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Working across Boundaries in Urban Land Use and Services Planning—Building Public Sector Capabilities for Digitalisation

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Abstract: This article addresses the challenges and capability gaps confronted by public administrations concerning digital transformation and the use of novel tools in the context of land use, facilities and urban services planning. The present state of planning and management processes in Finland is introduced and reflected through experimental piloting conducted in two Finnish cities. Participatory action research and design research methodology was utilised to identify the main challenges as well as unravel the possibilities of digital transformation in the context of public services planning. The resulting analysis revealed the critical importance of facilitating integrative policies and coordination when working across knowledge boundaries between administrative domains. The paper contributes to a wider theoretical and conceptual understanding, as it discusses the advantages and feasibility of digital tools as boundary objects for cross-sectoral work in smart, people-centred urban governance. The authors see this direction of research as a fruitful ground for further investigations within the interdisciplinary urban planning research context.

Keywords: urban planning; service networks; public facility planning; smart urban governance; process innovations; intelligent decision support systems; boundary objects

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1. Introduction

Urban services, such as health care and social services, educational services, emergency services or public transport services, form the basis for citizen welfare and contribute to a great extent to the quality of everyday life [1,2]. Facing the challenges of urbanisation, demographic changes, economic scarcity and other long-term trajectories, governments are compelled to enhance the capabilities needed for the 21st century in order to better respond and adapt to new realities in a world of complexity, interdependencies and uncertainties [3]. Urban planning, as a transition management procedure and policy framework, operates in the cross-pressures of acute crises and long-term urban transformation. Even though recent global crises have forced us to rethink urban shock endurance and led to the expansion of digital-first and contactless urban service delivery, the role of a physical city cannot be overlooked as long as people need physical care, education or social encounters.

Contributing to the smart city planning discussion, particularly from the viewpoint of process innovation in urban planning, our main research questions are the following: What are the main challenges encountered when pioneering a systemic change? What sort of specific capabilities are needed to overcome the challenges? How can digitisation help the public sector in making evidence-based decisions towards sustainable, cost-effective and people-oriented service delivery? This article clarifies the possibilities, barriers and potentials of digitalisation in service network planning through two pilot cases. While recognising the role of technology as an enabler, we argue that, with the revealing of new

forms of cross-organisational engagement methods, smart cities are able to reach the full potential of digitalisation and technological progress. Even though our inferences are suggestive at this point, we wish to contribute to the discussion on the feasibility of digital boundary tools for supporting dynamic knowledge management and purposive collaboration among city officials, decision makers and citizens [4–7].

Service network planning as an administrative sub-task of strategic city planning refers to the process of defining where and when new service units will be built, how much service capacity is needed, which units will be maintained and which units will be closed [8]. The ultimate, and challenging, aim is to satisfy demand while maximising societal benefits with minimal costs, maintaining close-to-maximum occupation rates in existing units and without compromising service accessibility or causing negative public reactions [8,9]. In a well-functioning society, we often pay little attention to the complex processes and organisational mechanisms behind these service systems until something critical fails or decisions over local services directly affect our own life. Inherently, planning solutions have direct and indirect impacts on the well-being of the citizens, and these impacts should be demonstrated for decision makers who must prioritise the allocation of scarce resources under the given accessibility, budget, capacity and design specifications [8]. Thus, on a rational level, network planning concerns the optimal arrangement of the entity of services produced and/or organised by a city or a region, and meeting service demands over the short, medium and long term.

However, on a non-rational level, service network planning concerns a wide range of value-related aspects. Besides optimising the demand and supply of services, multiple interests, needs, facts, uncertain forecasts and, ultimately, values and opinions must be taken into consideration. Having a strong political dimension, disputes over service network decisions and their assumed impacts may take years and evoke strong public reactions. Debates often culminate in the scarcity of public budgets, as municipalities try to find financial savings by reducing their public service network coverage. Finland, as a Nordic welfare state with strong public service provision funded through taxation, offers an interesting frame on exploring these issues. As an example, the coverage of school networks has steadily been concentrating and shrinking over the past few decades in Finland. Such reductions have especially affected rural areas and small schools of less than 50 pupils. In 2000, about 40% of all schools had less than 50 pupils, while in 2018 the proportion was about 20%. Correspondingly, the number of large, integrated schools has increased, especially since the 2010s [10]. Understandably, this trend has evoked redebate among citizens and politicians. A recent study by [11] showed that the geographic distribution of local public services in Finland correlated with the number of politicians living in that neighbourhood. When investigating data on three municipal council terms from 2005 to 2017, they concluded that the likelihood of elementary school closures rose with the scarcity of delegates living in the vicinity of a school. The study also revealed that poorer neighbourhoods are under-represented in terms of delegates. This altogether reinforces the harmful effects of residential segregation as better-off residents are able to "vote with their feet" [11]. As [12] point out, school network planning is not only about organising teaching; it must also address societal questions of segregation and multiple other challenges related to urban development.

