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Published in:
Current Urban Studies

DOI:
10.4236/cus.2022.103024

Published: 01/09/2022

Document Version
Publisher's PDF, also known as Version of record

Scientific Research Publishing

Current Urban Studies, 2022, 10, 405-425
https://www.scirp.org/journal/cus
ISSN Online: 2328-4919
ISSN Print: 2328-4900

Exploring the Balance between Smartness and Sustainability in Finnish Smart City Initiatives during the 2010s

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How to cite this paper: Vainio, T., & Sankala, I. (2022). Exploring the Balance between Smartness and Sustainability in Finnish Smart City Initiatives during the 2010s. *Current Urban Studies, 10,* 405-425.
https://doi.org/10.4236/cus.2022.103024

Received: August 8, 2022
Accepted: September 19, 2022
Published: September 22, 2022

Abstract

In the era of rapid urbanisation, technological development, and climate change, there is an urgent need for urban sustainability. However, the globally widespread concept of a smart city has not delivered on its promise of improving sustainability with urban technology. Therefore, more knowledge on how current smart city initiatives are related to sustainable urban development is required. This study focuses on analysing the aims of Finnish smart city initiatives during the 2010s. We conducted a systematic review to gain a more detailed overview of the relations between smart city development and sustainable development. Our data gathering method was the convenience sampling method, and with data analysis, we used descriptive statistics and deductive content analysis methods. Results reveal the emphasis on smart governance and mobility issues in smart city initiatives. Also, sustainable development is largely dominated by perspectives of economic sustainability. To create more balance within smart and sustainable urban development, we need actions to include other aspects than only mobility and governmental domains of smartness or general sustainability objectives in urban development.

Keywords

Smart City, Sustainability, Review, Finland

1. Introduction

In the era of rapid urbanisation and climate change, there is an urgent demand for urban sustainability. The Paris Agreement's target is to decrease global warming below 2.0˚C above pre-industrial levels and to limit the global temperature rise

to 1.5˚C. IPCC (2018: p. 6) identified "cities and urban areas as one of the four critical global systems that can accelerate and upscale climate action". These critical global systems are energy, land use, ecosystems, urban infrastructure, and industry (IPCC, 2018). Most recently, at Glasgow Climate Change Conference 141 countries joined the Glasgow Leaders' Declaration on Forests and Land Use urging "all leaders to join forces in a sustainable land use transition" (COP26, 2021). Simultaneously, cities are also arenas for new technological solutions. For example, in Finland, current urban development projects seek to adopt new smart technologies, but at the same time aim at resource efficiency and creating more livable places that cater to the local citizens' wellbeing.

The notions of smartness and sustainability are being closely linked in policy discourses, as city leaders across the world have called for the management of cities in a way that fits both agendas (Martin et al., 2019; Yigitcanlar et al., 2019). However, the prominent idea of a smart city has not delivered on its promise of improving sustainability with the help of urban technology (Ahvenniemi et al., 2017). Recent reviews of smart city literature point out that smart city initiatives have extremely techno- and anthropocentric approaches that fail to incorporate the needs of the natural environment (Yigitcanlar et al., 2019). Kitchin (2016) highlighted that smart city initiatives based on an urban science approach, i.e. a computational modelling and simulation approach to understanding, explaining, and predicting city processes, should be re-casted by re-orientating in how cities are comprehended, by recognizing the nature of urban systems, processes, and science; and by adopting ethical principles. The urban science approach can lead to the focus on using quantitative indicators that are easy to measure rather than more complex indicators that are qualitative as nature (ibid).

In addition, some recent studies (e.g. Clarke et al., 2019; Heitlinger et al., 2018) have argued that design approaches should be taken one step further through the emerging more than human research agenda, which calls not just for more civic-led approaches to design smart cities but approaches that are inclusive to the environment and its non-human inhabitants. Along with the demands to redefine the smart city framework in order to better integrate urban sustainability aims, previous research also pinpoints the lack of empirical work done in this field (Martin et al., 2019). We need more understanding of the state-of-art smart and sustainable urban development.

In Finland, both urban technology development and the aims of sustainable urban development are stated to be high priorities in political decision-making, as the current government stated that Finland will be carbon neutral by the year 2035 (Finnish Government, 2019). To gain an overview of the state-of-art urban initiatives and the relations between smart city development and sustainable urban development in Finland, we conducted a systematic review of Finnish smart city initiatives that were studied and reported in the literature during the 2010s. As Green (2019) argued that "technology will have little impact unless it is thoughtfully embedded into municipal structures and practices", our study fo-

cuses on understanding and analysing the aims of Finnish smart city initiatives and investigating particularly the balance between smart and sustainable urban development. In addition to general urban development, we discuss urban planning, since IPCC (2019) has stated that land use creates stable path dependencies affecting the ways in which cities will function in a long-term perspective and that changing land conditions can reduce or accentuate warming and affect the intensity, frequency, and duration of extreme events in climate change.

