The perspectives of sustainable territorial development in smart cities

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Abstract

Objectives This paper aims to define the perspectives and peculiarities of optimizing territorial development and increasing sustainability in a smart city context. The importance of localizing the UN SDGs, the increasing popularity of the smart city concept associated with the ICT revolution as well as the need of finding out-of-the-box solutions to resolve the challenges faced by communities make this research scope highly relevant. **Prior work** The previous research shows that the smart city approach implementation may have sustainability-oriented and sustainability-lacking scenarios. The smart city concept may not always have linear impacts on sustainability. It is needed to further contribute to the scientific discussion focusing on particular smart city cases to provide recommendations for municipalities on how the territorial development can be sustainably optimized. **Methodology** The paper considers the practical cases of the three smart cities such as Espoo (Finland), Dundee (UK) and Bristol (UK). The literature review, analysis of public sources, case study, and in-depth interviews with the representatives of these cities are used to analyze, in terms of sustainability, the dimensions such as the strategic positioning, advancements and challenges, partnership and stakeholders involvement. **Results** It is determined that sustainable territorial development has huge potential of being reached and accelerated within the smart city environment. However, unleashing such potential may be threatened by lack of a particular sustainability agenda, misinterpretation of smart city as only a technological issue while the sustainability and inclusivity by-design vectors are missed. Overall, the strategies and practices of territorial development in these cities were considered. The concluding recommendations are likely to be useful for municipal authorities of other territories while intentionally applying smart solutions to reach more sustainable human-centric community development that will be beneficial for the vast number of Quadruple Helix stakeholders.

Keywords: SDGs, sustainability, smart transformations, smartification.

1. Introduction

Reaching the Sustainable Development Goals (SDGs), in particular the SDG 11, sustainable cities and communities, proclaimed by the United Nations in 2015 as a common standard of achievement for the UN Member-States requires reconsideration of existing policy practices and searching for innovative out-of-the-box solutions. [1] To reach sustainability on a global scale, it is vital to intensify various actions on an urban level, intensifying territorial development. [2] In addition to the conventional policy challenges, the local and regional authorities have to find human-centric and sustainable responses to the diverse risks such as climate change, rapid urbanization processes, inequalities, digitalization threats and others. [3] According to some estimates, the cities generate approximately 80% of global GDP and contribute to 72% of all global greenhouse gas emissions. [4] The rapid urbanization trends are also expected to lead to the significant increase of city population and even exacerbate the resources and sustainability associated challenges. Thus, it is quite logical to search for sustainable transformations on the city level. The Addis Ababa Action Agenda emphasizes on the vital role of science, technology and innovation (STI) as a means to achieve SDGs. [5] Overall, as the so-called post-growth society is characterized by the lack of opportunities for economic expansion and increased

scarcity of public resources, the digitalization-aimed innovative strategies such as the smart city concept are highly promising in intensifying growth, creating added value and resolving territorial challenges. [6] The increasing popularity of smart city projects worldwide provides a valuable basis for understanding the effects of smart cities. It is already visible that such effects might be double-sided and depend on the properness of smart city implementation. The theoretical conceptualization of smart cities remains vitally important to "program" cities inclusively and sustainably.

1.1. Prior Work

The valuable contributions to the topic of interconnections between sustainability level and smart city concept application have been made by Yigitcanlar & Kamruzzaman, Toli & Murtagh, Lopez & Castro, and others. [2,7,8] According to Yigitcanlar & Kamruzzaman, the smart city concept has huge potential to increase sustainability, but the impacts of smart city concept on sustainability are not always linear, so achieving sustainable territorial development needs special sustainability orientation in the smart city agendas which should aim to provide sustainable outcomes. [7] It should be noted that Mora, Deakin & Reid provided multiple case study analyses of smart cities, in context of the European best practices. [8]

There are some studies discussing obstacles associated with smart cities, in terms of sustainable development. Thus, Hojer & Wangel named five key challenges such as strategic assessment, competence, governance, top-down and bottom-up approach applications, mitigating measures. [10]. Kudva and Ye mentioned that socioeconomic inequalities and the digital divide hinder the process of becoming smart and sustainable. [11]