The arrangement of basic services is defined as municipal tasks by the Finnish Municipality Act 410/2015, and public service provision is often supplemented by private and third sector service delivery. On the administrative level, service network planning is an integral part of strategic land use planning as regulated by the Land Use and Planning Act 1999/132. As a municipal monopoly, land use planning has an explicit function to ensure that the general "public interest" is protected [13], and the equal provision of urban services is at the heart of this question. In order to be effectively organised, strategic spatial planning needs to be integrative, and overall coordination of sectoral plans is necessary. In practice, siloed sectoral planning suffers from discoordination and lack of broader stra-

tegic perspective, which often leads to unintended consequences [14] where service network development does not follow land use planning. In particular, urban sprawl and low land use efficiency worsen the preconditions of service provision and public transport. In order to tackle disintegration challenges, initiatives that aim to enhance the integrative capabilities of urban planning and develop more usable, democratic and effective practices, which bring diverging interests and understandings together under the same strategic frame, have been developed. [7]. In particular, the so-called MALPE work of Finnish city regions has been fostered as a means of trans-sectoral coordination of land use (M), housing (A), transport (L), services (P) and economic development (E) on different levels and sectors of government. However, the integration of PE themes into the MAL(PE) entity has remained a challenge, and it is argued here that the viewpoint of public services, in particular, has been overruled by other competing interests.

Previous Research and Paper Positioning

There is plenty of academic literature that deals with urban services provision from related disciplinary perspectives such as operational research, geography and urban studies. However, a clear knowledge gap exists when addressing the specific organisational, processual or technical challenges of service network planning and the required public sector capabilities for systemic change. As [15] note, existing research relating to public services is usually based on a number of oversimplifications. Altogether, studies that specifically focus on service network planning within the discipline of urban planning are rather incidental. Previous findings from Finland have confirmed that, on a general level, service network planning processes have been considered burdensome for citizens, city officials and decision makers alike [12].

In terms of methodological development, geography and mathematics offer relevant viewpoints that touch upon what DeVerteuil (2000) calls the model-building paradigm [16]. Methods that were originally developed for social networks research evolved into spatial analysis of urban street networks [17] or graph-based spatial analysis utilised in transportation planning. Numerous applications of dynamic optimisation models to school network and public facility planning have been presented over the years that focus on operationalising efficiency and equity according to, e.g., distance and geographical accessibility to services (see [9,18–20]). However, it is only in the past 10 years that a more widespread use of data-driven analytical tools and GIS-based methods has become available to architects and planners [21].

From a wider thematic angle, academic discussion on urban services has addressed various topics, such as citizen demands of urban services ([22]) or inequality aspects related to how costs and benefits are spatially distributed in urban society ([23,24]). In particular, the tension between politics and administration in determining the allocation of services, i.e., the question of "bureaucratic professionalism vs. politics", has evolved over the years into more recent discussions on the "deliberative bureaucrat" ([25]). Over the years, the division of work between the public, private and third sectors ([26,27]) with the issues of privatisation, decentralisation and externalisation of service delivery have been pertinent topics following the New Public Management and more "business-like" management of public service delivery ([28]). Furthermore, research has touched on urban sprawl and the cost of services [29], accountability and trust in local government in service provision [30], and the quality of life aspect and increasing demands for better public services [1]. Furlong et al. [31] touched upon the important viewpoint of actors and agency involved in urban service provision in the face of policy requirements at the local scale. Recently, Kumar et al. [32] analysed service planning in the context of smart cities and identified a need for strategic and integrated planning to design smart city services. Some scholars have approached the smart city through the lens of the recent service theories [15], which adopt a holistic vision to the service management and identify the "service system" as the most appropriate organisational model to support the emergence of value also in public services [33]. This fits with the newly emerged conceptualisations of City-

as-a-Service (CaaS), School-as-a-Service or Space-as-a-Service, and overall platform thinking, where public administration is positioned in the facilitator role. Thus, cities have begun to adopt a service-dominant logic with new management approaches to services instead of the old production-oriented or goods-dominant logic [34]. These also connect to new emerging frameworks that attempt to transform the government policy towards more human-oriented service provision and management through personal data. All these recent approaches highlight a holistic framework and systemic nature of both the smart city and the service system. This also resonates with the idea of a city as a social-cybernetic system [35,36] including citizen feedback and cyclical learning. What can be seen as a potential risk is that, while leading smart cities are expertly using data and intelligent analytics respond to specific challenges of smart cities [2,37], the gap between leading and lagging cities may continue to grow in the future. As an example, in the city of Berlin, only 5% of public sector workers had laptops before the COVID-19 outbreak. This brings up the question of digital maturity and organisational readiness for developing digital process innovations, which in turn improve public services planning and delivery.

2. Materials and Methods

Research on urban planning practices and process innovations cannot be conducted in a laboratory. Instead, a highly pragmatic and participatory approach is needed that emphasises the relevancy of exploration, design-driven problem solving, stakeholder involvement and contextual knowledge for understanding the problematics at hand. In design research methodology (e.g., Research by Design, [38]), the professional designer's viewpoint and understanding is acknowledged in the process of knowledge production. The operations of research involve the real-world, multi-layered context. Therefore, the trans-disciplinarity is an essential part of the design research methodology, either seen as the practical nature of design research (academia/practice, e.g., [39]) or, more broadly ([40]), according to the general definition of trans-disciplinarity, including participatory research approach, life-world problems, search for unity of knowledge beyond disciplines and transcending contents [41,42] (pp. 437–439). This approach has similarities with "exploratory action research" (exploratory AR) [43], an approach developed for educational research purposes, emerging as a logical description of a form of practice also considering the researcher's past experience. However, the systematic approach to Participatory Design (PD) [44] has an essential role in structuring the PD process into three phases, (a) a real-life problem situation, (b) information that will help us understand organisational practices and identify the needs and wishes of participants and (c) testing and evaluation [44]. In this paper, the main emphasis of PD at present is on the first phase (a) and partially on the second phase (b) considering the conceptual nature of our approach towards the needed tools.