Our research questions are as follows:

- What characteristics of smartness are represented in Finnish smart city initiatives during the 2010s according to smart city research, and how are they related to urban planning?
- What are the stated sustainability aims of Finnish smart city initiatives according to smart city research?
- What kind of connections between smartness and sustainability, if any, do Finnish smart city initiatives during the 2010s have according to smart city research? And as a sub-question, what is the role of urban planning in this connection?

To understand the balance or imbalance in Finnish smart and sustainable urban development, we first investigated what are the general aims of the selected smart city initiatives by categorising them according to EU's six domains of smartness (Manville et al., 2014). In addition, we assessed the extent to which urban planning processes are integrated into smart city practices. This also aims to tackle the challenges that Martin et al. (2019) pointed out as a lack of empirical data and IPCC's (2018) above-mentioned notion of land use as one of the critical systems in combating climate change. Then we looked into the sustainable development aspect of the research articles and if the initiatives studied stated a sustainability aim in any way. Finally, we analysed the relationship between the different dimensions of smart and sustainable development and their relevance to the urban planning context.

On a national scale, the smart city is an important framework in Finland's national economic development policy, where the role of cities has also grown in recent years (Anttiroiko, 2016; Halme et al., 2014). City governments are the main actors in stimulating local smart city development, especially when their own strategic environmental, economic, or social goals are at stake. Local smart city projects are usually collaborative processes involving working together with companies, local research institutions, and actors from the national and EU level in terms of funding or other incentives. Together with the participatory turn in urban governance and planning, co-creation and citizen involvement have become part of smart city practices, especially through platformisation (Anttiroiko, 2016).

The institutional framework for Finnish smart city development is based on national programs, such as INKA Program (Innovative Cities, 2014-2017) and

the Six City Strategy (2014-2020) that have boosted cities' innovation activities related to open data, public services, and sustainable urban development. Anttiroiko's (2016: p. 24) study on participatory innovation platforms in the three Finnish cities of Helsinki, Tampere, and Oulu shows only a partial integration of smart city-related projects into official planning systems and development policies.

This paper is structured as follows. First, we discuss the background of smart city development and connections between smart and sustainable urban development. Following that we describe our methodology with data gathering and data analysis phases during the study. Thirdly, we present our results by analysing data according to the smart city domains and then, according to the stated sustainability aims, and finally, analysing the balance between these different smart city domains and stated sustainability aims. Finally, we discuss and conclude our findings.

2. Lost Connection between Smart and Sustainable Urban Development

For almost two decades, the smart city has been the dominant paradigm in the field of urban development. The hype around the concept has been particularly visible in the way that cities promote themselves in global arenas (Yigitcanlar et al., 2019). World cities, such as New York, London, and Paris have been acclaimed in global rankings (IESE Business School, 2019), but even the considerably smaller Helsinki, capital of Finland, has been one of the most highly rated cities, for example, in the field of smart mobility solutions (so-called MaaS, mobility as a service, see: Spero, 2018). A common interest in the smart city framework during the 2010s is also evident in the academic literature where studies on smart cities boomed between the years 2013 and 2016 (Trindade et al., 2017).

Although the term is appealing to both urban administrators and the business sector, the smart city has faced a lot of criticism in academia. Overall, there is a lack of consensus on the definition of smart cities. In general, the idea of a smart city is to improve the daily life of residents through intelligent solutions embedded in the city's infrastructure. Ahvenniemi et al. (2017) are even more straightforward in claiming that the main goal of a smart city is to improve sustainability with the help of technology. The role of technology cannot be dismissed as the origins of the concept are more or less "rooted in technological advancements as the principal enabling factor", according to Anttiroiko (2016: p. 4). Soe at al. (2022) emphasise real-life experiments when institutionalising smart city research and innovation.

However, the strong technological orientation in the pursuit of smartness has been criticised for becoming more of a goal in itself rather than a tool for greater purposes, such as sustainability (Martin et al., 2019). Reviews of the smart city literature point out those smart city initiatives usually have a very technocentric approach that fails to incorporate the needs of the natural environment (Yigitcanlar et al., 2019). For many, smart city has become a dominantly ICT-related

buzzword with strong corporate interests (Yigitcanlar et al., 2019; Pierce et al., 2017).

One strand of criticism raises the question of complexity: the smart city framework is insufficient if quick technological fixes are being sought to tackle cities' problems that are highly complex by nature (see Anttiroiko, 2016; Lyons, 2018: p. 8). Yigitcanlar et al. (2019: p. 360) point out that "urban smartness is beyond technological smartness". Likewise, Hajer (2014) calls for smart urbanism instead of smart cities, a new kind of orientation where livability and the needs of the citizens are taken as seriously as the efficiency of different flows of matter and energy.

The connection between smartness and sustainability is critical in the context of cities and urban development. A common history is already there since according to Yigitcanlar et al. (2019), the concept of smart city originates from the 1990's planning movement that called for "smart growth" in order to battle urban sprawl, a dynamic that was facing many cities in North America at the time. Smart growth and new urbanist advocates promoted planning that would create more dense, walkable, and transit-oriented districts where the need to own a car would be obsolete.

