SMART CITY LOGISTICS FOR SUSTAINABILITY: A CASE STUDY OF SUSTAINABLE CITY LOGISTICS IN HELSINKI

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ABSTRACT

Purpose: There is an increased need for more sustainable city logistics solutions. Challenges like global warming has made city actors increasingly aware of their role in finding sustainable city logistics solutions. The goal of this study is to explore the development of sustainable city logistics solutions from a city-internal perspective, utilizing technological frames as a lens.
Approach: A single case study methodology, investigating various actors in the city of Helsinki, was taken. Interviews and secondary data were used, and respondents included city department officials responsible for traffic, environment, and business development as well as regional development companies and programs running last mile and urban development pilots.
Findings: Based on the reports and interviews, we observed that in general, Helsinki city has a clear innovation and technology emphasis pertaining to sustainable city logistics. However, at the same time a fragmentation of efforts and a lack of cohesion is present observed in the discrepancy between the importance of the overall goal of carbon neutrality and anchoring sustainable city logistics solutions to it through actions. The heightened emphasis on innovation to reach city logistics sustainability may result in a more passive role for the city.
Practical implications: This research offers novel insights for policy guidelines for cities and company managers engaged with city logistics. The study can help in guiding development of sustainable city logistics solutions.
Originality/value: The research contributes to a better understanding of the role and influence of the internal city actors on sustainable city logistics development. The technological frame perspective provides a better understanding of how internal city actors, and their activities are aligned and how potential incongruence in goals is manifested.

Keywords: City logistics, sustainability, innovation, actors, technological frames

Introduction

City logistics research delves into a multifaceted realm, where the complex interplay between resident well-being, logistics and transport systems, and the intricate web of administrative decision-making and policy frameworks governing urban sustainability and livability has gained significance (Cardenas et al., 2017). Reducing and managing city traffic and freight in cities is of heightened importance due to climate change (Paddeu et al., 2018). As an example, one fifth of carbon emissions in Helsinki come from traffic, and the City of Helsinki has an ambitious target of being climate neutral by 2030 (City of Helsinki, 2021). Yet, the complexity of the city logistics system makes sustainability development challenging for cities and other local authorities, and comprehensive approaches are needed to address sustainability concerns (Bjørgen et al., 2021). Cities need to cater and balance both resident, business, and other stakeholder needs. This balance becomes more complicated when new technologies like drones, curb side robots, and various electric vehicles become more common on city streets.

In the complex city logistics context, it is crucial to understand how the dual effort of both sustainability and innovation is executed to foster sustainable city logistics solutions. This study explores the sustainable city logistics actions and goals of city actors utilizing a lens of technological frames. Technological frames describe the underlying assumptions, expectations and knowledge people have about technology (Orlikowski & Gash, 1994), and they are dynamic and context dependent (Lin & Silva, 2005). Understanding the frames is important since differences in the frames held by cooperating actors have been found to

significantly affect the progress and outcomes in many contexts. We argue that the lens of technological frames is particularly relevant in this context because city logistics activities involve a complex network of actors with varying objectives. The technological and innovative actions that these objectives are centered around is under development, meaning it is a both flexible, adaptable and malleable stage. sustainability development in city logistics is likely characterized by multiple interpretations, which may conflict with each other. The purpose of this study is to examine how the goal (in)congruence of various city actors influences the efforts to develop innovative and sustainable city logistics. The study answers the following research questions:

- How is sustainability framed in the city logistics goals of various actors?
- How are goals and (in)congruence of these goals manifested in actions towards sustainable city logistics?

We investigate a single case. We investigate the City of Helsinki and its internal actors. The joint goal of the city actors is illustrated by the sustainability strategy of the city of Helsinki (City of Helsinki, 2018) and specifically the target of carbon neutrality by 2030 (City of Helsinki, 2021).