In this case, we have utilised real-life exploratory pilots as a means of gaining knowledge with the cities of Kuopio and Helsinki in 2018 and 2020. Both cities represent still rare but highly important public sector early adopters in service network planning digitalisation. Kuopio as a regional centre of Northern Savo (population ca. 120,000) and Helsinki as the capital city of Finland (population ca. 650,000) plan and renew their urban service networks in a continual manner. Both had recognised bottlenecks and deficiencies in their practical work and perceived that efforts to handle acute situations too often dominated over long-term anticipatory planning procedures. The main challenge is that city management today is happening in silos and that data-driven insights supporting anticipatory planning and policymaking are missing. This means that cities have difficulties in forecasting how much service capacity is needed in the future, where the optimal location of service units is, and when to invest. At worst, investment decisions worth millions of euros are made next to a factless vacuum. Based on these identified pitfalls, Kuopio initiated a pilot project in 2018, called DigiPAVe, which was co-funded by the Experimental Finland [45] key programme by former Finnish Prime Minister Juha Sipilä's government.

The programme focused on promoting digitalisation and an interoperable information management ecosystem for the Finnish built environment and construction sector. The Kuopio pilot focused on developing an initial concept for dynamic service network planning and digital tools supporting planning processes. Partly based on the experiences from Kuopio, Helsinki initiated its own development work for process improvement which focused more concretely on piloting a technological solution during spring 2020.

The empirical documentation produced during iterative piloting included project plans with objectives, final reports, workshop and meeting memos, presentations, visual illustrations, and thematic group and individual discussions both in-situ as well as remote sessions due to COVID-19 precautions in 2020. The results were assessed against the digital maturity framework provided by the Center for Data Science and Public Policy, University of Chicago [46].

Pilot Descriptions

Currently, information for service network planning processes is mainly provided manually, and most cities use diagnostic reports and case-by-case solutions to support planning. In some cases, the knowledge base and planning processes are at least partly digitalised, and cities are able to utilise data in BI dashboards for performance monitoring. The cities of Kuopio and Helsinki sought to replace project-manner static reporting and manual data gathering with dynamic, data-driven planning processes that would match the needs of the cities' divisions of Daycare and Educational Services. As there were no off-the-shelf solutions available, the cities first had to create an innovation setting that allowed flexibility to explore, encounter small failures and spend some time on iterations. Government-supported external funding was the triggering factor for initiating development work in the case of Kuopio. The City of Helsinki was prepared to initiate in-house development work combined with support from technology vendors. The main stakeholder groups who were involved from the city organisation side represented real estate services, growth and learning services, urban planning services, city office and ICT services. Each division has domain-specific tasks and core processes that connect to the overall process of service network planning and ultimately service provision for citizens. Starting from the very basics in the digitalisation process, it was important to first define what information is essential for service network planning, for whom and for what purpose. The project team needed to create a preliminary data model, and conduct an inventory of information systems and available data. The development work related to the new operational model occurred through iterations with a technological prototype development (distributed SaaS application with a map-based view on the service network). It was crucial that stakeholders were motivated to be involved so that their continuous feedback and ideas could be incorporated into the prototype development. During the pilots, it was noted that the prototype served as a sufficiently concrete object for demonstrating benefits and communicating the specific needs, challenges and objectives over disciplinary borders. The exploratory pilots substantially increased the stakeholders' understanding of the processual, organisational and technical capabilities needed for the transition towards data-driven service network planning.

The objective of Kuopio and Helsinki was to reach a digital maturity level, where planners could deploy analytical tools with automatic data flows in service network planning and anticipate demand/supply gaps based on different growth scenarios and estimate investments needs in the coming years. The presumption was that, when evidencing strategic decision-making with near real-time situational awareness and urban forecasting scenarios, the anticipatory capabilities of cities in urban service demand/supply prediction and service optimisation are significantly enhanced. As an example, it was roughly estimated that with a 5% decrease in building investments, the City of Helsinki could save up to EUR 15 million/year on daycare services network costs. In terms of sustainable development, cities would be able to reduce traffic emissions and the carbon footprint of

public service networks by optimising the accessibility of service units. Moreover, network performance could be monitored near real-time, e.g., in terms of usage rate of facilities, building condition, energy consumption, or expenses per pupil. Better allocation of expert working time was also considered a highly valuable objective. With automated data flows, there would be no need for manual, slow and expensive information gathering projects anymore. Planners could add new service units on the fly to the map with user-defined parameter values and see the effects immediately. Besides improving anticipatory planning and budgeting, the digital tool should also be usable for knowledge inclusion of politicians and citizens. The ultimate purpose would be to increase governance transparency and provide a platform for citizens to be involved in developing their local services.

3. Results

3.1. Process Capabilities for Digital Transformation

Traditionally, city organisations are seen as bureaucratic institutions with independently and asynchronously running subdivisions organised around specific tasks and goals. This is no longer feasible, as cities need to tackle the challenges of the 21st century and keep up with the rapid technological progress. Therefore, smart cities seek ways to improve the productivity and cost-effectiveness of services provision with digitalisation. Even though Finland is among the world leaders in terms of citizen digital skills and provision of public electronic services, digital transformation in the public sector planning processes requires first and foremost building organisational capabilities, not just focusing on technical readiness. What we consider especially critical in the context of urban (services) planning is process efficiency and information efficiency; the paradigmatic shift from static and siloed planning processes to evidence-based dynamic design.