In addition, the work done at the EU level has given a strong imperative highlighting the role of smart city as an engine for sustainable development and urban transformation (Martin et al., 2019), linking it to the sustainable development agenda of the Brundtland Commission (World Commission on Environment and Development, 1987).

For example, one of the most widely known definitions of a smart city comes from the EU, with a seemingly holistic view including six dimensions of smartness: smart economy, smart people, smart governance, smart mobility, smart environment and smart living (Manville et al., 2014). In this paper, we use the term smart city as a search term but also view the concept in this kind of broader sense including different aspects of city life.

Apart from the techno-criticism, smart city's inherent anthropocentrism has also been problematised. Some scholars call for a "more-than-human" smart city that takes into account the non-human aspect of the city, such as the ecosystems (Yigitcanlar et al., 2019). On the other hand, even the human aspect of smart cities is falling behind. In order to enhance social sustainability, such as equality, citizen participation and wellbeing, Martin et al. (2019) call for a deeper analysis on the social benefits of smart city initiatives, as they are now primarily balancing just economic and ecological interests (see ecological modernisation, Jänicke, 2008).

Smart cities can be defined in multiple ways, key distinctions being: the latest urban technologies, such as sewage systems, water supply networks, and mass transit systems; ICT combined with infrastructures, architecture and everyday objects, or our bodies (e.g. Batty et al., 2012; Batty, 2022; Polese et al., 2019; Townsend, 2013); economy and governance driven by innovation, creativity and

entrepreneurship, enacted by smart people (Kitchin, 2014); a focus on urban development that enhances lives of citizens (Schaffers et al., 2012). In our review, we define smart city with its six dimensions: environment, people, economy, mobility, governance and living (see Manville et al., 2014) that focus on such urban development that enhance lives of citizens with urban technology.

In recent years smart has often been replaced or accompanied by terms such as "resilient", "carbon neutral" or "resource-wise" to communicate a strong emphasis on sustainability and tackling climate change. This points out the need to align, re-align, or reconceptualise the paradigms of smart and sustainable cities. Re-conceptualisations or reinterpretations, such as smart-sustainable cities, have been introduced, where smartness would be complementary to sustainability actions (Martin et al., 2019: p. 647). However, it should be noted that combining or even comparing two concepts that have both been criticised for being more or less vague, is not an easy task (see Lyons, 2018: p. 8).

One attempt to depict the possible relations between the concepts of smart and sustainable is presented in Lyons' (2018) article. A very common way of understanding is seeing smart and sustainable as separate but sometimes complementing each other. Here smart is usually used in a context that emphasises technological solutions whereas sustainable can be seen to relate more to planning discourses. A more integrative approach sees smart and sustainable as inseparable: all that is smart is sustainable at the same time. The third alternative is to view the sustainability paradigm dominant too smart or the other way around. Lyons (2018) notes that policymakers should become aware of these different relationships to evaluate policy and practices regarding smart and/or sustainable development initiatives.

If a smart city was originally set to reach the goals of more sustainable development and social equity, we're interested in exploring in this paper the smart cities of the 2010s by looking at the situation in Finland, where the role of local governance is fundamental both in most urban development projects as well as in supporting general well-being of its citizens.

In this study, we are interested in the connection between smart city practices and what is actually done in terms of shaping the physical city. The role of urban planning and its context-specific relations need to be considered when assessing individual plans or projects (Ruokolainen & Kolehmainen, 2017). On a more global scale, cities are key players in climate policy, and their actions especially in land use create stable path-dependencies affecting how cities will function in a long-term perspective. While transformation for urban sustainability is foremost needed at a city-wide or even more so at a regional level, usually the modest starting point is one city district where different initiatives and projects are piloted (Martin et al., 2019). From the perspective of city officials, spatially fixed smart city "living labs" are seen as more manageable (Evans & Karvonen, 2014). They might also be the first building blocks to constitute a brand for a certain district or area. On the other hand, difficulties in scaling up the results to other

areas might create a situation where just one district and its population benefit while the rest remain unchanged (Martin et al., 2019: p. 647).

3. Methodology

To gain deeper insights on the connection between smart and sustainable urban development, we focused on reviewing research on smart cities and chose Finland as a case study of our research. This research approach was chosen for two reasons: the gain a broader, national level overview to understand impact of strategies and policy aims and secondly, to gather data that is based on objective measurements to avoid hype around the concept of smart city. Therefore, we didn't include or analyse public documents such as city or municipal strategies directly. As strategic public documents may have different types of motives and forms, scientific papers follow a more unified form, which made the comparisons possible.

We conducted the research by using both quantitative and qualitative methods. We gathered the data between April and August 2019. Data gathering was done by a convenience sampling method. The data analysis phase followed between July and November 2019. The data analysis was conducted by descriptive statistics and deductive content analysis methods (see **Figure 1**). This approach was chosen to ensure that the review is as systematic as possible to be replicable by other researchers, and above all, ensure the justification for further research.

3.1. Data Gathering

Our review aims to gain a comprehensive view of the investigated phenomena. Therefore, we approached the theme of Finnish smart cities and sustainability and the related data with different search strategies. We aimed to have reproducible search records and thus followed the guidelines of systematic reviews having a criterion-based selection process. Our review is based on data from the following resources and search strategies:

1) National search: Articles on smart cities in Finland in Finnish published between 2010 and 2019 (April 2019).

