobilized ([Larkin, 2013](#)) for economic and political purposes. [Pujadas and Curto-Millet \(2019\)](#) apply thinking infrastructures to show that platforms are more than a piece of digital infrastructure that enables a match: they involve categorizing moments with consequences for the definition of responsibilities and accountability.

## Method and context of the research

Work on this study's empirical background began in 2018 after the launch of Smart and Wise Turku (SWT). Finland is famous for its high measures of digital inclusion and openness, which extends to trusting public administrators with personal data ([Kuovo and Kankainen, 2009](#)).

The empirical context of the city of Turku was considered a “most likely case” (Flyvbjerg, 2006), i.e. likely to succeed in making the idealized smart city strategy into a workable practice.

Data were collected from stakeholder meetings, workshops, meeting memoranda and other documents (see Tables 1 and 2). In 2018, 16 semi-structured interviews were conducted with the public managers (PM) and industry representatives. The goal was to gain an emergent perspective on the SWT project and explore how technologies change individuals’ perceptions of the world. Later, a “netnographic study” (Kozinets *et al.*, 2014) was conducted on two participatory budgeting platforms arranged in the cities of Turku and Helsinki.

The study initially adopted an abductive approach to the case study (Dubois and Gadde, 2002) and the construction of theory (Timmermans and Tavory, 2012), as recommended by Langley and Abdallah (2011) and Welch *et al.* (2011) and in contrast to the “linear schools” (Pekkari and Welch, 2018) of Gioia and Eisenhardt.

At the start of the project, data utilization and citizen engagement acted as the bedrock of SWT, linking the six determined focal points (Figure 1). The researcher proceeded to observe how the project moved between smart and wise, depending on which actors constructed or obtained SC knowledge. The researcher developed an understanding of the “dynamics of emergence” (Cecez-Kecmanovic *et al.*, 2014) and “logic of practice” (Tsoukas, 2017) by iteratively studying one unit of the city administration before expanding the focus to other locations as new relations emerged. Nicolini (2009) described this strategy as “zooming in” and “zooming out” of practice.

The project highlighted smart cities performance in interviews, press releases and meetings. This enabled the researcher to observe and experience how people and technologies were perceived from different perspectives, as well as the consequences for different actors. For example, meetings of the communications division in 2018 discussed how performance was challenging to measure, due to the lack of data at the project’s early stage. A reminder that obtaining data and applications, automating processes and actions and deriving meaningful insights from these developments is a time-consuming process.

At times, the public managers had little to no control over Turku’s smart cities performance, or – as Kitchin’s (2014) termed it – the epistemology. For example, in 2019, the Future Today Institute recognized Turku as the seventh smartest city in the world. The city emerged as a unit of accountability via a class of industry-identified indicators. Value

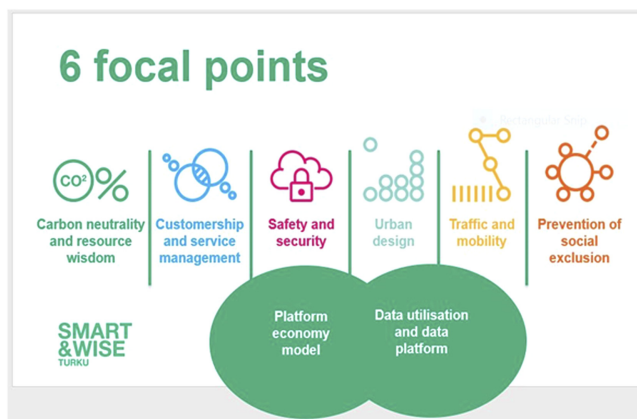
	Individual interviews/ # interviews	Group interviews/ # persons	Observations	Positions	Netnography
Public Managers	10/14	4/23	Manager observation in 3 divisions and 4 focal points (see Figure 1)	Development Managers, Project Directors, Strategy, Open Participation Specialists, IT Director, CIO	
SC Industry representatives	1/2	1/2	Consultant observation	Business Developer, Senior Advisor Consultant	
Participatory budgeting platforms			Nethnographic study of online community		2
Total	11/16	4/23			2

**Table 1.**  
Core data

Table 2.

Documents and other empirical material

Sources	Description	Year (items)
Reports	Turku city reports on the SWT project + reports from the 6Aika projects	2018–2020 (60)
Industry white papers	Corporate reports on SC	2018–2020 (4)
Websites	SWT project website/participatory budgeting websites/different city websites	2018–2020 (6)
Email	Email conversations with public managers, industry representatives	48
	Emails from participatory budgeting platforms	1,556
Press/Media	Articles on the SWT project	2017–2020 (8)
Social media	Closed Facebook groups	2017–2020 (3)
Meetings	SWT communications, planning and coordination meetings	2018–2020 (16)



**Figure 1.** Key focal points of the SWT project (City of Turku PowerPoint)

creation in SCs was thus externalized and occurred without the division or focal point unit being able to control it hierarchically.

While zooming in and out, the researcher observed how data did not measure participation, thus organizing the boundaries of the smart city; therefore, all those concerned with engagement were suddenly outside the SC's epistemology. In terms of accountability relations, the ontology made Turku "smart" in the eyes of industry. Big data collection was clearly important. Resources were used to establish "the first city-owned data company in the world": Turku City Data Oy. This had consequences for SWT, as the director of strategy and director of development were appointed to lead the new unit.

While there was some confusion as to how the new unit was related to SWT, these combined activities produced a discourse focused on tracing as a form of value and accountability in smart cities. This idea of a form of "meta-governance" (Meijer, 2018) based on tracing data infrastructures was mainly referred to by PMs from the focal points of "carbon neutrality," "safety and security," and "traffic and mobility" (see Figure 1). Boundaries shifted repeatedly, particularly in 2020, when the platform for participatory budgeting was introduced, and a new relationality to the citizens participating became apparent through the platform. The researcher had already started a netnography on the participatory budgeting platform in Helsinki in 2018. Turku chose to use the same platform provider in 2019. The researcher could follow this implementation process in team meetings.