The problem with a static and diagnostic evidence base in service network planning culminates in the problem that information contents become outdated quickly, and a large portion of the work is spent on (manual) data gathering, which is costly and time-consuming. The final plan is delivered in the form of a report, which undergoes political processing. This traditional and static "blueprint" approach dismisses the fact that the operational environment might change overnight, instead expecting the future to occur as depicted, in a particular moment in time. Based on the experiences of the pilot cities, there are several reasons why static reports are difficult to utilise as decision-making material. In some cases, the reliability of the fact base in terms of quality, accuracy and up-to-dateness can be questioned in the decision-making process, the provided information is regarded as incomprehensive, impacts are not clearly presented or information is simply already outdated when the report is handed over. These notions resonate with the views of [47] in their article dealing with intelligence in public organisations. They state that uncertainty of information is at least a threefold problem for public organisations. First, there may be a lack of information or there may be too much information. Second, the information may be outdated. Thirdly, the information may concern only the present situation, even though information about the future is needed.

3.1.1. Process Ownership and Accountability

Urban services planning operates at the cross-section of several administrative areas, and while a city-wide, integrative perspective between subsystems is necessary, clear process ownership is also critical. There are several levels of managerial accountabilities (see [30]) that need to be unequivocally defined. At the operational level, the core service delivery processes have direct accountability on the factual services delivered for the citizens; at the tactical level, city departments are accountable of delivering the needed outputs for their "inner client", e.g., from zoning to real estate services (construction site), and from real estate services to educational department (school building). At the strategic level, there is political and leadership accountability for the optimal arrangement of the service production structures and allocation of resources. Furthermore, there is leadership

accountability of creating the enabling conditions for this entity to work. Our analysis indicates that, in order to "get things done" and deliver the expected outcomes, cities have developed their own unique protocols for managing these processes. Some organisations approach it more from the public facilities management point of view, while others expect the process to be more "client-driven". Most cities in Finland do not have dedicated planning units with clear ownership of coordinating service network planning processes. More typically, there are horizontal working groups or (more or less) temporary project teams which prepare material for political boards who then decide on actions. Even though these formal and informal settings between city departments exist, planning processes still face unexpected problems which are caused by unclear division of responsibilities and deficiencies in knowledge transfer.

3.1.2. Information Asymmetry

Information asymmetry refers to the problem of knowledge transfer and knowledge concentration in a handful of experts. The specific challenge is that it also translates into a significant amount of concentrated power. Another potential problem is the selective production of information to fulfil policy objectives that have already been decided. The identified asymmetries in our pilot cases were related not only to sharing and transferring knowledge across domain borders, but also on the deficiencies in communicating plans beforehand with other city departments, even if unofficial information exchange is carried out with decision makers. The biggest information asymmetry still exists between administration and citizens, who appear more as objects to be informed than subjects included in the situation where knowledge is generated. As stated by [48], the efficiency of urban services delivery improves when local governments have better knowledge of citizens' preferences and needs. Even though collaborative preparation work and stakeholder engagement takes time, early knowledge inclusion may actually save valuable time in reduced complaints [13]. Similarly, [48] state that bargaining in information production and knowledge creation phases cause multiple problems in the implementation and may result in unwanted outcomes. Besides faster project lead time, other obvious benefits of information symmetry include improved quality of decision-making with a stronger knowledge of impacts. Knowledge inclusion also strengthens openness and transparency of public governance. Current practices tend to provide a vertical transmission of information from service providers to service users (top-down), as noted also by [30], or the other way around from city administrations to political decision makers. Horizontal knowledge transfer can be considered problematic.

3.1.3. Asynchronous Planning Processes and Time Horizons

Identified challenges are also related to asynchronous planning processes and time frames which complicate the predictability and convergence of interdependent tasks. The fact that service network planning processes are typically initiated due to political motives, shortage of public funds or acute problems hampers systematic coordination. In rare cases, they are regularly executed based on scheduled review periods, such as city council terms. Furthermore, related process time horizons vary between the long-, mid- and short-term. A time span characteristic of strategic master planning is ~20–30 years, detail planning ~5–10 years, city budget planning ~1–4 years, facilities acquisition ~1–5 years, building refurbishment cycle ~30–50 years and building life cycle ~100 years. It is particularly challenging to synchronise the different time horizons of planning so that short-term decisions are logical in light of future demands [8]. Service network planning is characterised by sequential subtasks, starting from demand forecasts, followed by a requirement review on specific needs, continuing to architectural programming, designing and competitive tendering and ending up with the construction phase and service delivery. Each decision phase forms a "bifurcation point" for further work. Incongruity can lead to severe problems in the scheduling, resourcing and implementing of individual projects and failure of the "system" to deliver required outputs, such as service units, within the time scope, in

the agreed quality and within a certain budget frame [5]. This prerequisite for having the needed deliverables in place from preceding processes (knowledge or physical entities such as building sites) makes the entire process vulnerable to disruptions or timing mismatches, and creates a risk for projects piling up on someone's desk. Too often, the result is a negative "domino effect" and ad hoc decisions manifested, e.g., in a growing number of temporal service facilities. Under heavy pressure, city officers have to plan and execute a response quickly, which may result in outcomes that do not meet the service user's needs and create unnecessary costs. A wicked problem that practically all Finnish municipalities struggle with is the poor condition of public buildings, which cause unplanned closings of service units and thus lead to capacity shortfalls. These problems are more likely to happen when scheduled renovations are postponed due to budget shortages. The estimated renovation deficit in the municipal service buildings in Finland is currently EUR 9 billion [49]. This gives obvious reasons for cities to find alternative, more agile ways of facilities acquisition and public procurement processes to outsource risks and alleviate budget and schedule pressures.