1.2. Paper Scope

With a view to the high practical and theoretical value of the topic, it is important to focus on particular cases of the leading smart cities to contribute to scientific discussion determining the aspects and peculiarities of implementing smart city concepts and the impacts on sustainability as well as providing recommendations that may be useful to other other cities pursuing the smart transformations. For this purpose, it was decided to comprehensively discuss the cases of Espoo (Finland), Dundee (UK) and Bristol (UK) that are recognized as trailblazing smart cities and are associated with a high focus on sustainability. Considering their smart city agendas and practical dimension of smart city implementation is viewed as highly useful to contribute to answering the question of what are the prerequisites of unleashing the potential of reaching sustainability in a smart city context.

1.3. Methodology

The methodology is multi-dimensional. The literature review, case study, analysis of the public sources, including the websites of the public authorities of these cities are the key instruments used. As an additional tool used to draw the final recommendations the

interviews with the representatives of these cities, including academia, council members, social activists were conducted. The approaches of three cities such as Espoo (Finland), Dundee (UK) and Bristol (UK) were discussed, in the context of three dimensions such as the strategic positioning, advancements and challenges, as well as partnership and stakeholders involvement.

2. Main findings

2.1. SMART City Definitions

There are various definitions of smart city concepts, which is largely determined by the evolutionary nature of this approach, lack of standardization, and case by case basis of defining. Although the component-based approach to defining smart cities is widely spread, the definitions can be classified into several groups. For instance, Toli & Murtagh distinguished between sustainability-oriented definitions and non-sustainability-oriented definitions. The sustainability-oriented definitions focused on the performance of the environment, economy, mobility, people, quality of life and governance, while non-sustainability-oriented definitions were limited to the efficiency of transportation, education and administration. They viewed limitations in smart city definitions as related to citizen accessibility, misrepresentation and the particularity of existing urban fabrics [2] As pointed out by Desdemoustier and others, defining smart city architecture should aim at serving the government purposes to reach innovativeness and sustainability, while the standardized definition is likely to positively affect the processes and outcomes of smart city concept implementation. [12]

The current large gap between smart city and sustainable city frameworks suggest that there is a need for developing smart city frameworks further or re-defining the smart city concept. It was emphasized on the importance of having a balance among environmental, economic and social aspects , so the concept of smart cities should be viewed as lying beyond simply taking advantage of various modern technologies to reach optimization. [13]

For the purposes of this research, we emphasize on the relevance of the following definition jointly developed by UNECE and ITU through a multi-stakeholder approach which involved over 300 international experts. "A smart sustainable city is an innovative city that uses ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects". [14]

2.2. Approach of Espoo (Finland) building a sustainable future

Strategic Positioning

The City of Espoo is known as a Sustainable Learning City. Espoo is a very young city, a former rural area, which had been rapidly developing since the 1940s and then transformed into a fully self-sufficient industrial city gaining the city status in 1972. [15] Espoo together

with the two other Finnish cities such as Helsinki and Vantaa belongs to the Helsinki-Uusimaa region, which is considered as one of the innovative leaders in Europe. The region is associated with an efficient smart specialization approach (S3). At the end of April 2020, the new revised S3 strategy was adopted emphasizing on the smart use of resources such as ecological, environmental and social. The resource-wisdom is prioritized by the region, in terms of economic development. There is a clear emphasis on cluster-oriented smart growth. The SDGs strategy of Espoo is indispensable from the regional SDGs strategy. [16] The region prioritizes focusing on the following SDGs such as No poverty (SDG 1), Quality education (SDG 4), Industry, innovation and infrastructure (SDG 9), Sustainable cities and communities (SDG 11), Climate action (SDG 13), Peace, justice and strong institutions (SDG 16). It is a great example of how the UN SDGs can be integrated in the smart specialization strategy. The region is characterized by startup culture and knowledge. Research is a strategic priority, the region has the highest PhD concentration concentration level in the EU. [16]

The smartification of Espoo goes along with sustainable development strategies. It is important to mention that Sustainable Espoo development programme focuses on the following targets of sustainability:

- Build a sustainable Espoo by using smart solutions;
- Develop streamlined and sustainable transportation;
- Create emission-free energy production and smart energy solutions;
- Help the citizens of Espoo to live sustainably;
- Integrate the city better in the surrounding environment. [17]