Literature Review

The city logistics landscape is becoming increasingly complex (Boysen et al., 2021). Complexity is added by the many heterogenous stakeholders involved (Mangano & Zenezini, 2019), including residents, shippers, receivers, logistics service providers (LSPs), and local authorities (Kiba-Janiak, 2016). All these actors have varying expectations and goals (Lindholm & Browne, 2013), that can be hard to find unified views on (Gammelgaard, 2015). The biggest group of city logistics research focuses on commercial and customer perspectives (Kiba-Janiak et al., 2021), so there is need for a variety of perspectives. Previous research has provided understanding of stakeholders in city logistics including, for example on city logistics project implementation involving stakeholders from an organizational change perspective (Gammelgaard, 2015), actor roles and public–private interactions in networks (Lindkvist et al., 2022), and stakeholder reactions to urban freight policy innovation (Stathopoulos et al., 2012).

The role of cities and other local authorities in developing sustainable city logistics solutions is crucial, as they carry the role of improving the quality of life for the inhabitants (Kiba-Janiak, 2016; Kiba-Janiak et al., 2021). Still many local authorities struggle with designing incentives and regulation that would support sustainable city logistics (Fontaine et al., 2023), and there is a need to better include city logistics in urban planning and development (Kiba-Janiak et al., 2021). A more strategic approach as well as specific measures are needed in city logistics to support high-level goals such as emission reduction (Akgün et al., 2019). City logistics policy can take the form of regulatory measures such as vehicle size and weight restrictions, market-based solutions such as congestions charges, land use and planning measures such as parking spaces, or infrastructure developments including space for urban consolidation centres (Cardenas et al., 2017). Yet, many studies have focused on the city as one homogenous actor amongst other stakeholders. Within the context of sustainable city logistics innovation assumes a pivotal role, serving as a driving force for achieving sustainability in logistics (Roscoe et al., 2016). It is imperative for policymakers and regulators to promote both digitalization and innovation, thus nurturing the growth of sustainable solutions (Ardito, 2023). Government policies and investments can play a key role in initiating sustainable business models and often a local authority can be the customer of innovative services (Guo et al., 2022). In this context, it is crucial to understand how municipalities work with the combined effort of innovation and sustainability to reach sustainable city logistics. Before a city can function as an entity, its internal processes need to align. Alignment of goals, activities and other measures has been pinpointed as crucial for city logistics efforts (Akgün et al., 2019; Fontaine et al., 2023; Gammelgaard, 2015; Kiba-Janiak et al., 2021). Previous research, such as Akgün et al. (2019), has looked at factors influencing local authorities' policy making, focusing on aspects such as policy context and resource availability.

Using the perspectives of technological framing could increase the understanding of the underlaying interpretations that impact decision-making processes. For example, difficulty in the use or implementation of a technology can arise when different people in an organization have different technological frames i.e., differing cognitive structures to deal with technology (Orlikowski & Gash, 1994). Different actors also rely on their technological frames when coping with complexity and uncertainty (Spieth et al., 2021), and the nature of these frame differences is called congruence (Orlikowski & Gash, 1994). Technological frames have, for example, been used to; investigate how stakeholders' perceptions and beliefs are influenced by social and political processes (Lin & Silva, 2005), look at the relationship between techno-ethical orientation and ethical decision-making in supply chains (Verma et al., 2022), understand how managers use their individual technological frames for sensemaking during technology foresight activities (Klos & Spieth, 2021), and to understand generative mechanisms of the adoption of logistics innovation (Tanskanen et al., 2015). The context of technology use is important, as technological frames are dynamic and change over time, and adoption of new technologies is both a social and political process here all stakeholders frame and reframe their perceptions of technology (Lin & Silva, 2005)