3.2. Organisational Capabilities for Digital Transformation

The prerequisites of successful digitalisation of service network planning processes are dependent on organisational commitment. The experimental pilots in their part affirmed that both "staff buy-in" and "leadership buy-in" is a high priority in digital transformation. Established organisational culture does not always welcome experimentation or digital innovations, and resistance to change routines is common. Yet it should be noted that people usually are not resistant to change as such, but more accurately resistant to change that they do not own or understand [50]. Frontline staff buy-in is the crucial first step, because if front-line staff in the operational level of service production are unaware of the importance of data that exists related to their daily routines, they might provide data only because they are required to. At worst, they consider data collection as a hindrance to their "real job".[46] Leadership and political buy-in also has a major role in forming the organisation culture that demands up-to-date data to justify decisions. An important question related to service network planning is the accentuated role of political influence. If political electorates are requiring data-driven insights and a better fact base for allocating public resources, then it is easier to reach digitalisation targets. A clear political mandate certainly helps administrative units justify the efforts and acquire the needed technical resources. In the best-case scenario, data is provided near real time as part of organisational daily routines, seamlessly integrated into the operational processes and the benefits, are quickly returned to the staff. The organisation has dedicated staff and data content owners who have clear responsibilities with regard to the data and other data infrastructure and maintenance issues.

3.3. Technical Capabilities for Digital Transformation

Even though the scope of this article is not to focus on the technological layers or ICT platforms supporting smart city planning as such, it is relevant in this context to briefly discuss the hurdles set for data-driven urban planning by the inefficiencies in the technical readiness of cities. Currently, it is challenging to form an overall situational picture of public services and related facilities based on reliable data. To build the required capabilities, cities need to address the question of data governance throughout the stages of the data life cycle, including creation, storage, use, modification, transfer, copying, sharing, archiving and disposal of data. The pilots revealed that even though cities own their urban data, in many cases it is only accessible within the source system where it is collected. As an example, cities maintain and store building information in their internal systems in parallel to national building registers. This easily leads to fragmentation, quality issues and duplications of data. If the database is built on closed, proprietary technologies that are not able to interoperate with other technology vendors, it also prevents developing innovations that could use public sector data. Ideally, urban data is in a single repository

of master data storage and real-time aggregation and automatic linking of data exist without any need to track down or clean the data. It is accessible in machine-readable, standards-based open format and available through an API. [46] This is also promoted by the new Public Administration Information Management Act (906/2019) in Finland. It highlights the principle of openness, safe and efficient use of data and interoperability of information systems and resources. The pilots showed that there is still a long way to go. The first hurdle to overcome is the identification of data from heterogeneous sources that is governed by different people in different departments and stored in different formats. At present, interoperability can be regarded as low, as key fields are missing, which hinder, e.g., linking building data to operational data on educational services. Another major step to be taken concerns data quality, which means enhancing the processes where the data is first generated and avoiding errors, data duplications and manual handling. In terms of data storages, the situation currently varies depending on the administrative department and type of data. Generally, Finnish cities have well-maintained geo-referenced data sets and registers related to legislative tasks. On the other hand, some data can be stored locally in network drives as PDFs or images. Inherently, urban planning is focusing on forecasting the future, yet it is also relevant to follow historical trends to see if the city has been successful in its efforts to provide impactful services for its citizens. Regarding digital maturity, one aspect is therefore to evaluate how much history is stored and how updates are handled. Lastly, the level of data granularity varies depending on the source. Some of it is available in city-level or zip code aggregates, such as data provided by Statistics Finland. To increase the data granularity and accuracy of service demand prediction, person-level information is needed. The existence of such data is good in Finland, but there are still considerable challenges in utilising it for service network planning due to data privacy issues. Currently, sensitive information cannot be used at all or it can be occasionally used in selected internal projects with strict ethical permissions. To reach the level where life event/person-level data could be utilised in people-centric service network planning, data privacy issues must be reliably resolved.

3.4. Outlining Theoretical Premises for Digital Boundary Objects

In the previous sections, we addressed the challenges identified in a specific context of service network planning and sought to describe the related systemic governance challenges. We support the notions of [15] that improved conceptual and theoretical understanding of change management practices related to public services planning is necessary. They also state that this topic is inherently under-theorised in literature, and to understand the transformational shift, it needs to be analysed both theoretically and empirically in future research. As described above, service network planning is a good example of public administration knowledge-intensive work, with several disciplinary work boundaries, varying task arrangements and differing goals [7]. Actors are typically heavily dependent on each other's activities and outcomes of sequential and parallel work processes. The challenge is that the public governance framework and management system is relying on vertical control hierarchies, standard operating procedures and steering mechanisms, including policy guidance, normative regulation and annual legislative budgetary appropriation cycles. Paradoxically, complicated, wicked problems do not respect organisational borders or siloed systems. To borrow terminology from [7], coordinative governance capacity and co-alignment of activities are needed, which can be defined as the management of dependence among activities (tasks) and resources [51].