Overall, the city emphasizes on the three fundamental dimensions of its development expressed in three words such as Tiede (science), Taide (art), Talous (economy) [18] The presence of such targeted programs viewed by interviewees is vitally relevant to program territorial development comprehensively. It helps avoid the smart city misinterpretation as solely a technological issue, while sustainability is set by design. Such an approach of including smart components in the sustainability strategy and vice versa including sustainability components in the smart strategy has been positively estimated by the interviewees. Moreover, it was associated with tackling smart city misinterpretation and other challenges. Espoo views sustainability as one of the key criteria to thrive. [19] Over the recent years, the investments in sustainable solutions such as public transportation, campaigns on sustainable lifestyle, nature conservation projects, reaching carbon neutrality by 2025, city bikes, and others have significantly increased.

Advancements and Challenges

Espoo pays particular attention to the implementation of circular economy principles, most of which are implemented in the industrial district of Kera, located close to Helsinki. The SMART and Clean Kera project involves repurposed buildings and new circular buildings. In the sustainability benchmark studies of 145 European cities conducted by Tilburg University in 2016 and 2017, the city was ranked number one. [19] Over the recent years, the investments in sustainable solutions such as public transportation, campaigns on

sustainable lifestyle, nature conservation projects, plan to reach carbon neutrality by 2025, city bikes, and others have been increasing. [17, 18] The city has conducted the SDGs voluntary review, which showcases high attention to reaching the SDGs as a priority. [20] Particular part of the review is devoted to the correlation of smart city technologies and sustainability. Espoo considers and applies digitalization in a human-centric way. There are diverse initiatives aimed at providing higher digital literacy and citizens expertise in the fields of disruptive technologies such as AI, Internet of Things, open data, city digital ecosystem, etc. Espoo offers mobile training for the development of residents' and personnel's sustainable development skills through developing mobile apps, other learning platforms. For instance, Espoo and private partners have developed the MY2050 game, a mobile app that educates users about circular economy and climate change. The Omnia training group focuses on creating training products for sustainable development. This and other examples of projects facilitating digital competences are viewed as a tool of mitigating the risk of digital exclusion. The smart city services also provide better rendering of health services that are now provided in some online, which positively affects the environment and minimizes the risks of infection.

In 2019, Espoo became the first European city to launch a 3D city model as an open interface service to boost economic and socio-cultural development. The city is actively experimenting, the City as a Service and School as a Service are viewed as highly promising digital frameworks that could be expanded and used in other environments. The Espoo Innovation Garden,which is the biggest innovation hub in Nordics, is associated with great opportunities for the circular economy and attraction of investment. In addition, in the framework of the Espoo affordable homes program to resolve homelesness problem, more than 10000 homes were constructed as well as the efforts to prevent homelessenes through preliminary rent financement are undertaken. The city actively develops geo-heating technologies to reach its zero-carbon emission target. [20]

The interviewees estimated the digital city educational projects highly positively. The most relatively reached goals are Climate Action (SDG 13), Industry, Innovation and Infrastructure (SDG 9), Quality Education (SDG 4) that overall reflects the dimensions highlighted in the review, in terms of advancement. One interviewee mentioned that he viewed smart city positive effects in connection with comprehensive educational campaigns and digital literacy. Overall, the challenges to implement the SDGs were considered as minor and easy to overcome. At the same time, still despite the high achievements, the lack of general awareness and understanding of project urgency in their community, financement of the SDGs initiatives, especially of small or medium scale and lack of previous expertise were considered as challenging by the interviewees. The financement challenge was reiterated in the resources considered as well. [19] Also, it was specified that it would be highly promising to reach improvement in Responsible Consumption and Production (SDG 12).

