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## Article

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# Contrasting “Smart Mobility” and “Sustainable Mobility” in Transport Governance: The Case of Municipalities in Estonia

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## Abstract

Modern cities are developing exponentially and thus ensuring mobility is one of the key challenges. The solution can be viewed as the determination of optimal vectors of strategic city development, including transport as a sub-system. One dominant theme in respective research discourse is sustainable mobility. A competing concept, “smart mobility”, is fuelled by on-going ICT development, aiming to bring about urban transformation with a data-driven approach. While, to a certain extent, smart approach does provide improvement to quality and efficiency of urban life, resulting also in contribution to sustainability goals, then in terms of philosophical foundation, it appears rather an input-driven approach, whereas the logic of sustainable mobility is driven foremost by outputs. Therefore, in this study, the two approaches are treated as two distinct development vectors.

Estonia is a pioneer of digital innovation, so the local transport development can be similarly assumed to be ICT-infused. Our study observes the detailed nature of transport system governance and aims to identify the relationships between smart and sustainable paradigms. The study analyses the governance paths of urban transport systems in a sample of medium and small municipalities in Estonia, by evaluating explicit development strategies. The ensuing analysis of expert interviews using a quasi-binary method contributes to the scientific discussion on the smart and sustainable balance and co-existence with empirical insights to policymakers.

The study indicates that a local transport governance paradigm is not only influenced mainly by local socio-economic characteristics and environmental factors but also notably on the competence, knowledge, skills and beliefs of incumbent officials. Furthermore, the established relations between smart and sustainable development indicators provides a basis for assessing balance in transport development concepts, as it is possible to consider the integrated concept “smart and sustainable” as a paradigm evolution.

## Keywords

Smart transport development, Sustainable urban development, Smart and Sustainable governance, Smart city, Smart mobility

## JEL Classification

H72, Q01, R11, R58

## Introduction

Over the past decade, according to UN data (United Nations, 2015), urban dwellers have surpassed those living in rural areas, necessitating a strategic approach to urban development. This underscores the challenges and opportunities the increasing global urbanisation trend presents, focusing on developing smart and sustainable cities (Clarke, 2017; Silva et al., 2018). The critical tasks for cities involve identifying optimal ways to respond to new challenges, integrating modern technologies, and ensuring a balance between long-term goals and available resources. One key aspect is increasing urban development and planning efficiency (Blasi et al., 2022). The rapidly growing level of urbanisation and the processes associated force both national and municipal authorities to take measures and implement urban system development policies, considering integrated smart and sustainable transformations (Ahvenniemi and Huovila, 2021; Foltýnová et al., 2020), where the mobility and transportation plays an important role (Anand et al., 2017). The integrated method guarantees a comprehensive view that includes

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measurable data, visionary models, and a strategic plan for advancing smart and sustainable city concepts. By harmonising these frameworks, cities can thoroughly and efficiently evaluate their journey toward achieving smart and sustainable objectives (Clarke, 2017). Regardless the prevailing context, some recent scholars (Yigitcanlar and Kamruzzaman, 2018; Anastasiadou and Vougiaris, 2019; Ahvenniemi et al., 2017) have deliberated on the feasibility of developing the entire urban system, along with its subsystems, exclusively based on the criteria of "smartness" or "sustainability".

The discussion revolves around the concepts of "smart" and "sustainable" cities, with scholars highlighting the need for a robust definition of these terms (Lee, 2017; Ruhlandt, 2018; Albino et al., 2015). The literature presents various descriptions of the development vectors for urban areas, posing challenges, primarily regarding uncertainty, for the scientific community in terms of defining goals and assessing city performance indicators (Ligorio et al., 2022; Bifulco et al., 2016; Kutty et al., 2022). Moreover, the difficulties described also apply to methods of indicative assessment of heterogeneous city performance and the role of various stakeholders and decision-makers (e.g. municipal authorities, citizens) (Yang et al., 2020; Ahvenniemi et al., 2017; Horbach et al., 2023). Considering this issue indirectly, there are approaches according to which the described directions of development of urbanized territories have several distinctions in their characteristics (Ligorio et al., 2021). Despite differing opinions, there is a growing inclination towards combining smart and sustainable elements into a unified development concept, emphasizing sustainable development with cutting-edge technology as a primary tool. (Ahvenniemi et al., 2017; Majumdar et al., 2021; Martin et al., 2018). In other words, in the topic of strategic urban planning, pursuing the goals of sustainable development, the application of smart city technologies plays nowadays an important role (Antwi-Afari et al., 2021; Šulyová and Kubina, 2022). It is noteworthy to highlight this approach's significance in decision-making processes, where a pivotal role is directly assigned to municipal authorities (Ibrahim et al., 2018).

According to Soe and Drechsler (2018), Estonia highlights the country's leadership in digital innovation, particularly in the transport sector. Estonia's approach involves integrating Information and Communications Technologies (ICT) into various aspects of daily life, emphasizing digitalization, innovative solutions, and data-driven focus (Lanamäki and Tuvikene, 2021). The primary responsibilities are distributed among the government, private sector, and scientific community. This collaborative effort, underpinned by an advanced IT platform (e-state), not only facilitates the connection of residents through digital personal identification (ID) but also aligns with the United Nations' Sustainable Development Goals (SDGs). The incorporation of this platform into various facets of Estonians' daily lives, including the transport sector as part of the e-Estonia project (Prause and Tuisk, 2020; Lanamäki and Tuvikene, 2021), underscores the Estonian state's commitment to long-term industry development in harmony with sustainability objectives.

The emphasis on the "Smart" direction, which integrates digitalization, innovative solutions, and data (Soe and Drechsler, 2018; Hadachi et al., 2020), not only propels the swift growth of the information technology sector but also contributes to the achievement of SDGs. This forward-looking approach is evident in the implementation of inventive projects in urban transportation (Ainsalu et al., 2018), reflecting Estonia's dedication to creating smart and sustainable cities that align with global sustainability initiatives. The Estonian case serves as a basis for discussing the proportion between smart and sustainable city indicators, indicating the possibilities for assessing these ratios and their impact on the organizational performance of transport in Estonian municipalities (Bibri, 2018; Song et al., 2022; Smékalová and Kučera, 2020).

Recognising the distinctive local context is imperative in delineating developmental trajectories, particularly concerning prioritising either a smart or sustainable paradigm in the strategic frameworks governing the development of cities and municipalities, even within relatively smaller nations such as Estonia. Within traditional and contemporary paradigms of urban governance, the analysis of formal dependencies among components and stakeholders is frequently omitted, owing to the complexities introduced by bureaucratic, socio-political, and economic factors. Scholars highlight that contextual factors are commonly neglected in scientific discussions (Ruhlandt, 2018). It's essential to closely consider the impact of the local status quo and decision-making autonomy for each municipality. Considering these factors is vital when creating policies and strategies to ensure urban structures' smart and sustainable development.