Platform walk-throughs were organized where city PMs and the researcher were walked through the platform by the designer Decidim. Both projects were new so no “customs” (except the ones designed into the platform) of the community existed on the platforms and thus the “entrée” (Kozinets *et al.*, 2014) of the researcher and other participants was made on the same footing. The two platforms evolved differently as PMs and participants engaged with the infrastructure. In Helsinki, interaction between citizens, platforms and PMs led to the removal of an evaluative infrastructure (example presented in the findings) while Turku kept this material arrangement. Since engagement in smart infrastructures was of interest, the researcher avoided “lurking” (Kozinets *et al.*, 2014) and interacted on the platforms. In Turku, the author submitted a proposal, called “Insomniacs park” that was accepted. This helped the researcher follow new nodes of connectivity that formed when the public managers offered citizens, including the researcher, group consultations to hone the proposals.

The study covered as much “infrastructural territory” as possible using traditional interviews, email conversations and observational techniques (Table 2). Among the various activities observed, those relevant to this paper were the construction of the project’s so-called “platform economy model,” “data utilization and data platform” (Figure 1) and the participatory budgeting initiative.

Once the empirical moments were determined, the researcher reviewed the relevant field notes and transcripts and combined inductive, deductive and iterative approaches in generating, applying and developing the coding system. Coding was performed manually. A hermeneutic approach (Mees-Buss *et al.*, 2020; Van Maanen, 1979) was adopted when analyzing the data. As the analysis of the development of SWT unfolded not only gradually, but also asymmetrically and accidentally, it became particularly important to explore how social and material considerations are mobilized, become relevant and are rendered visible.

The researcher conducted the research in iterative cycles (Glaser and Strauss, 1967) and applied systematic combining (Dubois and Gadde, 2002). Interpretative rigor was applied by probing and heuristics to encourage theorizing by opening the process of interpretation to additional insight. This interpretive process was, at times, a collective effort, as recommended by Mees-Buss *et al.* (2020).

Drafts of the paper were presented to other researchers to test the robustness of the concept. Systematic combining, the interplay between the empirical examples, and the concepts in recent accounting and urban governance studies led the researcher to turn to the concept of “thinking infrastructure” as a fruitful analytical and theoretical method for approaching the data. In the final stages, systematic combining (Dubois and Gadde, 2002) continued as the researcher worked iteratively with the data and literature on thinking infrastructures. In so doing, previously developed codes (Big Data and Participation) were revised to “Human Intelligence,” “Participation,” and “Accumulation of knowledge in ICT” and integrated into a 3 \* 3 matrix (Table A1) that not only represented the data but also broadly captured the emergence of the smart cities and contributed to the literature.

## Findings

This study aimed to illuminate how infrastructures “think” and how technology cognitively configures users and actors: a process that Mazmanian *et al.* (2014, p. 831) termed the “shifting, figural, asymmetric and dynamic negotiations between people, social structures, information technologies, and representational objects.” This section discusses empirical moments (presented in the previous section) pulled from the data. The section starts with a subsection that places the reader within the context being studied, i.e. the emerging smart city. Three subsections explore the interaction between the phenomenon and its context deeper (Dubois and Gadde, 2002). These subsections are labeled in line with the final codes



presented in the method section, i.e. smartness as accumulation of knowledge in ICT, smartness as human intelligence and smartness as participation.

*A city becoming smart*

SWT team meetings often discussed the “platform economy model,” and this discourse often gave rise to conceptual conundrums. Group interviews facilitated by external consultants began with an explanation of how such platforms were defined. For example, one facilitator addressing 12 PMs sought to

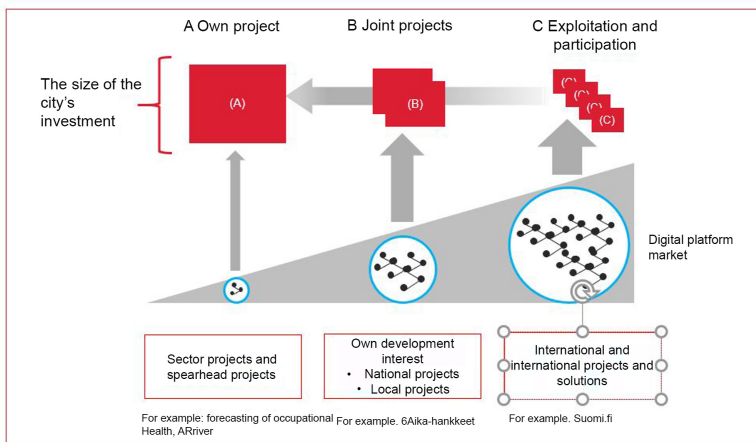
find an understanding of how Turku should evolve in this “platform thinking,” what it should proceed in doing, and how things could be comparatively evaluated. (Consultant, Solita Oy)

In this instance, the platform was conceptualized as a “complex way of thinking.”

PowerPoint slides were presented in three group sessions, one with five participants and other two with a dozen. The representational object that generated the most collective configuration was a visualization of the Platform Development ABC (Figure 2). This team effort allowed the researcher to get a better sense of the connections between the different units, ICT and representational objects.