Partnership and Stakeholders Involvement

The Public-Private-Partnership concept lies at the heart of Espoo's SDG work. [21] Espoo is associated with the huge innovation ecosystem, where there are approximately 20,000

jobs, 15,000 students, 5,000 researchers and more than 30 research institutes. [20] The strengths and high performance indicators of Helsinki-Uusimaa region is largely attributed to the intense partnerships and collaborations with the research and academic institutions. [17] The key aspects of Baltic Sea Region smart-up cooperation are boosting regional transformation, engaging inter-regional collaboration, boosting entrepreneurship and entrepreneurial discovery processes, saving the Baltic Sea and tackling grand societal challenges. [22]

The fundamental role of partnership was also mentioned in the process of interviewing the research contributors. In the framework of another KIEPPI project the Partnership Model for Sustainable Neighbourhoods is being developed aimed at providing higher synergies and creating a united circular area. [19] The city emphasizes on involvement of stakeholders assigning the interested project leaders. The Espoo Youth Council, Elderly Council, Disability Council are involved in the decision and policy making, directly articulating the voice of particular groups . Here is the philosophy that the City is transformed not for people but by people, which is revealed in the city motto such as "Make with Espoo". As stated by the city representative from the academic field, partnership is a key prerequisite of sustainable development. At the same time, it is still promising to further expand partnership. Generally, in practice, companies, numerous startups develop and experiment on a local level with new solutions in Espoo that can be further applied on a larger scale.

2.3. Bristol - European Green capital

Strategic Positioning

Considering Bristol is a great chance to reflect on the approaches of the UKs greenest city. At the same time, Bristol is one of the UKs biggest cities, which was recognized as a European Green Capital 2015, won the Smart City Award in 2018, as well as reached pole-position on Huawei's UK Smart City Index. [23] It is important to note that even before the SDGs were set up as a strategy 2030, Bristol had been associated with sustainability and significant attention to environmental issues.

From the strategic viewpoint, the Bristol smart city policy interpretation emphasizes the relevance of the sustainability component. Thus, the very purpose of the smart city concept implementation refers to making the city moving, healthy and safe, in a sustainable way. So, sustainability criteria is viewed as one of the smart city essentials. Overall, the smart concept is considered to be a well-balanced combination of hard and soft infrastructure with a human-centred approach to:
- Make Bristol more liveable, workable and sustainable
- Manage the city and civic resources as effectively and intelligently as possible
- Deliver world-class citizen-centric city services
- Underpin a continuous process of reinvention, transformation and creativity,
- Support economic development and long-term prosperity. [23]

Advancements and Challenges

The open data, traffic optimization, sustainable food supply, cultural, energy-saving and learning smart initiatives are viewed as city priorities as a part of one city action plan aimed at reaching higher interoperability and broadband-related benefits. The one city plan integrates SDGs. [24]

The interviews with the city representatives conducted in framework of this research determined the following smart-city related benefits, in terms of sustainability, such as open data (live data on air quality on the city council website, at the time of the interviews working in testing mode), quality of life survey data, improved information about managing energy supplies, decarbonization mechanisms and projects. Moreover, the respondents have mentioned the live data about traffic congestions allowing to regulate the traffic flows in and out of the city to prevent traffic jams, which also contributes to lower pollution level. Making the control system smarter as stated by the survey participants has significantly contributed to resolving the congestion problem, which is vitally relevant, as Bristol is one of the most congested cities in the UK. In terms of sustainability, smart technologies have been viewed as providing better cultural opportunities. One of the initiatives is a playable city including the talking city furniture that is viewed as one of the promising ways of improving the touristic attractiveness of the city. The CCTV cameras monitoring the harbour contributed to higher safety, as in case of some emergencies close to the harbour, the data from sensors is delivered to the city emergency team to respond. Among the relatively most reached SDGs, the interviewees have named Partnerships to achieve the Goals (SDG17), Climate Action (SDG 13), Sustainable Cities and Communities (SDG 11). The lack of funding and financial resources to implement the SDGs was named as one of the key challenges along with lack of awareness about the SDGs and the required level of institutional support that complicates taking actions or resource finding. The AI-based algorithmic decision making and technology-driven declusion as well as citizen scoring are also considered as risky aspects of Bristol smart city.