Consequently, this deduction follows the primary research question posed by the authors of the paper, followed by two sub questions:

*RQ 1. How can the integration of smart mobility and sustainable mobility concepts in transportation governance be characterized within small and medium-sized municipalities in Estonia?*

*RQ 1.1. What criteria are used by local decision-makers to determine the combination of smart and sustainable mobility indicators in small and medium-sized municipalities in Estonia?*

*RQ 1.2. Can the mix of smart and sustainable development markers be evaluated as a suitable balance between development trajectories in Estonian small and medium-sized municipalities?*

Considering the complexity of the concept of a smart and sustainable city as a temporally indefinite process, it can be deemed necessary to articulate a certain level of mediation (Yigitcanlar and Kamruzzaman, 2018), where the

definition of a smart city is understood as a smart direction of development with a root element of data (Docherty et al., 2018). The sustainable city is presented as sustainable development with the central element of the environment (Longo et al., 2019). To enhance the scientific discourse with comprehensive insights and offer valuable perspectives to policymakers and stakeholders, this study examines and presents empirical data derived from an analysis of the ratio between smart and sustainable urban development. The study specifically explores how transportation is managed in small and medium-sized municipalities in Estonia and proposes potential directions for further research. Studying the balance between smart and sustainable city concepts is a fresh research approach, identifying it as a notable gap in existing literature (Bibri, 2021). In our interpretation, balance involves a harmonious interaction and a well-rounded approach that unites the fundamental principles of both smart and sustainable development concepts. This approach implies the efficient allocation of resources and efforts among key stakeholders, including technological investors, policymakers, entrepreneurs, and citizens (Peng et al., 2023; Rafaj et al., 2022). Within the framework of the balance concept, the integration of ecological, socio-economic, political, and local aspects takes place, ensuring equilibrium and comprehensive development of urban ecosystems towards the achievement of sustainable development goals on the state level. This approach finds justification in the context of the statement by Ullah et al. (2021), which projects a significant increase in global investment in smart city initiatives, expected to reach \$189.5 billion by 2023. The authors of this paper emphasizing the importance of an intermediary role in understanding the unified concept of a smart and sustainable city, suggesting a framework to analyse the ratio between these two elements, and opens the possibility for future research on the topic of organizational management in the context of smart and sustainable cities.

The research adopts a mixed-method case study methodology, utilizing semi-structured interviews with experts to analyse the transport development strategies implemented by Estonian municipalities. Focusing on the municipal scale, the author analyses how the interconnected strategies and development activities of the Estonian medium and small-sized municipalities address the smart and sustainable goals, emphasizing the prevailing direction in development (Ahvenniemi and Huovila, 2021).

The following section presents a review of the literature, which served as the foundation for creating a framework for assessing strategies for developing cities and municipalities, including an overview of the assessment technics for smart or sustainable cities and important indicators of the described concepts under review. Section 3 outlines the methodological process, considerations and dataset used in this study to address the research questions. Afterwards, the authors provide an overview of the empirical results obtained in Section 4 of the paper. Section 5 presents the analysis and discussion. In the final Section 6, the paper's authors conclude the work performed, highlighting the study's main findings.

## Literature Review

### ***Navigating the Evolution and Paradigm Shift***

The concept of a sustainable city is constantly evolving, integrating significant technological and scientific advancements, and aligning with the ongoing urbanization processes. This dynamic transformation involves a strategic shift towards the seamless integration of technological innovations (Bibri, 2021). As cities strive to become more sustainable, they increasingly recognize the importance of harnessing cutting-edge technologies to address environmental, social, and economic challenges (Clarke, 2017). Recently, academics and urban planners have increasingly highlighted the crucial role of technology in realizing sustainable urban development. As a result, the administration of urban areas is evolving into an intricate challenge, and integrating innovative city concepts emerges as a potential solution (Šurdonja et al., 2020; Zemanova et al., 2022). Gazzola et al. (2019) have concluded by comparing sustainable and smart municipal development approaches that achieving sustainability goals has a higher potential for success in smart-centric approaches. On the other hand, Lyons (2018) emphasises the need to balance technological and social considerations, highlighting the significance of overarching goals and directing attention towards sustainable urban living. Additionally, the author underscores the critical role of interdisciplinary collaboration in realising positive outcomes for urban populations (ibid.). At the same time, Yigitcanlar et al. (2019) have highlighted in an extensive literature review the impossibility of achieving smart goals without sustainability. Still, it points to the possibility of achieving development goals by combining the potential of intelligent citizens, modern technologies, and valid urban development policies (Benites and Simões, 2021; Strelcová and Janasová, 2018). By coalescing these concepts to achieve a sustainable future (Gazzola et al., 2019; Bibri, 2021), stakeholders' discourse is shifting toward a "smart and sustainable" city (Bifulco et al., 2016; Majumdar et al., 2021). In this situation, cities face a multitude of challenges in urban transport, health, safety, and environmental protection (Clarke, 2017). Depending on the circumstances, development towards sustainability (achieving goals) is a complex and multi-disciplinary challenge facing policymakers, planners, decision-makers, and those who influence urban development processes (Bibri, 2021). In summary, the progression towards sustainable urban centres necessitates amalgamating cutting-age technology, interdisciplinary cooperation, and harmonising technological and social dimensions to realise the "smart and sustainable" urban development paradigm.

### ***Sustainability and Smart Perspectives in Transport Research***

Despite the shift in the modern paradigm towards integrating smart concepts, several authors still refer to the traditions of sustainability in transport research. Silva et al. (2018) have highlighted that since the 1980s, sustainable development has been the dominant paradigm in the development of urban agglomerations. Reasoning about atomic issues in the sustainable transportation topic, the current threat of climate change by harmful emissions (Korablev et al., 2021; Ahad et al., 2020), as well as the rapidly growing level of urbanisation with the associated processes (e.g., vehicle ownership level) (Huovila et al., 2019), pose core problems, where mobility of residents (including the ability, to commute, to access services and to exchange information), plays a vital role (Mounce et al., 2020). Xing et al. (2013) had a similar position, analysing and evaluating the sustainability and coordination of the development of transport systems, stating the importance of transport as a necessary socio-economic component in achieving sustainability goals.