The enabling conditions for cross-organisational work that combines actors and their different overlapping political, technical and social realities [31] can be reflected through the boundary object theory, originally introduced by Star and Griesemer [4] and brought into the context of Finnish strategic spatial planning by Mäntysalo et al. [6,7]. The use of "boundary object" is described by [5] as a means of representing, learning about and transforming knowledge to resolve the consequences that exist at a given boundary. To-

gether with Carlile's [5] interpretation from an organisational approach, the original definition provides additional understanding for the direction of design research. Further, boundary objects have different meanings in different social worlds, but their structure is common enough to more than one world to make them recognisable, a means of translation [4]. This provides a fertile theoretical ground for exploring the use of digital tools as boundary objects in an "interest game of stakeholders" in urban services planning. Carlile [5] summarises from an organisational point of view that the use of a boundary object is described as a means of representing, learning about and transforming knowledge to resolve the consequences that exist at a given boundary. The pragmatic view of knowledge and boundaries is proposed as a framework to revisit the differentiation and integration of knowledge. [5,51] Carlile's [51] integrative framework for managing knowledge across boundaries is found to be particularly relevant here. In anticipatory planning, the focus is set to improve knowledge transfer, especially in the early phases of planning and decision-making processes, and crossing knowledge boundaries between specialised experts and those affected by the end results. A sufficient level of shared understanding is required, while at the same time it is also necessary that individuals specialise around different problems and possess different kinds of knowledge assets necessary for a successful outcome. However, domain-specific knowledge is difficult to "convert" and explicitly share with other stakeholders. For this purpose, "externalised" inter-cultural objects, also called boundary objects, can be of assistance [7].

The joint knowledge creation and knowledge conversion processes can in parallel be examined through the well-known theoretical framework developed by Nonaka et al. [52–55]. As they state, the conversions between tacit and explicit knowledge happens through socialisation, externalisation, combination and internalisation. [53] The first happens as individuals communicate in social interactions, such as in formal or informal planning meetings. Externalisation takes place in various forms of documentation, whereas combination is a process of integrating explicit knowledge from many sources, which is typical for urban planning. Internalisation takes place over time, as knowledge diffuses in the organisation and becomes embedded in daily routines. The proposition here is that with a boundary tool, these "translation" processes can be better assembled, enhanced and governed. Knowledge conversion takes place at the individual, group, organisational and inter-organisational levels, and therefore crossing the vertical boundaries becomes equally important as crossing the horizontal ones. Additionally, Nonaka et al. present four categories of knowledge assets which describe the forms of inputs and outputs in knowledge creation processes. As forms of tacit knowledge, experiential knowledge assets and routine knowledge assets refer to the skill sets of individuals and expert know-how, which is formed and refined in daily practices and organisational routines of city administrations. As forms of explicit knowledge, conceptual and systemic knowledge assets are, in turn, articulated in shared vocabulary and meanings and delivered in standard forms. Conceptualisation and systematisation on knowledge assets is a task well suitable for information system based digital tools. As [56] points out, data and information can be stored in computers, but knowledge and wisdom are human endeavours.

Innovations and knowledge production seem to be intertwined. It is known that most innovations happen at the boundaries between disciplines or specialisations [57]. Carlile [5] continues the idea of "knowledge boundaries" [58], stating that "knowledge is both a source of and a barrier to innovation". Managing knowledge across boundaries encompasses the possibility of innovation [51]. Therefore, considering the contents of this article, we focus on the knowledge boundaries and specialisations, especially paying attention to the role of practical knowledge and how it is taken into consideration when making tools for cities for dynamic service network planning, which may be seen as needing an innovative type of approach.

In the planning theory, Davoudi [59] conceptualises the knowledge–action relationship as a "practice of knowing" involving "knowing what", "knowing how", "knowing to what end" and "doing", where the practice of knowing is a dynamic process that is

situated and provisional, collective and distributed, purposive and pragmatic, and mediated and contested [43]. This resonates with a pragmatic view of "knowledge in practice", where knowledge and knowing cannot be separated from an individual's engagement in the "practicing" of their practice [5]. Carlile [5] continues that a pragmatic view of "knowledge in practice" is developed, describing knowledge as localised, embedded and invested within a function and how, when working across functions, consequences often arise that generate problematic knowledge boundaries [5]. Novelty creates differences and dependencies that are unclear, and different interpretations exist and thereby shared meanings are necessary to be developed [51]. In the translation or interpretive approach, Carlile [51] refers to Nonaka [54] about creating shared knowledge and especially making tacit knowledge explicit (originating [60]).

Hence, the first step is to build the prerequisites for information processing and transferring of knowledge assets, what Carlile [51] calls syntactic knowledge boundaries. Engagement to similar activities eventually starts to create shared vocabulary and meanings. Using Carlile's [51] terminology again, the next phase is to confront the semantic or interpretive boundary where the process of translating knowledge takes place. Lastly, engaging to the process of transforming knowledge and crossing pragmatic or political boundaries as a prerequisite for action and creating impacts is required. In our case, the pilots, confronting each of these knowledge boundaries, revealed deficiencies in current practices, lexicon and technical systems that need to be improved (see Figure 1).