In Bristol, the SDGs campaigns initiated by the NGOs or activist networks are highly disseminated. One of the initiatives is the Global Goals Center, which showcases the 17 SDGs heroes nominated by the community. Such an approach helps disseminate best practices and raise awareness. [25] Moreover, particular attention is paid to voluntary reviews. The Bristol SDG Alliance has conducted the first Voluntary Local Review of SDG progress in the UK . The review is based on considering 140 indicators, in context of reaching the UN SDGs. The climate initiatives were positively estimated, referring to the extensive increase in the number of green spaces, development of parks and open spaces. In 2018 Bristol was the first UK city to declare a climate emergency. There is a great civic engagement to reach carbon neutrality by 2030. There is a trend of decreasing household energy consumption, while the capacity of renewables is increasing. [26]

At the same time, the city Council elaborated on the problems such as increasing poverty and food insecurity that especially affects youth and children. There is a high number of homeless people in Bristol. This challenge was also mentioned by the interviewee, who viewed the SDG 1 as having the lowest progress level. At the same time, there is a rapidly

evolving and efficient food delivery network to reduce food waste. The urban food delivery is considered to be a form of social movement and activism, being highly democratic in its efforts of bringing sustainable and inclusive outcomes. [27]

Partnership and Stakeholders Involvement

Bristol focuses on developing partnerships on different levels. As stated by the interviewees partnership is one of the most reached goals. The private partners are actively involved in resolving the challenges. For example, most of the food delivery applications are run by the private stakeholders. As mentioned in the report, the Council also seeks to diversify external corporations on the regional level . Council aims to engage with the West of England Combined Authority (WECA) and other regional partners in order to create a Smart Alliance. [27]

Bristol actively engages and empowers the SDGs initiatives. As an example mentioned by the city resident in the interview, there is a competition happening each year where participants get rewarded for reducing their ecological footprint through choosing more sustainable ways of moving to work. The Knowle West center is at the heart of accumulating innovation. Bristol Energy Network and Knowle West Media CentreThrough employ technology and the arts to come up with creative solutions to problems, focusing on stakeholders involvement, training and employment. [28] Intrapreneurs who are the employees leading sustainable transformation are considered as fueling power of sustainable smart transformation.

It is important to mention the city-university collaboration. Bristol Universities and academic institutions are actively engaged in localizing SDGs, policy-making, project development and implementation. [28] Moreover, Bristol is a part of various international collaborations such as the MetroLab Network, the Global Parliament of Mayors as well as city-to-city partnerships in Europe, US and Asia. [23] As stated by the interviewee, Bristol combines an up-bottom and bottom up approach, so the incentives come not hierarchically from the authorities but rather simultaneously from a decentralized stakeholder network who are leading the change. Overall, the social movement nature is typical for sustainability projects in Bristol.

2.4. Dundee

Strategic Positioning

Dundee is the smart city of 148,000 residents which makes it highly interesting to consider the interrelations of smart concept implementation and sustainability in the environment of the small city. Dundee focuses on two aspects such as open data provision and smart transportation. [30], [31]

The city council emphasizes on the following directions and activities such as green spaces creation, enhancing biodiversity, reducing waste, increasing energy efficiency, promoting renewables, tackling climate change and others. [30] The smart city ecosystem is

considered as a tool of improving air quality and human health, reducing CO_2 emissions and other greenhouse gases, creating more inclusive employment opportunities, better community engagement, attracting investments and reducing poverty, increasing climate knowledge, supporting local economy through ensuring secure local energy supply, reaching community engagement, etc.[32] It is important to note that in June 2019, the state of Climate Emergency was declared by the Council as a sign of recognising the serious environmental, social and economic challenges associated with climate change. The city has developed a partnership Climate Action Plan addressing the themes of Energy, Transport, Waste and Resilience. The special Carbon Management Plan has been constantly developed since 2009. [32] The city also follows The Scottish Climate Change Adaptation Programme 2019-2024 that was proclaimed by the Scottish Government, which obligates the local and regional authorities to report emissions related to operations and service delivery. [31]

Advancements and Challenges

Dundee is at the forefront of switching to zero-carbon transport, while 20% of local taxis are already entirely electric. It should be noted that since 2008 the city carbon footprint has reduced by 40%. The proportion of emissions related to the Council property has reduced by 37 % which is largely related to the application of SMART metering. The Council is actively focusing on energy education and provides a free advice service to householders on energy saving through the Dundee energy efficiency advice project. [31] As pointed out by Brown and others, Dundee is focused on developing smart and sustainable mobility solutions, yet it scores compara- tively poorly when essential services or the broad spectrum of smart city initiatives are concerned. [31]