Several authors (Anastasiadou and Vougiaris, 2019; D'Amico et al., 2020; Garau et al., 2015) have treated smart urban mobility as a critical route for minimising adverse impacts of transport on the environment. According to Zhao et al. (2022), the concept of smart mobility in China is regarded as the most direct approach aimed at improving the quality and efficiency of urban life. Cledou et al. (2018) have analysed the services in nine smart cities globally by exploring various approaches to designing intelligent mobility services. Cledou has defined these services as solutions based on an integrated ICT infrastructure to improve urban transport and citizens' mobility (ibid.). Some of the highlighted initiatives are aimed at innovative optimisation of traffic control methods (Cello et al., 2016) and the exchange of transport information by users and traffic area stakeholders (Richter et al., 2020) of urban systems in real-time using artificial intelligence technologies (Sumalee et al., 2018). Finally, investigating the smart direction in transport development (Tokunova and Rajczyk, 2020) concludes that the concept of a smart city and the use of so-called smart initiatives have significant potential to increase the efficiency of the functioning of urban subsystems. As a result, the transport system becomes a complex structure for solving most urban problems. First, this concerns the economic and financial efficiency of organisations involved in the system, both municipal and private (Battarra et al., 2018), as well as the overall quality of life.

Researchers across disciplines frequently use combined methods to study cities and their transport (Illahi and Mir, 2020). An increasing volume of research in the transport field requires a qualitative approach (Næss et al., 2018) to understand complex causal relationships in the urban transport sector. Held and Gerrits (2019) have applied qualitative comparative analysis methodology in examining the e-mobility policies of several European cities. They concluded that a balanced policy in promoting (stimulation) e-mobility and the di-stimulation of car usage powered by combustion engines has a significant correlation. Serrano-López et al. (2019) concluded similarly in choosing unique approaches to regional urban planning. Combining qualitative and quantitative methods, Porru et al. (2020) have argued for a broader explanation of sustainable mobility and better support to decision-makers due to several common misconceptions concerning developing the road network to improve the transport situation. Maintaining a dedicated commitment to sustainability underscores its lasting significance since the late 20th century. Given the significant influence of transportation on urban life, smart urban mobility emerges as a pivotal solution. Effort such as implementing ICT-based traffic control measures and facilitating real-time data exchange represent a transition towards more intelligent transportation development, offering the potential for both economic efficiency and enhanced urban welfare. Researchers emphasize the importance of adopting a holistic approach, essential for informed policymaking and the formulation of sustainable development strategies.

### ***Smart and Sustainable City Evaluation Strategies***

A study by Sharifi (2020) analyses options for assessing smart cities and presents a typology. The author concludes that assessing a smart city is a relatively young but rapidly developing area of research compared to assessing sustainability. In contrast, Huovila et al. (2019) have raised a question on the difference between diverse assessment standards with an opposite urban focus. Seven standard sets of indicators (e.g., ISO 37120, ETSI, ITU4902, ISO 37122, etc.) are relevant for assessing cities' smartness or resilience. In another study (Ahvenniemi and Huovila, 2021), the authors studied the strategies of the six largest cities in Finland for the presence of directions toward smart or sustainable development. They came to an unexpected result, according to which the goals aimed at "smart development" are not described in detail in the strategies. However, all the studies of examined cities have claimed "smart goals" for development (Ahvenniemi and Huovila, 2021). The study of Feleki et al. (2018) involved the consideration of 18 indices and seven systems for evaluating the sustainability of cities. This brought attention to 284 diverse assessment indicators and a wide range of definitions for sustainable transportation (Illahi and Mir, 2020; Porru et al., 2020). According to Dall (2020), cities' sustainability and smartness should be considered according to an objective assessment and data obtained as a part of field observations. At the same time, (Sharifi, 2020) argues that various assessment schemes can combine primary and secondary data sources. According to Caird et al. (2016), open data is the main component of the smart development of urban systems and a vital criterion in assessing city performance. In the domain of assessing sustainable and smart cities, ongoing research reflects their nascent, yet rapidly evolving nature compared to traditional sustainability assessment practices. Divergent standards and indicators complicate evaluation, with studies highlighting discrepancies between stated goals and strategies. Researchers emphasize the importance of adopting a holistic

approach, essential for informed policymaking and the formulation of sustainable development strategies.

### ***Sustainability and Smart Indicators***

According to Caird et al. (2016), open data is the main component of the smart development of urban systems and a vital criterion in assessing city performance. Studying the components of a smart transport system, Chen and Silva (2021) have suggested a complex indicator of innovation as an aspect of an urban formation's technological maturity, making it possible to see the system's future potential. In contemporary contexts, the foundation for overseeing and advancing transport infrastructure is progressively shifting towards modern technologies, as emphasized by Tokunova (2018), where the importance of analysing data and implementing creative solutions is stated (Docherty et al., 2018). According to Van Oers et al. (2020), it is only possible with clearly expressed expectations in collecting and using data presented as a central component of the smart transport system in urban agglomeration. Indicators serve a universal purpose, not only in evaluating phenomena but also as tools for comparison and monitoring of development task accomplishment, as well as improving communication. (Klopp and Petretta, 2017; Ahvenniemi et al., 2017). In a study by Nedeliaková and Stasiak–Betlejew (2019), the importance of road safety and environmental impact are emphasised. In particular, the demand to develop the city's transport infrastructure (street-road network) is highlighted as a critical accessibility element (Gulyás and Kovács, 2016; Cho et al., 2022). Additionally, in the work of Nieuwenhuijsen (2020), the importance of transport planning is stressed as a discipline that contributes to urban development to become healthier through initiatives aimed at reducing dependence on individual transport and better land planning (Litman, 2021). According to Litman (2021), a sustainable transport system must meet the criteria of accessibility, environmental friendliness, and safety while observing the socio-economic balance in achieving environmentally sustainable development goals (Longo et al., 2019).

Complex indicators are often used to comprehensively assess a city as a whole or its individual systems (Abu-Rayash and Dincer, 2021). Approaching the issue of assessing urban performance using multiple indicators, Rama et al. (2021) have argued that city sustainability can be assessed with up to 87% accuracy using only three fundamental indicators. A similar position on the number of necessary and sufficient indicators can be traced in the work of Hély and Antoni (2019). The recent discussion underscores the vital role of open data in propelling intelligent urban advancement, aiding in data analysis, and fostering the development of innovative solutions to enhance transportation infrastructure. Key components of smart transport systems include innovation metrics and transparent data collection and utilization protocols, extending beyond mere evaluation to facilitate comparison and task monitoring. Emphasis is placed on addressing road safety, environmental concerns, and accessibility in sustainable-focused transportation systems to promote healthier urban development.