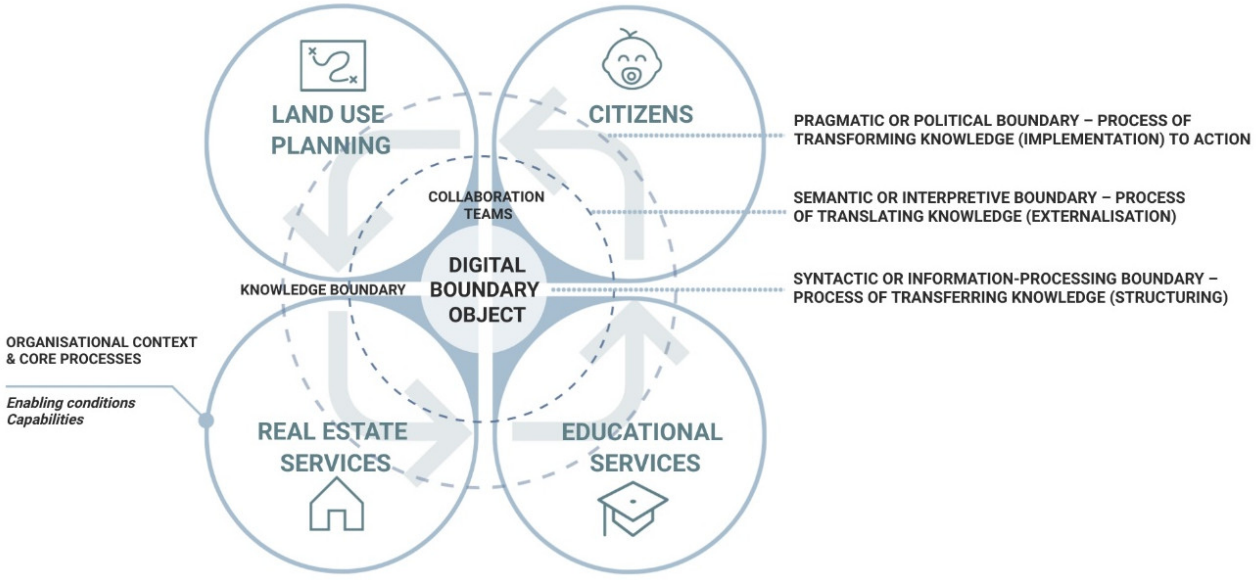

Figure 1. The concept of a digital boundary tool for dynamic service network planning. Transferring, translating and transforming knowledge[51] ~~seen~~ through an intelligent planning and decision-making platform.

4. Discussion

In this article, we aimed to bring forth new knowledge on urban services planning processes and related evidencing tools through design research and participatory action research methods. We were able to reveal empirical knowledge, which would have been difficult to gain otherwise. The limitations are acknowledged, namely that our case study approach provides rich case material but lacks in generalisation of the findings [61]. The resulting final analysis revealed three types of capability gaps that were related to (1) process, (2) organisational or (3) technical capabilities. The pilots have also shown that a participatory, design-driven approach can improve the relevance and feasibility of the resulting technological solutions as such. Furthermore, the results have given indications on the potential coordinative capacity of digital boundary objects in the course of inter-sectoral planning work by improving the transferring, translating and transforming of knowledge.

For further research, we suggest more in-depth exploration of how digital boundary tools could serve urban service network planning as a medium that connects the dots between actors, tasks, inputs, processes and outputs. They can also link different operational contexts and policy areas together and bridge the gap between those who create urban policy, those implementing it and those living with the impacts.

Our results have also highlighted the importance of enforcing accountability and transparency of public administration with a better, up-to-date knowledge base and ex ante evaluations of how public resources are used. In the future, intelligent planning and decision-making platforms could have the predictive power to shift city organisations genuinely to anticipatory governance and people-oriented service network planning that is constantly scanning between different time horizons and scales of planning and navigating uncertainty. Thus, they could be seen as tactical tools for planners to "muddle through" in a complexity and information flood [62]. However, as [8] state, even though sophisticated tools can be an important support for decision-making, the open inclusion of citizens is even more crucial to the practical success of the planning process. At best, digital boundary tools could provide an easily accessible platform while also promoting citizen dialogue and knowledge inclusion in public decision-making. This opens up possibilities for citizens to "vote" for a desirable urban future in advance—and not only by voting with their feet afterwards.

The experimental pilots confirmed the notion that knowledge and domain boundaries are especially challenging but critically important to cross in the early development phases of innovation projects, when stakeholders are without any common denominators, terminology or tools [51]. This also holds true generally in design and planning contexts, as in the early project phase, the stakeholders' capabilities to internalise each other's domain-specific knowledge and goals are weak. It is also crucial for anticipatory planning that the information and knowledge assets are distributed and simultaneously available instead of being front-loaded inputs to each planning phase [59]. The main lesson learned from the overall process of conducting the pioneer work described above can be summarised as follows: successful digitalisation is embedded in building organisational capabilities, not only in introducing new technologically advanced tools. The importance of tools or prototypes, however, lies in their ability to facilitate learning and demonstrate pitfalls and benefits. For stakeholders, so-called quick wins during the innovation process are key motivators, e.g., in showing the cost savings potential or showing how staff is going to benefit from the improved practices. In general, cost avoidance, savings and efficiency improvements are strong motivators for reforming operational models in the public sector, as in any industry. Lastly, the main challenges and capability gaps related to current planning and management practices of public services were identified.