2) International search: Peer-reviewed journal articles on Finnish smart cities in English published between 2010 and 2019 (May 2019).

3) Narrowing down: Selecting research articles focusing on smart city development.

- Either in one of the six largest cities in Finland or reviewing Finland as a case.
- With initiatives that had a fixed spatial setting [connection to urban development].
- Within the themes, Finland, sustainable development, sustainability or cities are given in the research database.

First, we searched published articles on Finnish smart cities, written in Finnish. As a result, we found only 10 relevant articles (see **Figure 1**). For a scientifically valid review, the empirical data and the found articles provided a too

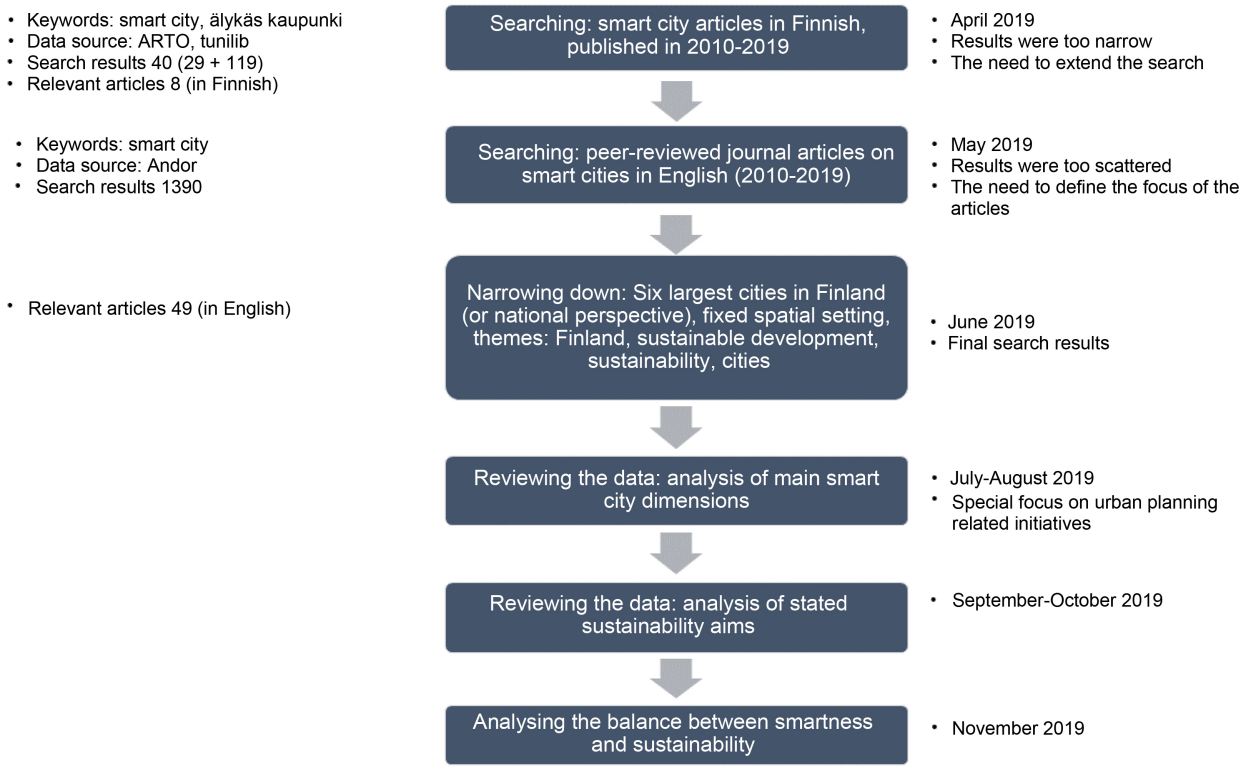

Figure 1. The research process.

narrow view on the research topic, and we were unable to cover our research questions. Therefore, we decided to extend our data search to peer-reviewed scientific articles on Finnish smart city initiatives written in English.

Related to the last data source, i.e. English written scientific articles on Finnish smart city initiatives, we utilised a systematic approach with a three-round literature review adapted from Yi and Yang (2014) including 1) search title/abstract/keywords from a particular database, 2) redefining the focus area, and 3) reviewing the data. During the first round, we searched Finnish smart city initiatives that were initiated in the 2010s and reported in a peer-reviewed scientific article resulting in 1390 articles (see **Figure 1**). The second round narrowed the results to the six largest Finnish cities of Helsinki, Espoo, Vantaa, Tampere, Turku, and Oulu, or to articles that viewed Finland on a national scale. The last round refined the focus area into articles that report case studies with fixed spatial settings and covered the chosen topics (Finland, sustainable development, sustainability, cities). During the last round, the first two researchers read through the thematic articles and categorised the data separately, and then, they discussed and decided the final selected articles (total 57 articles). During this phase, duplicates and irrelevant articles were also removed.