### ***Governance of Smart Cities***

A study by Tomor et al. (2019) examines the relationship between smart governance and citizen-government collaboration through information and communication technology (ICT), with a focus on sustainable smart cities to achieve the UN's 2030 Sustainable Development Goals (Ullah et al., 2021). The authors identify several parameters, such as politics, trust, political environment, and socio-spatial characteristics. However, despite promises, implementation often needs to be more robust due to a focus on efficiency that undermines meaningful citizen participation (Tomor et al., 2019). According to Ruhlandt (2018), these criteria give rise to vagueness problems in smart city management systems. He emphasises the need for research and analysis of components, measurement methods, and assessment of the influence of local factors on performance indicators, highlighting an extended ontological framework and various archetypes of smart city management. Wallsten et al. (2022) discuss the evolving situation brought about by integrating digital technologies into governance concepts, focusing on the strategic role of local governments. Government officials highlight the combination of social and technical components as the main difficulty, creating difficulties in understanding and justifying modern concepts of managing smart cities (Prokop et al., 2023). Ullah et al. (2021) highlight big data, IoT technologies, artificial intelligence, and robotics as the primary tools for smart management. On the other hand, Paskaleva et al. (2017) discuss the role of data management in smart cities, emphasising an inclusive and iterative process with stakeholder participation, especially at the local level. This process addresses sustainability issues in collaboration with city officials and stakeholders (ibid.). Persistent challenges stem from an emphasis on efficiency at the expense of citizen engagement, underscoring the need for a comprehensive grasp of socio-political and technical dimensions. Incorporating digital technologies into governance underscores the strategic involvement of local governments, highlighting the necessity of integrating both social and technical facets alongside inclusive data management practices to tackle sustainability challenges effectively.

### **Methods**

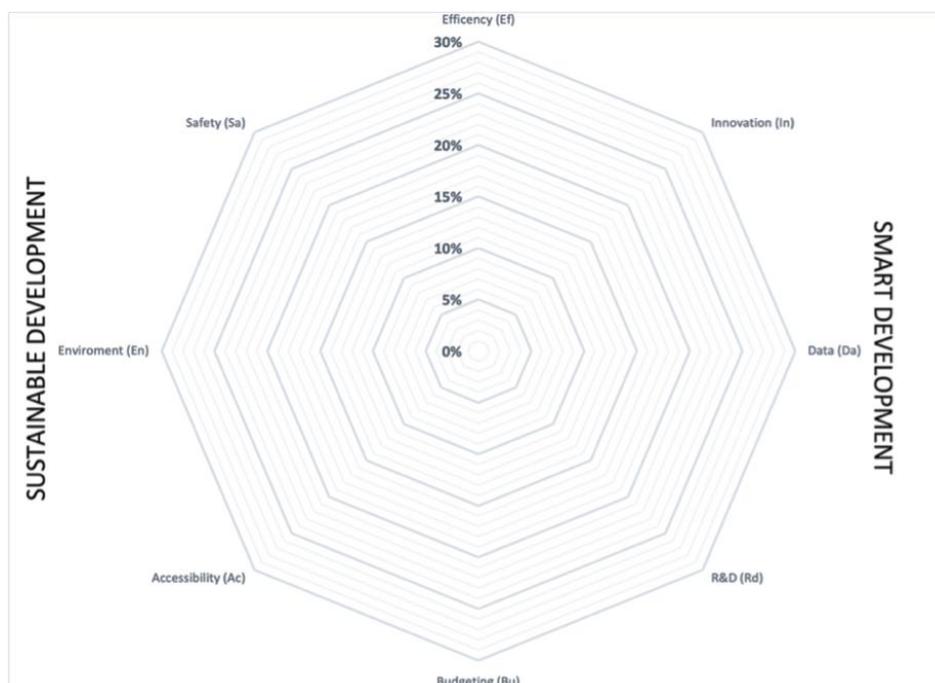
In planning the case study method of this paper, the authors considered the following points, made initially in the study by Pedrosa et al. (2012) that provided empirical criticism of the quality of case-study-based research in the field of logistics. The study proposes three main quality criteria for case study research: transferability, truth-value, and traceability. Our method diligently followed objective categorization and documentation to accommodate for

the latter two criteria. The authors consider the method fully transferable across geographical boundaries and, to a certain extent, also across governance levels (local, regional, state). Our cases of five Estonian municipalities are mainly aimed to be taken not in the context of what it means practically for the municipality development, but how the detailed situation of governance reflects the underlying concepts and furthermore to gauge the diversity of the mix of political priorities to demonstrate that the theoretical debate has significant practical implications.

This study aims to determine the development trajectories of local transportation systems in medium and small municipalities in Estonia and to treat local views in the context of the broader national transport planning perspective. Our sample consists of 5 urban formations: two medium-sized municipalities of Tartu and Pärnu, with generalized population values of 90,000 and 40,00 thousand inhabitants. These municipalities have administrative areas measuring 38 and 32 square kilometres. There are also two small municipalities of Paldiski and Viimsi, with generalized population values of 4,000 and 9,000, where the administrative area is 60 and 72 square kilometres, respectively, as well as the municipality of Viljandi with a population of about 17,000 and an administrative area of 15 square kilometres. This choice is based on a comprehensive indicator of the number of citizens, administrative area, and population density, which gives an understanding of the difference in size of the municipalities selected for the study. In this paper, the term "municipality" refers not only to the primary urban centre but also to the surrounding suburban and rural areas that fall within the same administrative territory of the municipality. Interviews were conducted with experts managing transportation development at both the local and national levels. Two experts from each municipality were interviewed to assess the local governance perspective. Additionally, two external experts underwent focused interviews to refine questions and facilitate a more thorough and objective overview. This method was employed to minimize subjectivity, enabling a more rigorous and impartial examination of the study's data and findings.

### ***Analytical concept for local transport policy evaluation***

The assessment of development directions for the presented municipalities was carried out according to the model developed for this study: a scorecard in a radial eight-dimensional diagram (see Figure 1). The key segments and indicators in the diagram are represented as vertices, categorized into two conceptual groups: sustainable and smart development.



**Fig. 1.** Radial Eight-Dimensional Assessment Model

During the initial literature review, the authors identified the vertices by examining common elements present in the formulations of sustainability and smartness within the context of transportation and mobility. As visualized in figure 1, the north and south poles characterize common indicators for both groups – budgeting and efficiency are indicating how the goals are achieved in the context of financial constraints. The west and east poles are key indicators of focal narratives with sustainability emphasizing environmental impact and smart perspective focusing on data-driven activities. The diagonals in the model are auxiliary indicators, which allow researchers a more detailed characterization of initiatives for developing the transport industry included in the sample and previously represented by municipalities.