As an example of the positive social effect of introducing smart technologies an interviewee paid attention to a more efficient way of transfer payment allowing making direct social transfers without unnecessary delays (that relates to the other Scottish Alliance city Glasgow as well). Another example mentioned is partnership and creating more employment opportunities stemming from the increased investments . The interviewees were extremely proud of advancements in the transport field. As mentioned in the report, Dundee City Council has 87 electric fleet vehicles. It has highly developed electric vehicle infrastructure. There are also car renting options such as Co-Wheels with 15 ultra low emission vehicles. The city encourages visitors and residents to walk and cycle through the projects such as WOW (Walk once a Week) encouraging children to record their mode of travel providing the opportunity to win a special badge, bike hire scheme supported by the Council and operated by Ride-on Scotland, Pedal to the Pool offering free swimming for children who are cycling to the pool. Moreover, 'Safer Routes to School' leaflets that have been distributed among the primary schools. Dundee also has a special eco-school project to educate children on sustainability and other fields. [31]

The interviewees have considered the most tangible advancements in the three of the goals such as Affordable and Clean Energy (SDG 7), Decent Work and Economic Growth (SDG 8) and Industry, Innovation and Infrastructure (SDG 9). The Dundee Waterfront development is one of the most active regeneration projects in the UK. [33] The Waterfront

has a commitment to sustainability that will help developers meet corporate governance obligations while offering the benefit of lower whole life development costs. It is viewed as one of the key investment magnets. This project has not only strong economic but also cultural impact. It has created new workplaces. Dundee Mobility Innovation Living Lab (Mill) develops diverse smart mobility solutions and applies smart technologies to solve societal challenges.[34] As stated by the interviewees, such projects contribute to transforming mindsets and facilitating more sustainable behavioral patterns. Among the key challenges the interviewees highlighted lack of general awareness, lack of financial support (sufficient but improvement is desirable) as well as the gap in expertise that may somehow affect the SDGs project initiation. Overall, the attitudes towards smart cities are positive, implementing smart technologies is viewed as grasping arising opportunities. As stated by Peel & Lloyd in their article from 2008, Dundee faced new communicative challenges requiring reconsidering the city image and creating new brand strategy. [35] Smart city positioning is mostly perceived as efficient by diverse stakeholders.

Partnership and Stakeholders Involvement

Dundee is a part of Scottish Smart City Alliance that is a unique collaboration of Scotland's seven cities such as Aberdeen, Dundee, Edinburgh, Glasgow, Inverness, Perth and Stirling with the Scottish government. There is an open data platform providing the member cities with the opportunity of sharing live data. The academia and private partners are also involved in such an interoperable eco-system. Dundee is associated with the advanced partnerships. During the interviews, it was mentioned that the partnership is fueling smart city transformations. The benefits of smart transformations are mostly attributed to the partnerships as the key strategic priorities.

The city council is viewed as an interface between communities and individuals. Dundee is associated with regeneration partnership. As in the early beginning of the 21st century stated by Fernie & McCarthy, 'Dundee Partnership' has evolved, in terms of institutional capacity. It has been changing to respond to different contexts and expectations shaped by the structures of community involvement. Currently, the city positions itself as stakeholder oriented. The interviewees estimated Dundee achievement of facilitating as high, however mentioning the space for further improvements.

3. Conclusions and Recommendations

The conducted analysis has shown that there are certain common tendencies in the sustainable smart approaches applied in the three cities such as Espoo, Bristol and Dundee.

Firstly, the partnerships take the key role and this goal (SDG 17) was viewed as one of the most relatively reached and important. Such a value of partnership has been articulated strategically in the open sources and reflected practically. The importance of partnership has been also highlighted by the representatives of these three cities who were interviewed. The private partners deliver the sustainable solutions, in the context of a combination of bottom-up and up-bottom approach. There is a quadruple helix model, in which academic institutions, universities, businesses, civil society, authorities and individuals actively collaborate. The innovative hubs, hackathons and living labs such as Gardens, Know

Media, Mill are the heart of smartification, attracting investments, positively impacting employment and testing sustainable solutions.. Regional and international cooperation is viewed as triggering the sustainable solutions. While Espoo and Dundee are parts of regional innovative networks and alliances, Bristol aspires to further develop this field viewing it as a strategic priority. Cooperation with the research institutions such as universities is actively developed in all of the targeted cities.