3.2. Data Analysis

With the gathered data, we conducted the deductive content analysis, first based on the EU's framework of smart dimensions (Manville et al., 2014). The EU's

dimensions of smart city are as follows:

- Smart governance.
- Smart economy.
- Smart mobility.
- Smart people.
- Smart environment.
- Smart living.

The data were categorised according to the EU's dimensions first by two researchers separately, and then by integrating the results of these two classifications into the final one. The primary and secondary dimensions of the initiatives were analysed separately. In the following phase (see **Figure 1**), to study the balance between smartness and sustainability in the urban context, we examined the stated sustainability dimension in our gathered data during the next phase. Our data were categorised according to the sustainability dimensions, the so-called three "pillars" of environmental, social and economic sustainability that were defined in 2002 during the Sustainable Development Congress in Johannesburg, accompanied later with discussions on cultural sustainability as the fourth pillar (Hawkes, 2001; Soini & Birkeland, 2014). These four sustainability dimensions are as listed below:

- Environmental sustainability.
- Social sustainability.
- Economic sustainability.
- Cultural sustainability.

Also, categories for those initiatives that address sustainable development at the general level and for those that had no mention of sustainability aims at all were added. The category for general development was added because not all the initiatives were able to identify as having a particular focus on sustainable development. The classification of the sustainability theme was conducted by keyword searches by one researcher. After these two-round classifications analysing the dimensions of smartness and stated sustainability aims, the results were investigated aiming to find the connections between the dimensions of smartness and the stated aims of sustainability. Following that, the more detailed possible cross-connections were analysed between the smartness and sustainability themes (see **Figure 1**).

4. Results: Smart City Research Related to Finland

In this section, we first present the outcomes of the analysis according to the smart city domains and then, according to the stated sustainability aims. Finally, we summarize the results by discussing the balance between these different smart city domains and stated sustainability aims.

4.1. General Smart City Aims and Urban Planning

To be able to get an overview of our data, we first categorised smart city research

related to Finland according to their primary and secondary foci. Based on our preliminary analysis, the research highlighting on smart governance (19) seemed to be the most prominent one in Finland during the 2010s following the foci of smart mobility (10) and smart economy (8). It seems that less research focus is on the smart environment (7) and smart living, but least of all, on smart people (1). Thus, it can be argued that Finnish smart city initiatives primarily focus on smart governance and less on smart people.

To gain a deeper insight into our data, we analysed the secondary foci of the smart city initiatives in Finland as well. This analysis indicates the previous notion of a relational share of smart governance (6), smart economy (6) and smart mobility (5). In addition, only a few of the smart city initiatives focussed on smart environments (5) or smart living (4). Furthermore, only one of the secondary focusses was on smart people. This analysis of secondary foci of the Finnish smart city initiatives confirms our previous findings that, in smart city initiatives, the primary focus appears to be on smart governance and less on smart people.

Regarding smart governance, cities and other representatives of public administration are in general key actors in smart city partnerships (see for ex. Six City Strategy). Moreover, amongst Finnish smart city initiatives, if the smartness dimension is the smart environment, the initiative often focusses on energy technology or on energy efficiency development (Niemi et al., 2012). Smart mobility is obviously important in the context of climate, but in this theme, the focus was usually on individual services (for ex. mobility apps) helping the daily lives of the citizens instead of building a systemic change in the transportation sector.

One of the aims of our review was to find practical and empirical evidence on the balance between smart and sustainable urban development in Finland during 2010s as reflections to Martin et al.'s (2019) and IPCC's (2018) notions of the existing status of global smart and sustainable urban development. Based on this aim, we analysed the role of urban planning in Finnish smart city initiatives. In general, the role of urban planning was mostly vague. Urban environments were merely seen as settings for smart solutions. We identified two types of smart city measures that dealt with upgrading the physical surroundings of a city or a certain district: Firstly, most of the articles introduced measures that can be considered quantitative, such as building smart infrastructure. This included bringing ICT solutions into the built environment or increasing the energy efficiency of urban infrastructure or buildings. The cases that had a clear connection to urban planning processes had used 3D technology in creating city models for urban planners.

This type of smart city development was usually connected to the cities' ambitions in introducing new kinds of "platform thinking" with for example open data sources for the use of developers and tech companies. The strong technology orientation can be considered as the mainstream of smart city development

and what Rönkkö et al. (2018) have described as data-driven urbanism. From the Finnish cities, especially Oulu seemed to represent this kind of development, which is quite understandable with its strong past as a key hub for developing Nokia's technology between the 1980s and early 2000s.