Figure 2 shows the different levels of centralization and decentralization of the “platform economy.” The letter “A” represents a hierarchical organization where the platform is owned by the city. Moving toward the right, the smart city enters more distributed forms of organization. This distributed urban autonomy, to borrow an idea from Bulkeley *et al.* (2016), is also considered more market-oriented, as platforms are often produced on the market. Smart cities can choose which parts of their governance are on their “own” platform (option A) or the result of joint projects (option B). In option C, smart cities engage in smart cities governance by “exploiting and participating” in platforms designed and owned by external national and international organizations. A preference for options B and C (in Figure 2) arose as the public managers configured different heterarchical practices and horizontal accountability systems. For example, as one interviewee stated,

The ABC of platform development. Selection of investment options (A, B or C) to promote and implement your own platform objectives



**Figure 2.**  
The platform development ABC (Solita Oy/Turku City)

In my opinion, the “platform” or “platform economy,” whatever you decide to call it, gives us a huge opportunity/ . . . /That is, when there is a lack of comprehensive capability in the city or private sector organization, but both actors’ capabilities complement each other, something new that may not even be previously known may appear (Public Manager, Customership and service management focal point).

This statement indicates that officials have identified inefficiencies in existing institutional arrangements. The underlying assumption is that new smart technology-enabled forms of distributed organization and enhanced autonomy perform better than traditional hierarchical and bureaucratic managerial control. This position is not based on the experience of actual systems or platforms but rather on the experiences of centralized projects that have failed, as well as frustration with “siloed” divisions that do not communicate with each other.

At a later stage in the research, reconfigurations of the platform models surfaced. For example, Turku City Data presented a kindred visualization (Figure 3). Here, decentralization was also connected to value (in line with the business model of Turku City Data). Knowledge through data is superior, as the accumulation of data is assumed to produce exponentially more valuable data. This adaption echoes the key promise of big data, which is that platforms and applications generate data that are then reused for new purposes. This in turn invites questions as to the need for governance of data usage (Meijer, 2018).

*Smartness as accumulation of knowledge in ICT*

When smartness is seen as an accumulation of knowledge in ICT, data is the preferred way to view the city (Meijer, 2018). Residents of smart cities are not seen as active players in this scenario. This is not necessarily a downside, as they can live with “value for money” technology, as one interviewee argued. This enables residents to live an automated life that is smart, as technology tracks their activities in the city infrastructure and adjusts the city in terms of comfort and efficiency. For example, as one interviewee reported,

/ . . . / they make a log of the temperature and other conditions in the property, all kinds of data, what food is offered in the staff canteens, and what is coming in. It’s a question of energy savings, how much has been saved in carbon dioxide, how much has been saved in water, such things. So, the thing is, it’s not just for the management; the information is returned to the clients and, for example, to the parents of schoolchildren/ . . . / (Public manager, Urban environment division)

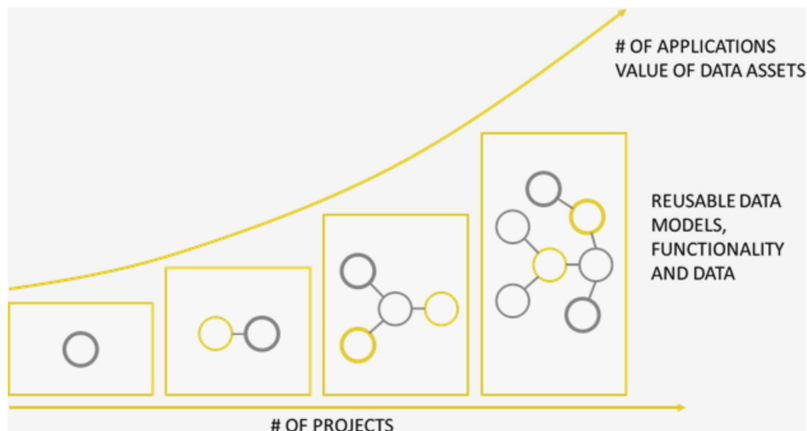


Figure 3.  
Platform thinking  
(Turku City Data)

According to this view, smartness is primarily achieved through more efficient processes and responsive urban residents who participate in invisible computational sensing and monitoring practices. The “Smart City Knowledge Graph” (Figure 4) produced by Turku City Data can be used to visualize data and bridge the gap between fragmented experiences and data, such as humidity, particles, power consumption and more sustainable spaces.

Accounts from the smart cities industry also highlight meta-governance, as computational sensing technologies are used for environmental monitoring and feedback.

The interviewees highlighted reconfiguration as an organizational process that incorporates new technology into old infrastructure. This process requires knowledge of the city and brings together diverse perspectives on design, data engineering and operations, in order to envision the future smart city and its behavior. The interviews also showed that a change in practice does not always begin with an assumed public manager’s intention. The human was re-centered in the situated socio-material practices, and new ICT or old infrastructure created a conditionality that made certain practices appropriate and legitimate. For example, one account describes the situation:

We have carried out different platform experiments, but we have not, at least in the area of well-being activities, achieved greater platform functionality. Perhaps the platform for traffic and mobility is currently more on target. (Public manager, Welfare division)

The existence of traceability infrastructure was the reason for more functionality. The researcher thus observed how such infrastructure not only mediates but also conditions organizational routines, as divisions with digital capability “format and furniture” (Pollock and D’Adderio, 2012) or create the framework and tools for other divisions.