5. Conclusions: Towards People-Oriented Urban Services Planning

As stated by [63] already 20 years ago, urban policy faces the most difficulties of all the sectors of public administration in identifying "what works" (see also [5]). Accordingly, demand for evidence-based policy and practices in the context of urban planning is not a new topic. [64] Recently, we have witnessed an exponential demand for data and analytical knowledge in government decisions, and cities have taken a historical digital leap due to the global COVID-19 pandemic. It has shown us that "crisis response is digital response" and, from now on, digital government and supporting technologies are a necessity, not a nice-to-have [50]. For urban planning, this creates a significant knowledge gap to better understand how urban service networks can promote future urban system redundancy in smart cities, and this will be an important direction for future research.

The ambiguous innovation work that the case cities have engaged in is not only to seek efficiency through digitalisation of planning processes, but to also steer the city administration towards demand-driven, people-oriented service provision. The benefits of replacing conventional production-oriented service provision models with the people-oriented service paradigm is to create more inclusive and efficient public services with better

predictions of where public service investments can have the largest welfare impacts. This new, dynamic and data-driven planning approach to next-generation government services thus aims to meet citizens' current (and future) needs, and seek actual and fluent interrelation among citizens, local services and infrastructure [2]. This transition can be seen parallel to the endeavours of transforming the rational "public administration machinery" into a facilitator of a services (eco)system that is seamlessly interoperable with other sectors of society. As stated by [30], according to this vision, the whole city becomes an integrated system of resources that interconnect with each other. For achieving this, digital twins as a systemic representation of the city functions combined with people's personal data are being pursued.

Meanwhile, we need to improve the technical and organisational capabilities of cities and ensure a willingness to openly support the process or product innovations needed. Fostering a culture of experimentation and agile piloting as part of capacity building for public sector digital transformation is equally as important. It should be noted that the threshold for individuals working in the public sector of saying that "there's a better way we can do this" is high. City staff members are regularly busy with their daily responsibilities, and therefore deviating from the routinely defined work or replacement of legacy systems is understandably difficult. Furthermore, by engaging in exploratory innovation projects, individual staff members are taking a personal risk in "moving away from the comfort zone" and pursuing assumed future benefits. Obtaining external support and leadership buy-in is by no means self-evident. On the other hand, agile development should be considered as a risk management tactic from the city's point of view. It is affordable to test best practices with cheap prototypes before commencing to the actual procurement.

Working with technology partners and start-ups has become more common for smart cities in their search for new technologies and solutions to critical urban problems. The difficulty is that the adoption of agile innovation processes is often hindered by the rigidity of public procurement frameworks. Another hurdle to overcome after successful piloting is to convert new knowledge into action, and further disseminate and scaling-deep, -up and -out the results to other departments or cities. Our pilots have shown that even implementing the best practices in the public sector is not easy, as many smart solutions and innovative projects are in danger of fading out after the pilot stage. An important prerequisite for efficient uptake of new operational models supported by digital technologies is the ability of public organisations to foster engagement and synergies between city administrations, policymakers, frontline workers (e.g., teachers), technology providers and, ultimately, citizens, for whom the system ultimately works. Process improvement should be fuelled by consistent improving of data quality and knowledge management practices, which requires organisational commitment. A fresh mindset is also required from technology companies to see city organisations more as innovation partners than traditional clients. Reflecting the types of scaling for smart city solutions defined by [65], some might lead to market roll-out, where the publicly open results are utilised by a private company for developing a product or service innovation to a commercially viable stage. Another type is an expansion type of scaling that happens when the initial pilot project is continued and expanded with new partners to the project, and by enlarging the geographical area in which the project operates. This type of engagement is taking place after the experimental pilots in Kuopio and Helsinki. The third type, replication, is a type where the solution developed and tested by the early adopters is replicated to another context, such as, in this case, replicating the solution developed for daycare service network planning to, e.g., health care services planning.

Currently, Kuopio, Helsinki and a new partner city, Turku, are continuing the pioneer work in a larger digitalisation initiative supported by the Ministry of Finance under the title "DigiPAVe 2.0–People-oriented service network planning". The main objective is to create shared operating models and harmonised data products that enable people-oriented and dynamic service network planning. To reach the vision of people-oriented,

equal, ethical and cost-efficient service provision is truly ambitious. Nevertheless, urban services are vital for urban competitiveness, and therefore smart cities will look at their service provision from a more customer- or people-oriented manner [66]. "Public good" is a slippery term and it might be overshadowed by other interests such as maximal utilisation of monetisable land. Moreover, the path towards this vision is paved with sceptic allegations on the public sector capabilities, which condemn the public administration as rigid, lacking the ability to exploit agile partnerships and thus suffocating innovation. To be realistic, this paradigm shift will happen gradually, and the strategic meaning of data increases as the digital maturity and organisational capabilities of cities grows. What makes the efforts worthwhile is that the value generated by process innovations can lead to decreasing costs of service provision and increased quality, and at the same time, cities can become more performance-conscious also in terms of the Sustainable Development Goals of the United Nations. Political underpinnings of public services planning cannot be dismissed. After all, it is a matter of deciding what kind of future the city builds for itself.

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