However, there were cases with qualitative measures as well. These cases were more people-oriented than most smart city cases (see Martin et al., 2019). They focussed on goals such as "quality urban living" or "well-functioning everyday life", which meant, for example, creating smart services for daily activities or surroundings, such as mobility or street lighting. Citizen participation and bottom-up development was a more evident feature in these measures of smart city development. This may be partly because stakeholder participation is required as part of the Finnish statutory planning system. Therefore, many of the projects aim at opening the development process to the wider public in order to expand the possibilities for civic engagement even further than what is obligatory. This type of citizen-oriented development points to a fairly recent shift in urban development and planning where functionality, livability, and attractiveness of the urban streetscape are seen as the city's competitiveness factors (Østbye et al., 2017). A commonly used term in this genre was "urban living lab", which seems to be one of the latest smart city practices, where services or other solutions are tried out in real living environments and in the use of local citizens (see also: platformisation in Anttiroiko, 2016). The smart urban districts, such as Kalasatama in Helsinki or Hiedanranta in Tampere, were usually the testing grounds where the locals could also take part in the planning processes, which gave a kind of a bottom-up approach to the development of commercial or public services.

4.2. Sustainability Aims

Our analysis indicates that not all the Finnish smart city initiatives state their aims to be connected to sustainable development (16) or sustainable development is acknowledged only at a very general level or is related to all dimensions of sustainable development (13). Of those initiatives, which have evident sustainable aims included in their aims and actions, the majority of those projects (28) focus on developing a sustainable economy, for example, investigating the role of competitions for open data applications in smart cities (Hielkema & Hongisto, 2013) or aiming at planning for energy-efficient cities (Kullman et al., 2016). Whereas there is a clear emphasis on economic sustainability amongst Finnish smart city initiatives, environmental sustainability (22) is less studied than an economic one. In addition, social sustainability (15) or cultural sustainability is even less investigated.

Those initiatives, which have the sustainability aims stated at the general level, are, for example, related to public transport travel times in the city of Helsinki (Jäppinen et al., 2013) or approaching the smart city as an organisational field and mapping sustainability-enabling configurations, (Pierce et al., 2017), or as a

participatory platform (Anttiroiko, 2016). In addition, as Erkkilä (2014) argues that smart urban development can be emphasised through collaboration. In our data, there are a few comparative studies between smart cities, such as Kuokkanen and Yazar's (2018) research on sustainability transitions in Helsinki and Istanbul or Valtonen's (2018) study on public objectives in large-scale urban development by comparing public and private land development. Finally, some smart city initiatives, in which sustainability aims are at the general level, focus on urban living labs in suburbs and modernisation and social uplift (Buhr, 2016) or developing a sustainability city index based on the intellectual capital approach (Alfaro-Navarro et al., 2017).

To sum up, Finnish smart city initiatives during 2010's particularly focussed on economic and environmental sustainability. Surprisingly, the substantial amount of smart city initiatives has no connection to sustainability at all.

4.3. Balance between Smartness and Sustainability in Finnish Urban Development

In Finnish smart city initiatives, sustainability aims were most likely to connect to economic sustainability (see **Figure 2**) and smartness is typically related to governance or the economy or both, e.g. into regional specialisation strategies (Kaivo-Oja et al., 2017) or cites as an innovation engine (Rantakokko, 2012). Thus, according to our data, the combinations of a sustainable economy and smart governance or sustainable economy and smart economy characterise the Finnish smart city initiatives and the balance between these aspects of smartness and sustainability is the most evident one.

When it comes to other domains of smartness, the balance is more ambiguous. Initiatives related to smart mobility are connected to sustainable development in more diverse manners. On the one hand, there are relationships between smart mobility and sustainable economy, see e.g. Hielkema and Hongisto's (2013) study on the role of competitions for open data applications, but on the other hand, initiatives include relationships between smart mobility and general sustainable development, for example, as the potential effects of shared bicycles on public transport travel times in the city of Helsinki (Jäppinen et al., 2013).

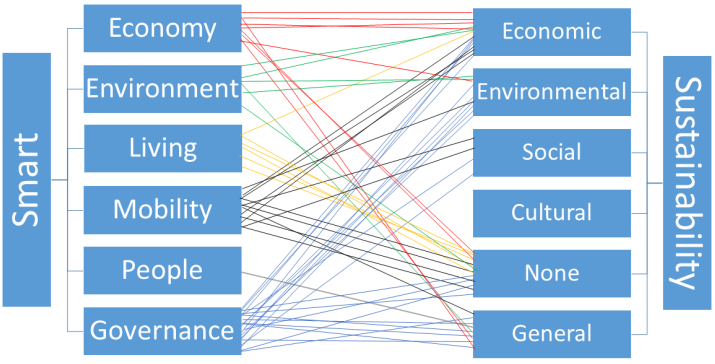

Figure 2. The (im)balances between smart and sustainable domains.

In a similar vein, smart environments are connected to sustainable development in many ways. According to our data, these initiatives report on connections between the smart environment and general sustainable development (Kuokkanen & Yazar, 2018), smart environment and sustainable economy in energy consumption (Niemi et al., 2012) or smart environment and carbon-neutral built environment as a sustainable environment (Vinokurov et al., 2018). As mentioned previously, only a few smart city initiatives focussed on smart people in Finnish smart city initiatives during the 2010s. One of them is a comparative analysis of the international ten smart cities by Anthopoulos (2017) including data from the city of Tampere connecting economic, environmental and social sustainability. Besides, Erkkilä's (2014) work on collaboration in smart city projects can be connected also to these three dimensions of sustainability. Based on only these two cases, it seems that initiatives related to smart people are related to all aspects of sustainability. Thus, the balance between smartness and sustainability amongst the initiatives of smart mobility, smart environment, and smart people is more ambiguous and stays at a general level.