Methodology

A case study approach, that investigates various at the actors inside the City of Helsinki (Finland) was taken, to give deep insight in the phenomenon studied (Yin, 2018). The unit of analysis is the organizational units within the City of Helsinki and their respective goals and actions towards furthering innovative and sustainable city logistics. The City of Helsinki provides a good case as the city has communicated specific city logistics and sustainability targets, has good data availability in policy documents and other reports, access to experts, as well as the complex environment of a capital city with more than 600 000 inhabitants. Interviews and secondary data, such as policy documents and reports, are used. Respondents include city department officials responsible for traffic, environment, and business development as well as regional development companies and programs running last mile and urban development pilots. Respondents were purposefully sampled (Patton, 2002) aided by a snowballing technique (Noy, 2008). Due to the intricacy of city organization, the researchers approached selected city departments, but discussed with them to select appropriate respondents with knowledge on the topic at hand. Respondents also suggested new respondents within their or other organizations. Respondents are presented in table 1. When the interviews were completed, manual pre-coding was used to get an overview of the data, and later structural coding was applied (Saldaña, 2009).

Code	Actor	Respondent	Roles and Organization
Core01	Mobility Lab (part of testbed Helsinki): an administratively a cooperation between Business Helsinki and Forum Virium, also strongly supported by the Urban Environment Division	CR1	Project Manager at Business Helsinki, Testbed Helsinki
		CR2	Project Manager at Forum Virium Smart Mobility Division
Core02	Urban Environment Division	CR3	Traffic Engineer
Core03	Forum Virium, Helsinki City Development Company	CR4	Project Manager at City Logistics Project division t Forum Virium
Core04	Business Helsinki	CR5	Leading Specialist, Business Helsinki Innovation Services
		CR6	Business Helsinki, Ecosystem Services
Supp01	Helsinki City Climate Unit	SR1	Project Director, Climate unit

Supp02	Urban Tech Incubator for clean and sustainable urban technology	SR2	Program Manager

Table 1: Actors and Respondents

To triangulate interview findings, secondary data was analyzed and compared to increase validity (Voss et al., 2002). The researchers selected the City of Helsinki reports and other secondary data in accordance with relevance for the research topic and with the aid of the respondents who suggested further readings. In total 23 reports and secondary data documents were reviewed to complement the primary data.

Result: Smart and Green City Logistics

Our data indicates that respondents have an affinity to look at new technology as something positive and as a driver for city logistics development. However, there is a discrepancy between the goals related to innovation and sustainability and the balance between sustainability and innovation that indicates incongruence in how goals are manifested. For example, last mile was specifically mentioned as a challenge in the Action Plan for City Logistics, but aside from this report, the last mile and most commercial logistics was missing from planning and reporting, and no specific actions were mentioned. On the other hand, the action plan for city logistics did have few and vague sustainability measures. This creates a gap between actions planned for city logistics and the reported action plans for carbon neutrality. The actors within the city of Helsinki would need to interact and collaborate to meet the overall carbon neutrality goal, but also to support sustainability development of city logistics.

We were able to identify a core group of actors (see table 1) including the Mobility Lab, the Urban Environment Division, Forum Virium (Helsinki City Development Company) and Business Helsinki as well as the supporting actors Helsinki City Climate Unit and the Urban Tech Incubator. These actors were identified in discussions with the City of Helsinki as core players in taking actions towards innovative and sustainable city logistics. The sustainability aspects of city logistics span several departments and organizations across the city of Helsinki. None of the individuals interviewed had full knowledge of the topic, i.e., the full spectrum of city logistics, innovation, and sustainability, but the combination of respondents provided a full picture. We observed that actions were spread out through actors and reports. All respondents whished for more sustainable city logistics development, but sustainable city logistics development did not really reside on anyone's desk, creating fragmentation and a focus on only some parts of the city logistics system though limited measures. To understand how the sustainable city logistics goal is manifested in practice, we looked at sustainable city logistics actions taken by the actors (table 2). Based on the reports and interviews, we observed that in general, the City of Helsinki has a clear innovation and technology emphasis pertaining to sustainable city logistics. However, at the same time we observed a fragmentation of efforts and a lack of cohesion, as presented next.