Research also revealed broader infrastructures. Technology designed by the smart cities industry and other market actors has stretched the accumulation of knowledge in ICT beyond the municipal level. According to the public managers, small city entities such as Turku, with a population under 200,000, are not enough to attract interest in terms of the global infrastructure. A single city, regardless of whether or not it has “a fancy gadget,” is not sufficient. The smart city model as a way to thrive in global competition was thus

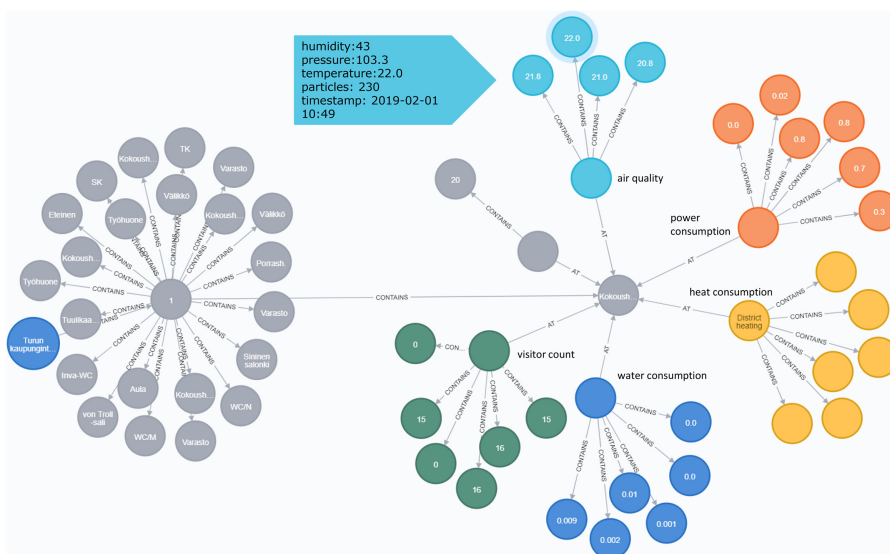


Figure 4. Smart city knowledge graph (Turku City Data)

problematized, as cities and municipalities are often required to create alliances if they wish to appeal to the industry as a whole.

This perspective was confirmed in industry white papers and interviews. A representative working with Nokia's smart cities solutions expressed that an SC approach "applies more to large complex cities than smaller cities." Dynamics of emergence could, therefore, be studied as the researcher zoomed in and out of locations, moving beyond a focus on the idiosyncrasies of local practices to experience how people and technologies perform across multiple contexts.

Ultimately, work on the ABC platform development led to the identification of 80 platforms for the platform economy model to consider. These platforms were the so-called bedrock platforms (the health data platform Omakanta.fi, global e-commerce platforms such as TenCent's PaiPai and Airbnb), as well as physical urban spaces (e.g. Turku Science Park.) In terms of governance, smart cities are not active on TenCent, yet in the words of the project's head developer:

we are aware of them and if they start to benefit us at some point, they can be utilized as they are, or by engaging in some activity of our own to achieve results that benefit us even more (Director of development of SWT).

This statement can be read in conjunction with [Power's \(2019\)](#) proposition that thinking infrastructures monitor their objects and make them visible, thus making them open to possible interventions.

#### *Smartness as human intelligence*

Human intelligence (wisdom) was a key issue when it comes to SWT. In the debate about smart cities, this dimension is often contrasted with data. When speaking about municipal initiatives to prevent social exclusion and promote resident participation, culture and sports, and day care and education services, public managers questioned the use of data tracing infrastructures. Using data that was acquired in this way made them anxious, as they did not find it credible or socially acceptable. Moreover, they "did not trace the right things" (Public manager, Recreation services), for example, the quality of services. Yet the managers did endorse the idea of a more distributed organization. As one Open participation specialist expressed, the future is one in which "10% of the work is done by the city – statutory services – and 90% is done by other organizations, that are partnering with the city." This collaboration of government with nonpublic stakeholders was considered important, and many accounts raised concerns around how people engage in ICT environments. One description is as follows:

We have, for example, an awfully good division-based wellbeing management team that was in no way affiliated with Smart and Wise Turku, but we actually talk about people with them, and not about some data or artificial intelligence or something. (Interim Open Participation Specialist)

Governance challenges surfaced, as knowledge through data was juxtaposed with other forms of obtaining knowledge. Human centrality was not something the city was well-equipped to deal with, the team felt, and so Turku should instead enter into alliances:

Well, we have this terribly wonderful organization, A-kilta, a support group for former alcoholics. The city has signed a partnership agreement with them to organize activities for elderly males in the Pansio-Perno area, which is one of our most challenging neighborhoods. (Project director, Communications unit)

Capable human actors were valued:

/ ... /we have the Mustikka education center, specifically for immigrant women who have experienced domestic violence or the like. Turku has a partnership agreement with the centre

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because they offer specific services for the target group that the city cannot offer/ ... / (Open Participation Specialist)

This tracing of human intelligence differs from the seemingly neutral data accumulation that governs the political community in the previous subsection. A distributed organization was quickly configured by the public manager, as two-third sector-run platforms that the city could partner with were identified. This is interesting, as underrepresented groups like minority women and recovering alcoholics are rarely considered in terms of smart city infrastructure. One exception is [Elyachar's \(2010\)](#) study on a women's practice in Cairo, where the author showed how historically constituted channels of communication were mobilized and made visible so they "could begin to serve as infrastructure for new infrastructures" (p. 460).

At times, incorporating old infrastructure into a platform caused anxiety and was met with resistance. Some public managers confronted with the Platform Development ABC image complained of significant concept and process ambiguity. They struggled to link the concept of the platform to their own division or area of expertise. Configuring (i.e. organizing people, things, activities and responsibilities that could be digitalized and plugged into the smart infrastructure) was time-consuming, leading one manager to report that "this kind of interview is really challenging. (Public Manager, Recreation services)"

Education Division public managers were reluctant to incorporate their students and teachers into a matchmaking infrastructure of supply and demand built "on the values of Airbnb" because, contrary to Airbnb, "we share scarcity." Frustration with process ambiguity as to not only *how* but also *who* should lead the SWT development was common. The public managers had participated in "all kinds of pilots and experiments" and were unsure of who actually could collaborate in the SC and who was accountable to whom.

### *Smartness as participation*

This section focuses on a specific digital platform designed to organize the City of Turku's participatory budgeting initiative, the Turku Resident Budget.