Regarding the relationships between smartness and sustainability in urban development, our data indicate that the missing connection is typical for those types of initiatives, which deal with urban smartness about smart living, such as decision making in infill development on collectively owned residential properties (Puustinen & Viitanen, 2015) or the study of Tynkkynen et al. (2012) on integrating public and private home care services. Moreover, these non-connected initiatives are also related to smartness at the general level, e.g. Tikkanen and Silvan's (2012) work on developing the service process of municipal home care catering or Inkinen's (2012) study on the best practices of the Finnish government information society policy programme. Thus, the imbalance here is the most distinct one.

Looking another way around, it can be argued that initiatives related to smart governance cover quite well the variety of the different sustainability domains, whereas initiatives related to smart economy cover mainly sustainable economy aims but have no connections to sustainable social development. In addition, and quite surprisingly, initiatives of smart living have a weak or no connection at all to sustainability aims. If smart mobility initiatives are connected to sustainability aims, most likely they are connected either on a sustainable economy or environment. In short, it can be argued that Finnish smart governance initiatives balance with sustainable development whereas smart living initiatives do not. As stated earlier, initiatives related to the smart economy or smart mobility focus on certain sustainability aims, such as a sustainable economy or a sustainable environment (see **Figure 2**).

Some balance between smart and sustainable development amongst Finnish initiatives during the 2010s can be found in smart governance initiatives. Those initiatives cover all the sustainability domains, whereas the balance is almost lacking in initiatives related to smart living or focuses on one sustainability do-

main as in the case of smart economy initiatives, which are related to a sustainable economy. Smart environment and smart mobility initiatives are something between those two extremes.

When investigating initiatives related to directly to urban planning, land use or land use policy, we found that the connections to sustainability are at a general level, see e.g. study of Alfaro-Navarro et al. (2017) on sustainable city index development or a framework of Pierce et al. (2017) for mapping sustainability-enabling configurations. Also, if the initiatives related to urban planning are centred on the issues of a sustainable economy, the smartness of the city is connected to innovation processes (Hatanpää, 2014) or regional policies for specialisation strategies (Kaivo-Oja et al., 2017), innovation platforms (De Falco et al., 2019) and data visualisations (Rantakokko, 2012). In addition, part of the sustainable economic and urban planning initiatives focuses on sustainable energy solutions for urban areas (Niemi et al., 2012) and urban living labs for supporting the development of sustainability and low carbon cities (Voytenko et al., 2016). Smart city initiatives related to environmental sustainability focus mainly on governmental issues, such as how to integrate land use and transport planning (Mäkinen et al., 2015) or strengths-based planning strategies outside of the urbanisation impact (Rönkkö & Aarrevaara, 2017).

5. Evaluation of the Balance between Smartness and Sustainability

5.1. Characteristics of Finnish Smart Cities

Mora et al. (2021) pointed out that so far; scientific knowledge has not succeeded in informing policymakers of smart city technologies resolving sustainability issues when it comes to smart city design and implementation practices. Our contribution presented in this paper is to fill that gap as the results from this study advance our understanding of the existing balances and imbalances between smart and sustainable development in Finnish smart city initiatives during the 2010s according to the smart city research. We found that the clearest balance can be found in those initiatives related to smart governance. However, almost a third of the initiatives have no balance or the balance was unclear due to unclear definitions of sustainability aims and objectives in the selected smart city initiatives. It seems that quite often the aim of smart city development is on smart technology and not, for example, providing support for sustainable development. This notion is in line with the previous findings by Martin et al. (2019) that a smart city aim is often a goal in itself rather than a tool for broader purposes, such as sustainability.

The major subject matters of smartness that are represented in Finnish smart city initiatives during the 2010s are governance, economy, and mobility. In other words, Finnish smart cities focus heavily on developing ICT and smart mobility solutions—and within these fields, the role of government, and particularly the

role of local government, is relatively important. This finding may indicate Finland's role as an ICT know-how country. According to the European Commission Digital Economy and Society Index (DESI), Finland has been one of the top countries for information and communications technology (ICT), and it invests heavily in ICT infrastructure. This has also led to early mobile breakthroughs, such as the analog network and the international roaming mechanism. In the field of mobile communication, companies such as Nokia or Supercell, have their impact on directions of smart urban technology development.

Surprisingly, for a country of an excellent PISA past, Finland seems to have only a few initiatives or studies related to smart people of urban areas. According to Manville et al. (2014), smart people include education, lifelong learning, ethnic plurality, and open-mindedness. Based on our data, in Finland, these themes are not covered widely in smart city initiatives during the 2010s even though there are many indicators of how citizens actively use technology in their everyday life. For example, in 2018 89% of Finnish citizens aged between 16 and 89 used the Internet, and 76% of them used it several times during a day (Official Statistics of Finland, 2018). Moreover, the Internet was most used with a mobile phone (Official Statistics of Finland, 2018).