The efforts towards sustainable city logistics in Helsinki have been primarily led by the Mobility Lab ('Core01'). This actor leads a collaborative initiative with Core02, Core03, and Core04 operationalizing testing and piloting activities. Their primary focus is testing and developing smart and digital mobility solutions that enhance sustainability. This effort involves private sector actors, and the city is a "testbed" for their solutions. The importance of utilizing big projects that don't limit the activities of private sector actors, but leave space for their innovation, was highlighted. It was seen as a tool to achieve the overreaching goal of climate neutrality by 2030 (respondent SR1). Respondent SR1 emphasized that cities can be forerunners and have a lot of impact on emissions and climate neutrality. However, other respondents (e.g., CR1, CR2, CR5) hold different views. They highlighted a market-driven approach to sustainability, where companies align with the broader "sustainability trend" due to their own volition. This perspective reduces the city's role as a driver of sustainable solutions. One respondent (CR3) mentioned parking policies and other policy instruments outlined in literature (Cardenas et al., 2017), but at the same time they did not see the city having a big influence on sustainability.

"Aside from the city's own transportation I don't think the city has much influence over what or how anyone transports anything […] of course the city can put in environmental zones or similar restrictions and maybe help with the location of distribution hubs." (CR3)

The respondents emphasized that the private sector, such as actions by logistics service providers, enable e.g., sustainable innovation in when executed in city-initiated projects. The purpose of leaving innovation to the companies was to not interfere with their interests but let them come up with the most suitable innovative solutions themselves (mentioned by SR1, CR3, CR1). The influence of the political city actors on supporting the goals was also evident in the data, for example in statements like "we could not do this [sustainability work] without political support" (SR1). The need for political support was also mentioned by CR6 who discussed the interplay with the democratically elected city council and its sub-committees, mentioning the Economic Development Sub-committee that approves the reports and activities of the Helsinki innovation fund that is providing resources for, for example, the activities of Core01 (mobility lab) and Supp02 (incubation program focusing on innovative and sustainable urban technologies).

However, all respondents agreed that actions need to be focused on a clear goal, be that more sustainability or innovation, but letting private sector players choose the specific actions. For example, if the goal was low-carbon transport, then companies should choose if cargo bikes, electric vans or other vehicles best suit this goal. In this context, SR3 mentioned that the risk in these scenarios is that the city doesn't get the solutions needed or the most suitable innovations, as the city goals might not align with commercial interests. Another challenge associated with the actions was the project nature of funding and the "personification of projects" (CR4) that hinders long-term development after pilots are concluded. Also, SR1 mentioned they were "allergic to pilots" specifically because these types of activities are hard to scale up. This creates a challenge as, from a sustainability viewpoint the built environment, construction and circular economy all came prioritized before logistics and transport, leaving sustainable city logistics development dependent on actions like small-scale pilots. CR6 also said "on the innovation side we must make priorities. You can't do it all even if there is demand", implying logistics is not a specific innovation priority.

City Goal	Selected Actor Goals	Example measures and activities	Actor(s)
Carbon Neutrality 2030	Smart, sustainable, and innovative urban technology solutions for city logistics	• Testing and developing smart and digital mobility solutions that promote sustainability. • Mandate to execute and operationalize pilots. • Bringing solutions to real urban environments to be tested and getting input from residents. • Incubate promising urban tech startups. • Innovation funding (EU and other) • Wide variety of company services • Promoting cooperation and ecosystem building	Mobility Lab (Core01), Forum Virium (Core03), Business Helsinki (Core04), Urban tech Incubator (Supp02)
	Develop sustainable traffic and transport solutions	• Promote electrification (vehicles) • Implementing new service concepts (e.g., in mobility) • Land use and city planning • Procurement guidelines • Policy and regulation (e.g., parking, low-emission zones) • Reducing emissions from heavy traffic with equipment choices and environmental criteria	Urban Environment Division (Core02), Climate Unit (Supp01), Business Helsinki (Core04)
	Attract innovative and	• Execution of large-scale projects • Helsinki Innovation funding	Forum Virium (Core03),

	sustainable (“smart and clean”) companies to Helsinki	• Distributing EU funds and city innovation funds • Focus on goal and give space for e.g., companies to innovate or execute towards goals, not limiting their specific activities.	Business Helsinki (Core04), Climate Unit (Supp01)