Secondly, there are well-communicated sustainability-oriented strategic priorities. The councils in all of these cities articulate the sustainability orientations. The sustainability strategies and smart city strategies exist simultaneously, while they are intertwined as smart city strategies involve sustainability components. Smart city is strategically interpreted as the tool of increasing sustainability, while missing the sustainability component was viewed as a threat by the interviewees that is likely to cause smart city misinterpretation.

Thirdly, the sustainability dimensions that are mostly impacted by the smart city ecosystem are urban transportation, decarbonization, open data systems, energy utility smart meters and raising awareness. Particular emphasis is on social applications and digital platforms such as food delivery services, parking apps, training and tools.

Fourthly, although the smart city concept in these cities is interpreted as providing higher investment opportunities, the lack of funding and difficulties with attracting funding, especially for smaller scale individual projects were present in all of the cities. Digital inclusion is still challenging to different extents. Despite high focus on training and educational campaigns, there is a lack of awareness about the urgency of the SDGs projects and possible lack of responsibility misinterpretation. The competence dimension was also viewed as quite trying. Overall, such information signifies the high importance of further promoting training and improving community soft skills.

Sixthly, the monitoring indicators like voluntary reviews in Bristol and Espoo or obligatory reporting on the SDGs progress in Dundee are viewed as enormously relevant. Such voluntary reviews allow to focus on the strengths and fill the gaps in the SDGs strategies. It is also a very important practice of informing stakeholders, populazing best practices and setting performance standards to reach the multiplying effect as a result.

Finally, the city councils use diverse incentives and encouraging tools to empower citizens. The directions of promoting sustainable transportation through providing diverse competitive rewards or sharing best practices are both effective from the perspective of the authorities and interviewed citizens. Overall, the game-like nature of training and tools results in better connections between citizens and public policy makers allowing co-creation in a diversified form in comparison to partnerships with the initially set formal roles. The school orientation of eco-education is well-visible through diverse campaigns such as School as a Service, Eco schools, etc.

Overall, the conducted analysis has strengthened the point of Yigitcanlar & Kamruzzaman which was considered in the prior work section. [7] The thesis that it is important that smart cities introduce particular sustainable agendas was proved on the case examples of all the

three cities. The strong sustainability philosophy helps avoid seeing the smart city concept as solely a technological issue. It contributes to applying the smart city concept as a tool for reaching sustainability rather than neglecting it. It is also hard based on the collected data to conclude that the connection between smart solutions and sustainability is linear. But it is clear that smart technologies may be helpful in this context. Increasing sustainability in smart cities requires a well-balanced comprehensive human-oriented and multi-stakeholder type strategy.

Summarizing the research outcomes, the author deems it relevant to give the following **recommendations to the local and regional authoritie**s intending to program sustainable smart city systems:

● Setting and articulating sustainability targets strategically. Inclusion of the sustainability component in the smart city framework and vice-versa.
● Facilitating partnerships (private-public), intercity, considering entering alliances on the regional, national or international level.
● Reconsidering institutional mechanisms of access to financement, funding, facilitating smart sustainability crowdfunding platforms.
● Considering the potential of applying open data tools for communicating and resolving the environmental issues , developing and distributing energy meters.
● Empowering citizens, creating diverse sustainability awards, using competitive strategies.
● Conducting voluntary SDGs reviews, drafting reports, setting the responsibility standards of the city councils and smart ethics. Improving monitoring mechanisms.
● Ensuring and constantly increasing the level of stakeholder involvement, in particular NGOs, private companies, academia and individuals with special focus on the vulnerable groups such as elderly, youths, people with disabilities. Working together with all stakeholders, co-creating.
● Organizing sustainability campaigns, marketing and branding sustainability, attracting opinion leaders.
● Testing digital solutions and getting feedback from the direct stakeholders to determine improvement strategy.
● Building strong soft, digital competences and expertise, facilitating smart sustainability education, organizing school programs.

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