This model allows to chart possible focal differences in each sample case. While in certain sense, becoming smarter would assist sustainability front and vice versa, the authors opted to treat it as a spectrum of possibly

alternative development paths. Indications of a policy discourse heavily favouring either sustainability or smart development in local transport and mobility suggest potential "blind spots" and missed opportunities to achieve a balanced synergy between the two aspects. The 8-way approach was built on the assumption that while there is a common ground in terms of dedicated budgeting and the need to build mobility towards higher efficiency, there are also development directions that are distinctly either more in line with the sustainability-driven approach or to-be-smart model.

### **Expert interviews and analytical evaluation approach**

A total of 12 interviews with a 22-question structure, were conducted to justify and gain an in-depth understanding of critical overlaps or disagreements between planned goals and initiatives and expectations towards sustainable or smart development. The typical interview lasted 90 minutes and the expert was a mayor, a deputy or a chief specialist in the transport field. The interviews were organized into specific subgroups, including strategic planning and future vision, innovation and ICT, environment, safety, and comfort. In a specific context, the strategic planning subgroup is based on officially adopted and published documents that delineate the strategic development plans for the transportation sector and the budgetary strategy applicable to sample municipalities.

The interview data was evaluated again using the 8-dimensional model (see Figure 1). The data obtained during the described interviews in calibrated form is presented in Table 1. Hereafter, a comparative analysis of the data was obtained in elaborating the development documents and the information obtained during the interviews. The findings and results are presented in the results section (Section 4) of this paper.

Each initiative and development goal underwent assessment based on an 8-dimensional model (see Figure 1) using a quasi-binary approach. In this approach, if an initiative mentioned in a response or statement during the interview aligns with one of the model's criteria, it is assigned a value of one (1). In cases of neutral assessment, where, for instance, the interviewee suggests a development initiative but lacks budgetary allocation, a value of zero (0) is assigned. Conversely, if there is a contradiction with the model criterion, a value of minus one (-1) is assigned. For example, a statement such as "Walking must be made safer and more comfortable by reducing the waiting time for road crossings by building additional crossings and paths and light traffic bridges", was evaluated as one (1) point in the Safety segment. For opposite example, the statement „There is little information on bus routes, departure times and connecting options and access to the information is difficult" was evaluated minus one (-1) in accessibility section. To minimize bias, the criteria were first evaluated by authors separately. Subsequently, these values are summed up for each municipality criterion, forming a value matrix.

**Table 1.** Interview Calibrated Value Matrix.

Municipality	Smartness				Sustainability			
	Efficiency (Ef)	Innovation (In)	Data (Da)	R&D (Rd)	Budgeting (Bu)	Accessibility (Ac)	Environment (En)	Safety (Sa)
Tartu	11%	13%	14%	12%	8%	21%	17%	6%
Viimsi	8%	13%	20%	18%	4%	24%	10%	2%
Viljandi	5%	12%	6%	18%	9%	25%	3%	22%
Paldiski	17%	20%	13%	11%	6%	18%	13%	2%
Pärnu	10%	10%	6%	11%	5%	26%	18%	13%
Total	12%	13%	15%	12%	7%	23%	12%	7%

<sup>1</sup> External experts

Estonia	12%	10%	6%	20%	7%	14%	14%	19%
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**Note:** <sup>1</sup> Auxiliary data, the distribution of quantified responses obtained during the focused interviews with external experts.

The interview data was evaluated again using the 8-dimensional model (see Figure 1). The data obtained during the described interviews in calibrated form is presented in Table 1. Hereafter, a comparative analysis of the data was obtained during the interviews. The findings and results are presented in the results section (Section 4) of this paper.

## **Results**

To reach deeper understanding of the issue, the authors conducted 12 interviews with representatives of 5 Estonian municipalities, whose competencies include planning, organizing, managing, and monitoring urban transport systems. During encoding interview transcriptions, the authors delineated 939 statements and arguments, followed

by the quasi-binary method for quantifying the acquired data to facilitate subsequent comparisons. (Garau et al., 2015; Held et al., 2019). Utilizing insights gained through an initial examination of municipal transport development documents, which served as a contextual component for subsequent interviews, substantial findings have been obtained. These results derive from an evaluation that distinguishes the arguments and statements outlined in sampled Estonian municipalities, aligning with the previously described indicators of radial eight-dimensional assessment model. The template (see Figure 1) allows visualizing the relations of smart and sustainable orientation in transport development for the selected Estonian municipalities.

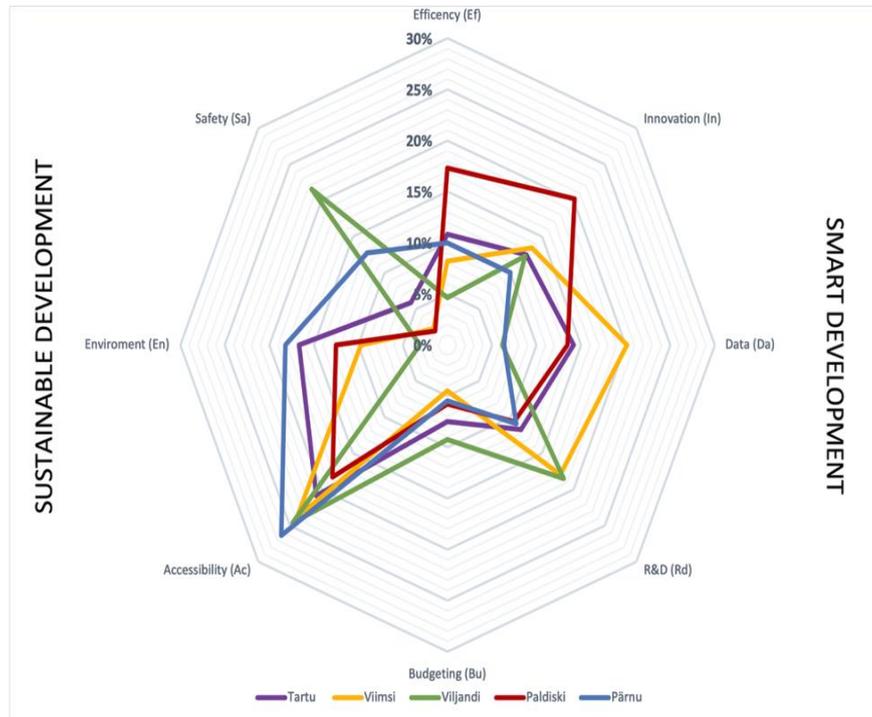


Fig. 2. Municipality markers in The Interviews Dataset

### ***Municipality of Tartu***

Based on the interviews conducted and an analysis of statements provided by representatives of the Municipality of Tartu, there is a tangible shift in its development trajectory towards a sustainable framework. After quantifying and evaluating the arguments, it becomes evident that several criteria related to sustainable development show increased indicators. The overall development trajectory of the transport sector is divided approximately 48% towards smart concepts and 52% towards sustainable concepts, indicating a focus on sustainability. For instance, the marker measuring the accessibility of transport infrastructure and overall Mobility has the highest value (21%) among all statements. In difference, environmental concerns constitute 17%, and safety of the transport system is only 6%.