Table 2: Actor goals aligning with sustainable city logistics and the city strategic carbon neutrality goal

We observed that in developing city logistics the focus is more on innovation and technology, than it is on sustainability. In this sense city logistics activities are not fully aligned with the overreaching sustainability goals in the City of Helsinki strategy. For example, in terms of resources, the Core01 actor (the Mobility Lab) is fully funded by the Helsinki innovation fund and projects are primarily technology oriented. However, implicitly, many piloted solutions have sustainability elements like the Shared Micro depots for Urban pickups and Delivery, that focused on enabling deliveries with cargo bikes, that in turn represent low-emission vehicles. Looking at reports and documentation beyond the Carbon neutrality 2030 actions, the city strategy and UN SDG documentation (City of Helsinki, 2023) has a much wider view on sustainability including social aspects and other environmental aspects like biodiversity, but also here innovation is mentioned as a “key way” (City of Helsinki, 2023, p. 18) of supporting sustainable development. (Fontaine et al., 2023) has noted that sustainability and profit goals might be conflicting, but in Helsinki, it seems the city is trying to solve this challenge by being innovation and market-solutions oriented in its sustainability work, exemplified by the selected actor goals and activities in table 2.

Discussion and Conclusions

This study contributes to city logistics and sustainability research by utilizing technological frames to gain a deeper understanding of how innovation plays into the development of sustainable development and how the roles and actions of cities interplay with innovation in a city logistics context. Our study investigated how the technological framing (in)congruence impacts the efforts towards sustainability development in city logistics. Previous research has established the significant role that cities play in the development of sustainable city logistics. However, this case study highlights a potential shift in the city’s role as an enabler of innovation and technology efforts. As Gammelgaard (2015) has previously noted it can be hard to find unified views on common goals in city logistics. In Helsinki the view on the joint goal (caron neutrality) seems clear, but the execution of the actions is fragmented into small projects. Importantly, the heightened emphasis on innovation to reach city logistics sustainability may result in a more passive role for the city itself. Rather than actively driving the development of sustainable solutions, the city is increasingly viewed as a platform for private sector entities to develop and implement their own innovative approaches. This is likely to affect the goals and alignment of the internal city actors that create this platform, as there is a discrepancy between the importance of the overall goal of carbon neutrality and anchoring sustainable city logistics solutions to it through actions. In the goals presented in table 2, it is clearly visible that technology and innovation is highly integrated in sustainability goal setting. Sustainability development is tied to a belief and framing that sustainability is achieved through technological development. Emerging from the data came the framing of technology resembling Ecological Modernization Theory (EMT) (Spaargaren & Mol, 1992). Respondents and secondary data alike seemed to believe in the notion that the private sector must transform and become ecologically modernized to support sustainable development (Huber, 2000). Here the City of Helsinki strategy coincides with EMT in that continued technological innovation is a solution to environmental sustainability issues (Fisher & Freudenburg, 2001) as environmental problems can be best addressed by further advancements in technology (Spaargaren & Mol, 1992).

Looking at only one city provided a possibility to delve into these intricacies, even if the focus is also a limitation of the study, as is the Nordic context. A factor limiting this research is the lack of data on the private sector and political actors. This shortcoming needs to be addressed by further research. Future work could also look closer into interdependencies as well as risks involved with goalsetting in sustainable city logistics development. The prominent role of innovation also provides ample ground for further inquiries,

such as using Ecological modernization theory (EMT), where the institutional reform needed to substantially reduce damage to the environment is the base (Spaargaren & Mol, 1992).

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