An accountability challenge surfaced shortly after the initiative's launch, as the introduction of the platform led to tensions between different public management practices. According to the literature, participatory budgeting strengthens the political position of the city's residents, which changes the power distribution and enables forms of collaborative governance ([Pereira et al., 2017](#)).

In the SWT project, the researcher observed distributed agency combined with instances of hierarchical control, as some public managers altered the residents' original propositions to fit their division and their own "regime of truth" ([Messner, 2009](#)). The residents, as rookie participants, became socio-materially entangled with Turku on the platform, which led the public managers to try to shape the emerging materiality.

This suggests that humans and machines assess each other in asymmetric and shifting ways. As an Open participation specialist stated, the organization was "tilting at windmills," due to the "transfer of power, and a change to old ways of working." However, even more interesting was the range of visibilities, in terms of infrastructure, that the platform revealed.

The proposals ( $n = 341$ ) submitted on the platform included ideas for new dog parks, Frisbee golf courses and better lighting in certain neighborhoods. After the initial submission of proposals, the residents were then asked to review and vote on the proposals. Most of the ideas fell in the area of leisure infrastructure. Some were minor: "at least three boat berths in the Hirvensalo area" to connect the city with the "treasure of Turku" archipelago, while others were larger in scale, such as a proposal to build a dedicated area for log homes.

Participating in the design and implementation of public policies brought residents' capabilities to the fore. The log house proposal was deemed "not possible" by the city because the

sewer capacity would be “too big an investment” and impossible to cover “with plot sales revenue.” The Turku Resident Budget initiative can, therefore, be understood as a technology of government that is “apparently humble and mundane” (Rose and Miller, 1992) and that trains citizens to understand infrastructure through knowledge of project management and budgeting.

Yet in a meeting arranged by three public managers to hone the researcher’s proposal, the managers acknowledged that many residents who participated in the initiative did not have these competencies. Those who did were identified as professionals (e.g. entrepreneurs or other commercial stakeholders) who had found a loophole that allowed them to lobby for projects that the city had rejected in its other operations. These findings also suggest that smart cities are not simply organized via platforms.

Performative implications of social and technological entanglements (Cecez-Kecmanovic et al., 2014) could be observed, as the platform and public managers needed to teach the city’s residents to perform competently. Smart cities need to hire “borough liaisons” – as the City of Helsinki has done – to coach residents, communities and companies on how to use the platform, engage with the city and develop sustainable project plans. This requires resources that smart cities do not always have. The lateral accountability created by this distributed autonomy, therefore, requires new programs and technologies in order to create new subjective experiences. As a result of SCG, citizens must be able to give an account in a specific forum and perform in terms of efficiency, productivity and innovation.

Figure 5 shows the researcher’s profile of the participatory budget platform: A gamified architecture of participation rewards and accounts for “participant actions and progress on

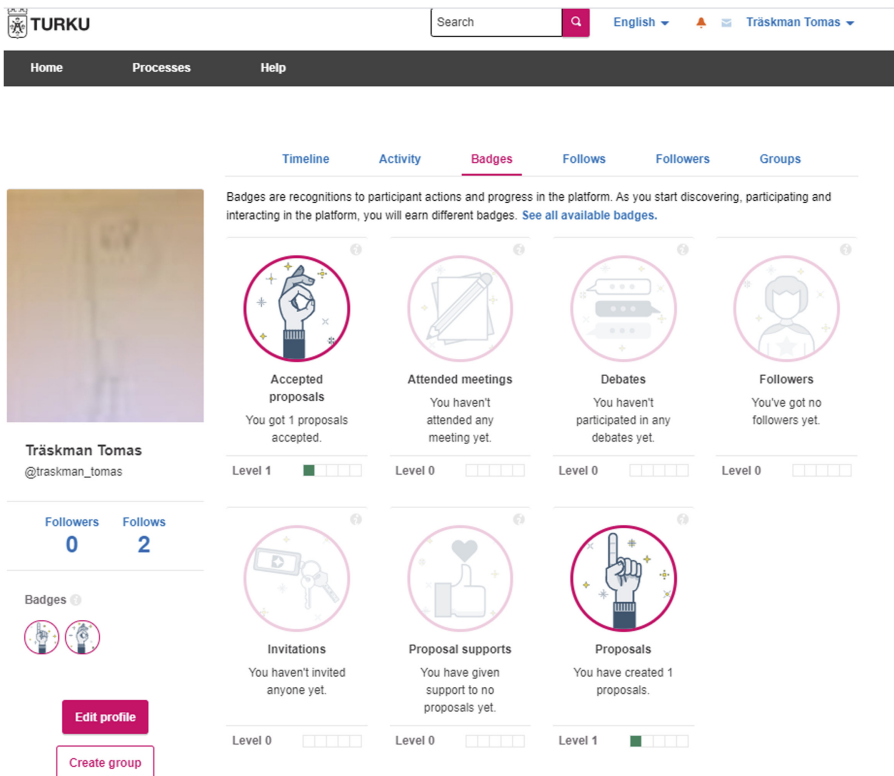


Figure 5. Researcher’s profile of participants on the Turku Resident Budget platform

the platform.” At the same time, the profile is part of an evaluative infrastructure, as it turns the participant into a “quantification.” For instance, a “followers” badge is granted when you reach a certain number of followers. Resident profiles are, therefore, an example of Kurunmäki *et al.*’s “instruments of quantification” that “shape and challenge the subjectivities and capacities of public service providers and users, and related understandings of personhood and citizenship” (2016, p. 401). The platform governs the residents, as participants are sorted according to what the “infrastructure of scoring” (Kornberger *et al.*, 2017) discloses.