The description of the interview results underscores the Municipality of Tartu's commitment to diminishing the convenience and speed of car traffic. They employ a pragmatic approach to establish sustainable urban traffic, appealing urban spaces, and an improved standard of living. The municipality aspires to achieve a balanced distribution of transport modes by 2040, considering the interests of various social groups: 26% of trips by car, 26% by bicycle, and the remaining by other modes of transport (light and active). Thus, it highlights a specific emphasis on enhancing the convenience and efficiency of public transportation by involving the creation of high-speed corridors, such as tram systems, as viable alternatives. Concerning environmental protection, there is a significant focus on acknowledging the increasing trend of motorization and the necessity for innovative solutions, such as transitioning to gas and electric vehicles and promoting public transport. The imperative prompts the urgency to reduce the harmful environmental effects of transportation's negative externalities. The municipality of Tartu also highlights citizen awareness in addressing climate change and sustainable development issues to encourage green Mobility through technological solutions.

The analysis of interviews indicates a recognized need for smart solutions in urban planning to diversify modes of transport, utilizing homogenous data for traffic management and improving systems efficiency. The municipality seeks to tackle forthcoming challenges in the domain of transportation by recognizing the significance of forming strategic partnerships with institutions of higher education and research organizations.

### ***Municipality of Viimsi***

By analysing the arguments and statements obtained during interviews with representatives of the municipality of

Viimsi, it is possible to identify the opposite distribution of criterion values in our model compared to the municipality of Tartu, demonstrating the trajectory of municipal development towards the smart concept. The share of smart development markers is 58%, while sustainable development is 42%. This municipality is characterized by a significant weight in the criteria for data (20%) and development and research (18%). In contrast, the authorities of Viimsi express scepticism towards progressive advancements in the transportation sector, particularly regarding the adoption of electric buses. They attribute this scepticism to uncertainties and a need for substantiated proof regarding such innovations' reliability, environmental impact, and economic efficiency. In interviews, it was also emphasized that the municipality prioritizes compliance with national directives over adhering to the European Union's guiding principles when shaping its transportation policy.

Within the framework of sustainable transportation development, special attention is paid to the accessibility of the transport system (24%), while environmental protection (10%) and transport safety (2%) are not sufficiently assessed. The Municipality of Viimsi is committed to sustainable development, as evidenced by the municipal authorities' willingness to collaborate with other stakeholders to align their urban planning objectives with broader environmental goals, such as reducing CO<sub>2</sub> emissions. In 2022, Viimsi switched to using gas buses, emphasising a practical approach to implementing environmentally friendly technologies. To support the high values of the transport system accessibility indicator, the municipality argues for the high efficiency of design and development of the transport system, making it accessible and reliable and providing a high level of connectivity for residents. Public transport stops are strategically located for accessibility and convenience, with all stops within a 6-minute reach.

The municipality of Viimsi also emphasises the importance of integrated land planning in shaping transport habits and aims to create work processes that reduce unnecessary travel and provide local economic advantages compared to other municipalities in Estonia. At the local level, multimodal solutions such as creating spaces for e-scooters on buses are being actively considered, thereby helping to create a more diverse and environmentally friendly transport ecosystem.

The Municipality of Viimsi takes a pragmatic point of view, paying particular attention to the system's overall efficiency; for example, technological and innovative solutions are assessed in terms of economic efficiency. If the solution turns out to be expensive, the municipality may refuse to implement it. During the interviews, the importance of data availability was repeatedly emphasised, as well as the need for real-time data to make informed decisions, emphasising the use of ICT. This municipality also declares its openness to cooperation with scientific institutions, which indicates a desire to keep pace with technological advances and research. The concept of smart development is supported by the statement of local authorities about their desire to create a unique digital control centre for the local transport system, increasing the personalisation and efficiency of services. During the conversation, respondents articulated the municipality's desire to be a pioneer in innovative transportation technologies, setting guidelines for other regions in transportation planning while promoting success through smart and affordable transportation solutions.

### ***Municipality of Viljandi***

The municipality of Viljandi prioritizes a sustainable approach to urban agglomeration development within the realm of transportation. A comprehensive assessment of local authorities' arguments and statements reveals a 44% emphasis on a smart direction and 56% on sustainability. Among the markers for sustainable transport development, the highest priority is given to transport accessibility (25%), while issues related to environmental protection and impact are less emphasized (3%). The criterion of transport security holds significant importance, constituting 22% of the total arguments and statements.

Conversely, in smart transport development indicators, representatives from the Viljandi municipality underscore the significance of research activities (18%). Notably, innovation criteria and the collection and utilization of transport data are articulated to a lesser extent, at 12% and 6%, respectively. This distribution aligns with the challenges faced by the municipal authorities. Financial constraints, particularly concerning the reconstruction of approximately 100 km of streets, underscore the municipality's focus on enhancing road transport infrastructure quality and the imperative for external funding to implement substantial improvements, ultimately enhancing citizens' quality of life.

In the context of a sustainable transport development concept, contradictory statements have emerged, suggesting that, among local authorities, public transport is not universally regarded as a robust alternative to private cars. Simultaneously, Viljandi is acknowledged as a city with a significant elderly population, prompting active efforts by the municipality to address challenges related to urban space and infrastructure design catering to the needs of its ageing residents. However, transport planning issues arise due to the need for solutions and funding at the state level.

The municipality addresses transport security concerns through ongoing government-funded infrastructure projects. Regarding the criteria for smart transport development, the local authorities stress the need for continuous traffic monitoring and data availability. Digital solutions are particularly highlighted to aid older people in navigating urban spaces. From an innovative transport development and research perspective, local authorities' express limitations

tied to insufficient competencies, leading to the acquisition of expert knowledge on a project basis. According to them, while data is optional for daily activities, occasional traffic studies are conducted through tender procurement. The uncertainties are often attributed to dependence on external financing, impacting the ability to implement strategic plans and innovative developments.