5.2. Shifting the Focus

When looking at the connections between smartness and sustainability, the smart governance domain covers all the sustainability dimensions, whereas initiatives related to smart living can be characterised as having weak relationships to sustainable development. Among the initiatives of our review, there was the development of housing qualities particularly for elderly citizens, such as developing and integrating home care services (Tynkkynen et al., 2012) or developing municipal home care catering (Tikkanen & Silvan, 2012). However, smart home technology is seen as one of the focus areas of consumer technology markets, but presumably, these initiatives that are in the area of smart home technology, are slightly unconnected to the stated aims of sustainable development focusing only on technology development. Again, this notion is in line with the previous findings by Martin et al. (2019) on the technology development emphasis rather than a tool for sustainability purposes.

In recent research on technology design, the focus of the research has begun to turn from human-centred design towards eco-centric approach, or biocentric approaches as current anthropocentric or human-centric approaches do not sufficiently consider the rest of the natural environment, see e.g. Yigitcanlar et al. (2019) and Clarke et al. (2019). This can lead to apathy towards environmental concerns and their lack of consideration throughout the planning process. Environmental issues are often "invisible", especially within cities. Based on our data, it must be noted that this research domain and more-than human-centric approach are missing from the Finnish smart city initiatives.

5.3. Future Research Directions and Limitations

Finally, it would be interesting to gain deeper understanding about the key factors and underlying causes in the smart city initiatives and decision-making processes from planning perspectives. The stated sustainability aims of Finnish smart city initiatives are most related to a sustainable economy or sustainable environment. Fewer aims are stated to be related to social or cultural sustainability. This may be connected to our previous notion of quantitative and qualitative measures in urban planning and smart city practices and, the "platform thinking" in smart cities. In other words, the stated sustainability aims cover those types of urban development, which can be measured in quantitative measures. The importance of cities and urbanization is recognized, but not studied in smart city literature. There is a common discourse about the increasingly important role of cities in combating the challenges societies face today, but these views aren't elaborated any further. We would also argue that urban planning matters if we wish to change the cities at a more systemic level.

It can be noted that our findings do not cover the whole and definitive picture of the smart city initiatives, but our findings cover only those smart city characteristics, which are based on smart city-related research. However, this may be a preliminary indicator for the bigger picture of the characteristics of Finnish smart city initiatives during the 2010s. On the other hand, our results may also indicate that the interest groups in Finnish smart city initiatives are from the technological sector. This notion is in line with Ahvenniemi et al.'s (2017) findings that there is "a much stronger focus on modern technologies and smartness in the smart city frameworks compared to urban sustainability frameworks".

One of the limitations of our study is the lack of studies in the field of humanities, architecture, design and social sciences in our data. The reason for that might be found in the characteristics of smart city-related research. It has been, at least until now, technology and business-oriented research field. Particularly, the lack of smart city initiatives related to the smart people domain could be caused by the fact that funding for the smart city initiatives comes mainly from the Ministry of Economic Affairs and Employment of Finland and not, for example, from the Ministry of Education. This might have led to a situation where smart city initiatives focusing on smart people are difficult to get funded.

It must be noted here that the term sustainable may refer to the field of information technology and to sustainable engineering, which means that particularly the technology that is designed or the operating systems are using energy and resources in a sustainable way. In addition, the term smart city is also contradictory as many of the different definitions reveal (Ruhlandt, 2018). One could ask, is smart city as a term even scientific enough to research on? It is argued here that cities have always been smart compared to rural areas, i.e. having the latest urban technology, such as sewage systems, water supply networks, and mass transit systems.

6. Conclusion

To conclude, this paper begins to define the situation of smart and sustainable urban development from the Finnish perspective. The aims of smart and sustainable initiatives are defined by distinguishing the dimensions of smartness and situating them with different sustainability aims. Finally, our analysis of the balances and imbalances in the Finnish smart city initiatives revealed that the balance can be found in those related to smart governance or to some extent amongst the initiatives related to smart economy, whereas smart living and smart people-related initiatives lack balance. Related to initiatives connected directly to urban planning, land use, or land use policy, we found that the connections to sustainability are at a general level These outcomes embody our understanding of what issues are the most important to discuss in future smart city initiatives and our suggestions of specific aims to pursue in smart city development.

We suggest the following directions for future research:

- The smart people domain includes education, lifelong learning, ethnic plurality, and open-mindedness. There is a clear gap to be filled in between this domain of smart people and sustainability.
- To gain a more balanced smart living and sustainable development, we need more citizen engagement and less focus on technologies in smart home initiatives.
- The focus of the research must turn from human-centred design toward eco-centric approach, or biocentric approaches as the current anthropocentric or human-centric approaches do not sufficiently consider the rest of the natural environment.

We argue that we need to reverse what is dominant in smart and sustainable urban development if the plans to have livable future urban environments with smaller carbon footprints are to be accomplished.

Acknowledgements

This article was funded by the SURE project, co-financed by the European Regional Development Fund through the Urban Innovative Actions Initiative (Grant No. UIA104-158).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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