In this accounting infrastructure, the resident is portrayed as a creative member of the city and is recognized for their impact on the local community and ecological environment. This gives rise to a new form of governable subject whereby individual duties of accountability become socialized (Rose *et al.*, 2006). However, in Helsinki, the exploration also led to a rethinking of the platform’s functions, as the “new subjectivity” shaped on the platform was denounced by anxious users of the platform. The city removed the resident profile from the platform. Removing similar evaluative infrastructures from, for example, eBay or Airbnb would be inconceivable, since they provide an interface for interaction and controlling mechanism central to their value-add (Kornberger *et al.*, 2017).

In an email conversation, a public manager admitted that “due to the lack of resources, nobody had time to plan how the functions could be utilized in practice.” The managers thus pondered what level of traceability is needed on the platform. The platform also functioned, in the words of Kockelman (2017, p. 16), as an accounting infrastructure for “those agents who are trying to account for agency.” Accountability was also highlighted by the designers of the platform, as “one must at all times show how, why, by whom and with what guarantees a certain type of object of a participatory process was dismissed, approved or blocked.”

In summary, interaction with the SWT project’s (existing and tentative) infrastructure helped actors imagine the opportunities and possibilities provided by smart cities. In turn, smart cities infrastructure traces, values and governs actors, identities, objects, ideas and relations to animate new desires and feats of imagination.

## Discussion

Through the lens of the empirical examples, this section seeks to show how technology cognitively configures smart city actors, redistributes accountability relationships and changes boundaries and infrastructures. The overall contribution of this paper is to fully engage with notions of cognition (e.g. embodied, distributed) and proposed cognitive value of smartness. The SC literature mentions this value and the notions but does not elaborate further on what happens when we take this perspective and articulate it in empirical settings, i.e. when ICT and cities “think” and act on opportunities and possibilities provided by smartness. The researcher grounds this paper’s theoretical perspective in the idea of a “thinking infrastructure,” detailing its tracing, valuing and governing elements in the descriptions presented in the findings.

### *Smartness and tracing*

Smart technologies “think” as they trace behaviors, preferences, choices, expectations and experiences (Bowker *et al.*, 2019). The case of the SWT project shows that objects and relations identified by tracing become resources for different value-creation processes. Turku City Data collects data and creates graphs for further analysis. On the participatory budget platform, people, locations and objects are sorted according to scores disclosed by different infrastructures.

In the SC literature, the notion of smartness leans heavily on data collection and analysis. Approaching smart cities through the lens of thinking infrastructures adds an element of exploration to smartness. For example, Turku City Data's business model builds on the production of graphs (i.e. new worlds for further exploration). In contrast to SC optimist accounts, smart infrastructure does not analyze; rather, it orchestrates decision-making and shapes distributed cognition. Further revelations are disclosed when thinking infrastructures generate relations (rather than references) between things, people and ideas. This relationality reshapes the world contingently around it. As new relations are disclosed in new forms of participation, so are new tensions. The relative failure of ICT-enabled collaborative governance as described by SC scholarship (e.g. [Pereira et al., 2017](#)) is not explained by the lack of interaction on, for example, social media. In addition to the instrumental view of smart infrastructure, the cognitive nature of smartness needs to be considered both in practice and in research: more traces in real time require more distributed cognition, i.e. more (epistemological) work for both PMs and citizens.

This paper has also shown that disclosing can be problematic. When Turku was identified as the seventh smartest city in the world, the relationality of thinking infrastructure was rendered visible. It was a moment of becoming. Accountability as the promise of identity emerged through tracing; here, smart cities suddenly became "a subject who *might* be able to give an account" ([Roberts, 2009](#)). However, as this identity has boundaries, it is also a categorizing moment, which [Pujadas and Curto-Millet \(2019\)](#) described as "a performative and political act with consequences in the definition of responsibilities and accountability." This example illustrates the agency distributing nature of tracing infrastructures.

#### *Smartness and valuing*

The existence of Turku City Data indicates that for smart cities, traceability is a value itself (just as a lack of traceability is, as [Power \(2019\)](#) observed, a value in organized crime). The resident profile ([Figure 5](#)) can be understood in terms of "entity-creation and maintenance" ([Power, 2019](#)) – a dynamic by which responsible agency in smart cities does *or does not* become widely distributed.

The evaluative infrastructures value objects and people, thereby creating distinctions and boundaries for the co-creation occurring on the platform. Ranking and ratings organize sense-making and decision-making by categorizing and hierarchizing. The number of "followers," and proposals "made" and "accepted" ([Figure 5](#)) are a form of performance measurement, as described by [Bovens \(2007\)](#), and they also function as a basis for evaluation and accountability. [Kornberger et al. \(2017\)](#) argued that visualizations, such as badges, build up cultural and symbolic capital, and in the context of smart cities, these visualizations develop political capital.

The SC literature highlights accounting as exposure. Proposals produced by citizens make, as [Castelnuovo \(2016\)](#) argues the SC smarter, but they also create traces that expose it. Rundown and neglected infrastructures are not only made visible, since the proposals are also reviews of the city's performance. In many of the proposals, the city is held accountable for mistreatment. The voting mechanism on the platform adds another evaluation. The more votes a proposal, the more exposed the city, or, for example, a division of the city administration, is. Tracing can, therefore, be understood in line with [Robert's \(2009\)](#) view on transparency as performative in that it "works back upon those subject to it in ways that are often counterproductive, or at least far exceeds the passive image of a simple making visible" (p. 958).

However, conceiving of the sensory aspects of infrastructure ([Larkin, 2013](#)), the affectual experiences disclosed by thinking infrastructures bring a new dimension to smart cities. As previously argued, smart cities governance is also the governance of urban perception. In SCG studies, such as those on smart collaboration ([Muñoz and Rodríguez, 2019](#)), ICT is



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presented as a sharing and matchmaking infrastructure. Addressing the aesthetics of infrastructure invites a different understanding of participation: it is also a sensing. The disclosing that occurred on the participatory budgeting platform highlighted emergent forms of value. Residents sensed the “smell of infrastructure” (Robbins, 2007), that is, neglected infrastructure, but the proposals also mobilized it as “love and care as a possibility, a prospect” (p. 28). This, therefore, is an example of how thinking infrastructure informs and shapes what Bowker *et al.* (2019) called “embodied cognition.”