### ***Municipality of Paldiski***

An evaluation of the Paldiski municipal authorities' arguments, initiatives, and statements obtained through interviews reveals the urban formation's inclination towards a smart development concept. Based on our model's criteria, 56% of the submissions align with smart transport system development markers, while 44% correspond to sustainable indicators. This alignment shares similarities with Viimsi Municipality's approaches, yet fundamental differences exist in the distribution of values among smart and sustainable concept values. Notably, innovation initiatives take precedence within the smart concept indicators, constituting 20% of the total arguments. Meanwhile, the significance of transport data and the research and development indicators accounts for 13% and 11% of the overall statements presented in interviews, respectively. Conversely, the sustainable concept indicators primarily manifest in criteria related to the accessibility of transport infrastructure and the overall transport system, comprising 18% of the total arguments. Furthermore, environmental protection holds 13% importance, while considerations of transport safety are reflected in only 2% of cases.

Interview data indicates that the municipality's smart orientation is underpinned by focusing on leveraging information and communication technologies (ICT) in the transport sector, utilizing applications for real-time route adjustments. The significance of clear communication and comprehensible messaging, particularly for older individuals, is underscored. The Paldiski municipal government is willing to implement pilot projects such as eco-friendly taxis, shared Mobility, and innovative transport solutions, emphasizing collaboration over competition. Additionally, Paldiski underscores academia's role in fostering innovative thinking for future generations and emphasizes partnerships with Mobility as a Service (MAAS) company. Interview results highlight the critical role of data in decision-making, advocating for transparency and diversity in collecting and utilizing traffic data. The municipality's objectives encompass supporting efficient transport infrastructure, connecting remote rural areas, and fostering inclusion for individuals with special needs. Urban designers are recognized for their pivotal role in creating accessible spaces.

In the domain of sustainable development, there is a recognition of the need to acknowledge the adverse environmental impacts and cost-effectiveness associated with circular public transport routes. The pace of change is gradual, encountering resistance, particularly among conservative older officials. The municipality is committed to fundamental changes in the transport system approach, emphasizing a local focus. Achieving a balance between political will and practical opportunities is deemed crucial, with particular attention given to initiatives at the local community level. Paldiski aspires to attain the status of Estonia's first environmentally sustainable municipality, emphasizing a commitment to smart and sustainable Mobility.

### ***Municipality of Pärnu***

The interviews conducted with representatives from the municipality of Pärnu reveal a distinct shift in focus compared to other analysed municipalities, emphasising arguments and statements related to sustainable development. The overall distribution shows a preference of 35% towards a smart concept and 65% towards a sustainable concept for developing the transport industry. Pärnu officials highlight accessibility as the primary criterion in the sustainable development concept, constituting 26% of total references. Notably, there is heightened attention to environmental protection, including transport safety criteria, with a 13% share, which remains significant. Conversely, there is limited support for smart development markers, with only 10% mentioning innovation and 6% expressing the importance of collecting and processing transport data. Transportation research and development are discussed in 11% of arguments and statements, indicating a relatively lower interest in smart development aspects within the context of the discussed concept.

In favour of a sustainable development trajectory, Pärnu officials have announced plans for an integrated public transport system, unifying various modes of transport to optimise resource allocation. The municipality adopts a pragmatic approach to environmental initiatives, transitioning buses to EURO 6 standards and exploring hydrogen technologies. Emphasis is placed on actively implementing environmental sustainability principles across various fields, setting a good example through the practice of high standards. Regarding transport accessibility, Pärnu highlights initiatives focused on calming traffic to enhance safety, including developing light transport infrastructure and low-floor buses, and reorganising the public transport network. The municipality actively encourages the adoption of electric vehicles by providing incentives like complimentary parking and charging stations. This effort aligns with the municipality's commitment to sustainable mobility, aiming to improve its citizens' overall quality of life.

Pärnu proposes initiatives like smart crossings for road safety improvement within the smart development context. Municipality representatives stress the need for efficient data collection and communication for knowledgeable decision-making, recognising the challenges of implementing information and communication technologies (ICT)

for efficient traffic management. The importance of proper data formatting and visualisation is also emphasised. Regarding cooperation with researchers (research and development marker), Pärnu representatives determined the significance of analysing international trends and highlighted international best practices to enhance the local transport system.

## **Discussion**

In modern times, most municipalities have some form of a prescribed strategic character. In local context, this necessity for Estonian municipalities is fixed at the level of law. This proposition has a complex structure due to its multidisciplinary nature. The addressed assumption is articulated both by the scientific community and by the experts involved in creating development plans based on different and often opposing points of view (Elgazzar and El-Gazzar, 2017; D'Auria et al., 2018; Lyons, 2018). Taking modern city development under a closer look, the findings draw attention to the transport sector as an essential part of the urban ecosystem.

### ***Relationship between smart and sustainable development***

Despite Estonia's limited geographical boundaries, the municipalities examined in this paper's demonstrate a variety of transport development trajectories. Local decisions often reflect the necessity for a cohesive national strategy. However, the varied goals set by each municipality present challenges in achieving uniform strategic directions nationwide. To foster a more sustainable and cohesive transportation sector in Estonia, proactive measures are required, including formulating national strategies tailored to the unique characteristics of each municipality. Based on the premises of our main research question (RQ 1), an integrated approach to transport sector development prevails at the strategic level in small and medium-sized municipalities in Estonia. In some urban agglomerations, such as Tartu, smart concepts interact with sustainability to strategically create a fair distribution between markers. However, in other municipalities, for example, in Viimsi, the emphasis is on innovation and smart technologies, while in Pärnu, the main focus is on transport accessibility and safety. Our findings suggest that urban formations prioritize innovation and transportation system development based on local regulations, sometimes deviating from European standards. This divergence may pose challenges in ensuring consistency and compatibility across different systems within the country. The relationship between the indicators of smart and sustainable concepts for developing the transport sector in small and medium-sized municipalities varies. In Viljandi, there is a proactive promotion of sustainable development, particularly in the domain of transport safety and the adoption of electric vehicles. This stands out distinctly in contrast to the smart concept. Other municipalities, such as Tartu and Viimsi, strive to harmonise both concepts. Most often, this distribution is driven by issues of financing and the effectiveness of smart solutions, where the distribution of financial resources between municipalities should be reconsidered to create more equal opportunities for all urban formations, promoting sustainable development and innovation in the transport sector. Promoting a common approach to balancing smart technologies and sustainable development strategies is necessary, encouraging interaction between municipalities and supporting the exchange of experience and knowledge. A concerted effort to balance smart technologies and sustainable development strategies is imperative. Thus, fostering interaction between municipalities and facilitating the exchange of experiences and knowledge is necessary. Moreover, integrating cutting-edge technology with interdisciplinary cooperation is vital for realizing the 'smart and sustainable' urban development paradigm, ensuring that technological advancements are harmonized with social dimensions. Discernible division and uncertainty in allocating developmental trajectories in a smart and sustainable transportation development context primarily stem from the diverse advantages associated with each approach. Interview respondents emphasise the economic aspect as a pivotal determinant in selecting a particular approach. Nevertheless, over the long term, smart initiatives may prove to be more economically burdensome, prompting a quest for alternative strategies in the organisation and management of the transportation sector. The presence of competent human resources is identified as a barrier to the practical realisation of such alternatives. Prioritizing sustainable solutions in sectoral development typically involves initiatives to enhance infrastructure, boost capacity, and optimize travel efficiency for users. Often, there needs to be more consideration for innovative trends and methodologies in collecting and analysing relevant transportation data.