### *Smartness and governing*

Urban governance literature highlights “citizen centrality” (Castelnovo *et al.*, 2016) and calls for a rethinking of “smart citizens” (Cardullo and Kitchin, 2019). This paper provides grounded descriptions of implications of such smartness with respect to how we make sense of the world and act in it. For example, in the present study, the interplay between hierarchical and heterarchical power relations was evident. Public managers altered the original propositions of city residents in the participatory budgeting initiative. The agency-distributing capacity of the platform generated “paradoxes of power” (Bowker *et al.*, 2019) that some managers could not tolerate.

In the emerging smart city, there were instances in which human intelligence could not purposively shape the entangled socio-material environment of the SCs. Distributed agency requires critical scrutiny, as individuals’ capability (i.e. the ability to engage with smart cities and their ICT) does not align with emerging meta-governance technologies. For example, the public managers stated that exposed groups can be traced in smart cities. Faced with having the responsibility for parts of the smart cities infrastructure that they do not entirely control, as well as groups they felt accountable to and for, led to insights into the consequences of paradoxes of power and created a sense of anxiety among the managers.

The description of the platform economy model showed how digital infrastructures become infrastructures only in relation to organized practices by public managers in the city administration. Collective reasoning happens asymmetrically on multiple sites and divisions with various materializations and rematerializations, where different units imagine “the ‘platform’ or ‘platform economy,’ whatever you decide to call it.” The Turku public managers questioned how they could live in and off smart infrastructure thereby disclosing worlds that do not fit seamlessly into the known smart city paradigm.

The inclusion of global platforms in Turku’s “platform economy” shows that infrastructure also leaves traces, as such traces “bleed out of any fixed material location” (Bowker *et al.*, 2019). This allows smart cities to act as a “pirate and parasite” (Kockelman, 2010), living within and off infrastructure. Examples of this include Airbnb and TenCent. This interplay between the social and the material allows the “multiple ontologies of actors involved in an infrastructure” to be traced (Pujadas and Curto-Millet, 2019), which, in turn, mobilizes infrastructure for the creation of new infrastructures (Elyachar, 2010).

The results also shed light on how the dynamics of thinking infrastructure transform external relations with multiple entities to internal relations, which in turn invites questions surrounding the “governance of governance.” The observations of the platform economy model highlighted how individuals perceive and engage with the material world, as well as the problems of agency and the distribution of responsibility when ICT distributes agency.

New entities such as residents and centers for women and meta-entities (e.g. the smart cities industry and its global infrastructure) were identified, challenged and problematized to define the boundaries of the new (public) “meta-entity” of SWT. Power (2019) argued that tracing also creates new accountability relations. The agency-distributing nature of tracing infrastructures brings about new agents above and beyond organizational boundaries. Here, responsibilities may not be clear and may be subject to continuous negotiation (Power, 2019). The question of

accountability pushes the public managers to rethink the boundaries of the SWT project. Statements by public managers identified “wise” yet underutilized communities (e.g. activists and advisory groups) that the current infrastructure is too rigid to integrate. These groups were, therefore, made into the “other” (Star, 2010) by the infrastructure.

Finally, the findings can be read in line with Roberts’ (1991) distinction between accounting as a technique and a socializing accountability “that acts as a mirror through which producers and their activity are made visible” (p. 363). The description of the public managers figuring out a platform economy model is relevant, as they explored “the possibilities of accountability.” Attention was paid to the interplay between the social and the material, which Scott and Orlikowski (2012) described as the “flow of experiencing.” Within this interplay, responsibility was the ability to be responsive to the possibilities of becoming both traceable and accountable. Research on smart cities has suggested a shift to distributed forms of production and organization. For example, Bulkeley *et al.* (2016) suggested a “distributed autonomy,” while Pereira *et al.* (2017) proposed ICT-enabled collaborative governance.

Yet these studies do not assess the feeling of such practices from within. The experience of becoming positioned in the material-discursive practice of a participatory budgeting platform illuminates how transparency affects those subject to it (Roberts, 2009). The researcher’s experience of being profiled enabled an embodied sense of the subjective effects of accountability as transparency. The analytical vocabulary of thinking infrastructures is helpful here since, not the least because it helps articulate accountability as a productive force, the smart citizen/researcher was traced, valued and governed, i.e. granted distributed agency to perform city ambitions.

In addition, the researcher and others were confronted by the platform’s configuration of residents, and the subsequent questioning pointed to the socio-material practices of more intelligent accountability (e.g. the decision by the city not to use the profiling feature). Similar to the balanced scorecard described by Roberts (2009), the evaluative infrastructures on platforms can be a learning, information and communication system where the platforms and the users discover the nature of their responsibilities to the other. There is poetry in the way new governance and accountability systems trace and reconfigure the territory of the common and allow new voices and responsibilities to enter into the political space.

## Conclusion

The contribution of this paper is that it examines what happens when smartness is understood as a thinking infrastructure. Different theorizations of infrastructure have implications for the study of smart cities. The lens helps us grasp possible tensions and consequences in terms of accountability that arise from new forms of participation in smart cities. It helps urban governance scholarship understand how smartness informs and shapes distributed and embodied cognition. Turku’s SWT smart city project bears much resemblance to Dourish’s concept of an accidental smart city. Turku became smart gradually, and different actors constructed it without a master plan and with a “lot of patching, hacking, jury-rigging and settling” (Dourish, 2016). Thinking infrastructure offers urban governance scholars an alternative perspective where infrastructure is not only a technical object, it is a language to be learned and a way of “tuning into the desire and sense of possibility expressed in the very materials” (Larkin, 2013, p. 337) of the smart city.

The present study had certain limitations. For example, indicators and metrics were not considered. Accountability promises performance, but just how exactly can smart cities governance performance be measured? Prior research has studied the building blocks used in the assessment of SCG (Castelnuovo *et al.*, 2016), but has not fully addressed indicators and metrics. In this study, tensions between “local” accountability and autonomy and the retention of central control in the name of “democratic” or “global” accountability were

observed in different settings. As infrastructure occurs when the tension between local and global is resolved, further research should focus on indicators and metrics as mediators in this occurrence of infrastructure.

In terms of practical implications, the descriptions echoed recent calls to leaders and managers asking how much traceability is enough (Power, 2019) as well as to define the limits of accountability. In terms of accountability, the public managers' translation and "changing" of resident proposals to create a "fit" are relevant. They demonstrate how residents must account in a "particular way" (Roberts, 1991) because other forms of justification are not legitimate in some contexts (e.g. in a division).

Similarly, those responsible for engagement should train groups of residents to have basic insights into the innovation processes. As the interaction between managers, citizens and platforms redistributes responsibilities, it reconfigures what Messner (2009) termed a "multiplicity of accountabilities." The ethical burden for the resident and public manager made accountable in platform-organized smart cities governance depends on how multiplicity is put into practice. Limits to accountability may be necessary if multiplicity translates into multiple demands for accountability.

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**Corresponding author**

Tomas Träskman can be contacted at: [tomas.traskman@arcada.fi](mailto:tomas.traskman@arcada.fi)

<p>Emergence of data utilization and data platform (Figure 1), <i>Turku City Data Oy</i></p>	<p>Emergence of “Platform economy model” (Figure 1) The model is to describe</p> <ul style="list-style-type: none"> <li>• What kind of platforms the city offers</li> <li>• What kind of actors can use the platforms and with what rules of the game</li> <li>• How value creation takes place from the perspective of different actors</li> <li>• How to promote and support interaction between actors</li> <li>• What are the roles and responsibilities of the city and other actors</li> <li>• How the city organizes and finances services and support related to the platforms</li> </ul>	<p>Emergence of <i>Turku Asukasbudjetti (Turku citizen budget)</i></p> <p>Digital platform for citizen participation, that helps citizens, organizations and public institutions self-organize democratically at every scale</p>
<p>City-owned data company that produces a knowledge graph framework for organizing data, exploring business problems and building reusable data products and analytic solutions</p>	<p>Human intelligence</p>	<p>Participation</p> <p>Turku citizen budget</p>
<p>Modes of smartness</p>	<p>Accumulation of knowledge in ICT</p>	<p>Participation</p>
<p><b>Processes of tracing</b> Illustrative example Illustrative quote</p>	<p>“Platform economy model” <i>Turku City Data Oy</i></p> <p>(in)visibility of infrastructures is mobilized in platform economy model group meetings /... they make a log of the temperature and other conditions in the property. All kinds of data, what food is offered in the staff canteens, and what is coming in. It's a question of energy savings, how much has been saved in carbon dioxide, how much has been saved in water, what has been, such things. So, the thing is, it's not just for the management; the information is returned to the clients and, for example, to the parents of the school! ...!</p>	<p>“Platform economy model” meetings</p> <p>(in)visibility of infrastructures is mobilized in platform economy model group meetings We have, for example, an awfully good division-based well-being management team that was in no way affiliated with smart and wise, but that well-being management team is such that you actually talk about people, and not about some data or [laughter] about artificial intelligence or something else</p> <p>Proposals on the platform disclose people, locations and objects Turku is “too small and cramped” with the “treasure of Turku,” the archipelago (proposal “at least three boat berths in the Hirvensalo area”)</p>

(continued)

**Table A1.**  
Methodological classification of the empirical phenomena

Table A1.

Modes of smartness	Accumulation of knowledge in ICT	Human intelligence	Participation
<b>Processes of valuing</b>	Turku City Data Oy	Turku citizen budget	Turku citizen budget
Illustrative example	Traceability is a value in itself for the SC generating representational objects (for example, smart city knowledge graph)	Evaluative infrastructure nudges citizens to perform in certain ways (citizen profile)	Citizens learn to sense value and the smell of infrastructure on the platform
Illustrative quote	"We have had different platform experiments here, but we have not, at least in the well-being activities, achieved greater platform functionality. Perhaps this platform for "traffic and mobility" is more to the fore now."	Accepted proposals badge "This badge is granted when you actively participate with new proposals and these are accepted How can you earn it Choose the participation space of your interest with submission for proposals enabled Try to make proposals that can be carried out. This way they are more likely to be accepted"	"In addition, it is impossible to cover this investment [in sewer capacity] with plot sales revenues and connection fees, as there are so few plots at a time and the value of the land is so low in North Turku."
<b>Processes of governing</b>	Turku citizen budget	Platform economy model group meetings	Turku citizen budget
Illustrative example	TIs transform external relations with multiple entities to internal relations on the participatory budgeting platform	A model emerges that describes what are the roles and responsibilities of the city and other actors (80 platforms)	The platform acts as a mirror through which producers and their activities are made visible
Illustrative quote	"A total of 3,001 Turku residents voted on the Asukasbudjetin's 239 plans. 52 projects progressed in implementation The city is responsible for coordinating and implementing the projects, but implementation will be done together with the proposers during 2021"	Creating the model "is really pragmatic, that is ... to find an understanding of how Turku should evolve in this "platform thinking," what it should proceed in doing, and how things could be evaluated between each other"	"one must at all times show how, why, by whom and with what guarantees a certain type of object of a participatory process was dismissed, approved or blocked"