### ***Local status quo***

In addressing our supplementary research question (RQ 1.1), the local status quo significantly influences the interaction between smart and sustainable development markers in observed municipalities. This influence stems from considering each urban area's unique needs and characteristics but often needs more attention to national factors. This is a common trend in most municipalities, where support for local initiatives can run the risk of inadequate attention to national aspects. Factors that determine this phenomenon include personal beliefs, competencies, and the level of knowledge of participants in the management process. According to the authors of this article, the current situation is reflected in the subjective assessment of the existing level of development of transportation systems by agents involved in the management process. This includes prioritization in local strategic planning and the adaptation and implementation of tools to achieve these objectives. The political context also strongly influences decisions. Considering that the influence of the contextual factor and its role in the decision-

making process in the management and development of urban agglomerations has currently limited exploration (Ruhlandt, 2018), this opens broad prospects for further research. Based on the respondents' position in the conducted interviews, as part of this study, the authors assume that the conceptual directions for developing urban transport systems, considering sustainable orientation, are perceived conservatively. Mechanisms that facilitate the exchange of best practices between municipalities must be promoted and supported to balance smart thinking and sustainable development strategies in the transport system.

### ***Smart and sustainable balance***

The proportion in the distribution and interaction of smart and sustainable city indicators in Estonia (RQ 1.2) might exemplify a strategic development balance within the small and medium-sized urban agglomerations. However, this question has yet to have a definitive answer within the confines of this study, sparking a debate about the most effective methods to balance innovative smart technologies and sustainable transportation development strategies. Simultaneously, it underscores the significance of acknowledging diverse approaches, the considerable autonomy in decision-making across municipalities, and the imperative to consider local and national interests. A critical aspect involves preparing local strategies aligning with national sustainable development objectives. The narrative emphasizes that successful development in Estonian municipalities necessitates enhanced coordination and the formulation of national strategy, prompting a closer examination of the balance between local and national interests. Beyond strategic considerations, disparities in funding among municipalities become noteworthy, introducing tension, and underscoring the need for a more equitable resource allocation. Financial aspects must be factored into the development approach to ensure a more equitable distribution of resources. This issue also underscores the necessity for more rigorous empirical data to derive concrete conclusions. In parallel, it is crucial to emphasize the enduring significance of sustainability, particularly in the transportation sector, where the integration of smart urban mobility solutions is pivotal for sustainable urban development. A more in-depth exploration of management principles and organizational efficiency indicators in small and medium-sized municipalities will enhance our understanding of the differences highlighted in the article. These differences are exemplified through antitheses in various cases, such as projects and initiatives implemented in the examined municipalities. The authors aim to examine both positive and negative principles guiding the transition to "smart and sustainable" and "sustainably smart" development in the urban transportation sector (Anastasiadou and Vougias, 2019). As further research, the authors propose focusing efforts on quantitative analysis of municipality development by investigating local financial reports and its possibly correlating patterns to political dynamics in these municipalities. It would also appear intriguing to examine the possible influence of political ideologies on mobility-related resource allocation of municipalities, considering both their sustainability and smart-themed characteristics. This could involve an assessment of entrepreneurial opportunities for small and medium-sized enterprises within the context of municipal transportation development trajectories.

### ***Limitations***

Within the limitations of the authors' study, focusing on urban development approaches and their subsystems, it is pertinent to acknowledge that the discussed dataset could be enhanced by considering a comprehensive temporal scope. This would allow for observing dynamic fluctuations in the equilibrium between innovative "smart" initiatives and sustainable strategies. Furthermore, the absence of an international context for direct comparison with our findings is underscored, as directly analogous research endeavours were not identified. Moreover, there is a pressing need to explore the interconnections between economic metrics and political ideologies, given their potential to illustrate goal setting and prioritization within municipal development and comprehensive understanding of socio-political and technical dimensions in transportation planning and governance.

### ***Conclusion***

The main findings and conclusions of this study are as follows. The authors' research has shed light on several pivotal aspects concerning the advancement of the transportation sector within Estonian municipalities. Despite the prevailing emphasis in the academic literature on digitalization and the integration of smart technologies across diverse sectors, pinpointing the exact trajectory of transportation sector development solely as smart-centric poses a considerable challenge. It is imperative, therefore, to consider broader digitalization initiatives in Estonia alongside the hurdles associated with implementing smart technologies within the transportation domain. The authors' study uncovered diverse approaches to transportation sector development in small and medium-sized municipalities in Estonia. This underscores the necessity for an in-depth analysis of governance frameworks and decision-making mechanisms at the local level, as well as the factors influencing priorities and the execution of projects in the transportation sphere. Furthermore, the authors identified that the local context influences the differences in the connection between smart and sustainable transport markers. This context is shaped by factors such as the competency of officials, their levels of knowledge and skills, and their beliefs in the management processes of transportation sectors. Notably, the authors emphasized the impact of electoral attractiveness and the uneven distribution of financial resources on these dynamics. The third observation is that the ratio between the smart and sustainable development indicators presented in our model can serve as a basis for determining the

balance between the transport development concepts discussed. However, this assumption requires a more in-depth study of the effectiveness of different methods of approaching the distribution of trajectories of smart and sustainable transport development in Estonian municipalities to develop balanced approaches that consider local needs and national strategy. The principles and methods of future research are discussed in the discussion section, as well as the limitations of the present study outlined in this section in the corresponding subsection. The authors' findings have significant implications for policymakers, urban planners, and stakeholders, providing valuable insights to develop more effective strategies for advancing the transportation sector. These strategies must consider local nuances and align with national objectives, potentially leading to the establishment of sustainable and smart transportation infrastructure in Estonia and similar contexts. The authors of this article declare no conflict of interest.

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