SCALING UP SMART CITY LOGISTICS PROJECTS: The Case of the SMOOTh project

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ABSTRACT

A large number of smart city logistics projects fail to scale up, remaining a local experimental exercise. Lack of scalability is, in fact, commonly recognized as a major problem. This study aims to determine the key success factors related to the scalability of smart city logistics projects. Scale up, which is articulated as expansion, roll-out, and replication, is defined as the ability of a system to improve its scale by aiming to meet increasing volume demand. Specifically, this study investigates scalability intended as expansion and roll-out.

A qualitative case study was conducted to fulfill the research purpose. The chosen case study is SMOOTh, a pilot project currently underway in the city of Gothenburg, Sweden, involving a diverse group of actors including Volvo Group and DHL. Semi-structured interviews were conducted with seven of the project's stakeholders. Through a thematic analysis, four categories and the respective success factors were identified. These are represented by business model, technical, stakeholders and regulatory factors. The paper concludes with observations and recommendations aimed at the pilot initiatives, adding new perspectives to the upscaling debate.

Keywords: Smart Logistics, Smart City Project, Pilot Project, Scale Up, Key Factors.

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ABBREVIATIONS

CSR	Corporate Social Responsibility
ICT	Information and Communications Technology
ITS	Intelligent Transport System
KSFs	Key Success Factors
LSP	Logistic Service Provider
MAS	Multi-agent systems
MaaS	Mobility-as-a-Service
PPPs	Public-Private Partnerships
SoS	System of System
UCC	Urban Consolidation Center

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1. INTRODUCTION

This chapter introduces the research field chosen for this study, corresponding to the upscaling of smart city logistics projects. The background and problem statement are discussed to introduce the research question. Finally, a presentation of the thesis layout and delimitations of the study is outlined.

1.1 Background

Societies and cities are facing a growing number of challenges, including climate change, the rise of pollution levels, and urbanization (Thompson and Taniguchi, 2001). These challenges impact and push cities to move towards an environmentally sustainable path. Much of this pressure is exercised on logistics transportation, which can be held partly responsible for traffic congestion, noise problems and poor urban environments.

Cities are consequently required to respond to these needs by introducing urban logistics initiatives aimed at implementing sustainable strategies for the urban environment (Taniguchi, 2015). These initiatives very often take the form of smart city projects that begins as pilots and then scale up (Winden and Buuse, 2017). Scalability, which is articulated in expansion, roll-out and replication, refers to the ability of a system to improve its scale aiming at meeting growing volumes demand (Winden, 2016; Philippe and Hansman, 2008). Smart city projects, on the other side, take advantages of ICT based on multi-stakeholder collaborations, designed to explore new logistic solutions in an experimental setting (Eskelinen et al. 2015; Winden, 2016). Innovative transport modes, indeed, take advantage of high degree of collective approach which makes possible to achieve high fill rate and reduced vehicle movements (Malmek et al., 2019). These projects are supported by the municipality and funded by subsidies (Winden and Buuse, 2017). The sources of funding include the Europe Horizon's 2020 program, which provides € 18.5 billion in subsidies for green transport and clean energy, as well as from the European Regional Development Fund (E.R.D.F), which promotes sustainable urban development by offering a minimum of € 16 billion between 2014 and 2020.

1.2 Problem Discussion

The existence of funds in support and interest in the field have allowed the flourishing of smart city projects. Nevertheless, most of these projects fail to scale up, ceasing to exist at the pilot stage (Winden and Buuse, 2017). The problem is evident, given that the greatest benefits derive from the scale up phase, which makes it possible to obtain cost-effective applications which can be accessed by a larger number of consumers. To avoid pilot project remains local experimental exercises unable to move their experience and solutions to real-life industrial scale implementations, a suitable degree of scalability is required.

The issue related to project upscaling has been scantly addressed by the existing literature. Winden and Buuse (2017) and May et al. (2015) committed themselves to developing, through their papers, frameworks capable of identifying the factors that have the greater impact on scaling of smart city projects. Nevertheless, none of the existing studies have in depth analysed the smart city projects which operate in logistic field. The logistic industry, indeed, is subject to industry-specific forces that may produce effects also in terms of identification of key scalability factors for the pilot projects.

1.3 Research Purpose and Research Question

The aim of this research is to study the scalability of smart city logistics project to fill the gap in the existing literature by identifying key factors for project scale up. This study will focus on scalability intended as expansion and roll-out. This is achieved by examining a smart city project practical case, represented by the SMOOTh project in the City of Gothenburg. The study, indeed, desire to provide with meaningful recommendations and guidelines for the pilot projects management purpose.

To achieve the purpose of this study the following main research question will be addressed:

What factors influence the scalability potential of the SMOOTh Smart City Logistics pilot project?

1.4 Disposition

As shown in Figure 1, the research paper is structured into 6 Chapters. The theoretical framework includes a literature review of academic research on smart city logistics and scalability. Next, the methodology is described, containing details of the research strategy, design, and method adopted for data collection and analysis. In Chapter 4, the empirical results from the interviews are presented. In Chapter 5, the results will be discussed and analyzed considering the research question of the study. Finally, in Chapter 6, related to conclusions, an overview of the more relevant insights of the research will be presented and suggestions for future research on the topic are highlighted.

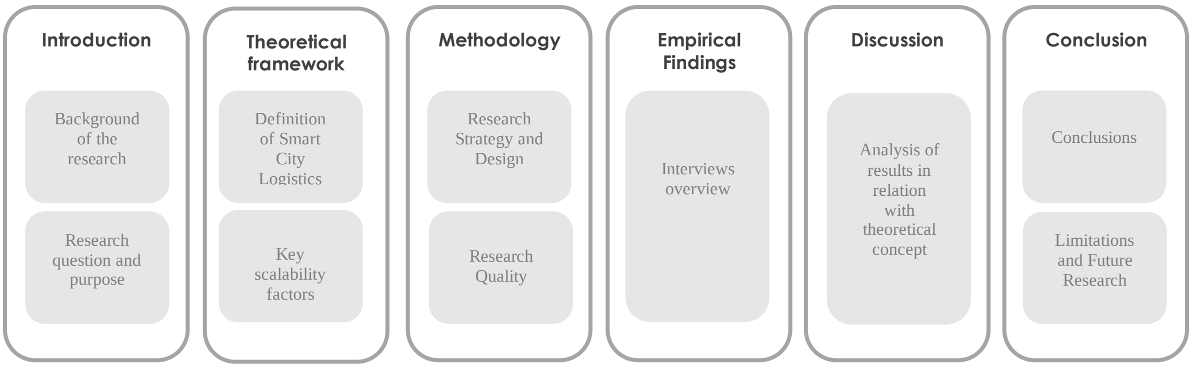

Figure 1 - Research structure overview

1.5 Delimitations

The delimitation of the research articulates in three main aspects. The first is related to the theoretical scope of this study which is limited to factors related to expansion and roll-out. More specifically the study focuses on city roll-out and/or geographic expansions. Key factors related to replication, on the contrary, will not be part of the research because different variables should be evaluated, and the elected case study would not have produced relevant findings on the topic. The second limitation concerns the fact that the results are specifically addressed to projects currently in the pilot phase. In fact, since scale up should be addressed from the pilot phase, the chosen case study is represented by a research project. Finally, the third limitation is represented by the geographical context; results of the research are indeed mainly applicable to European socio-cultural context.

1.6 The SMOOTh Project

The elected case study is the SMOOTh project, a three-year research project, launched in 2019. The solution proposed by the project aims at consolidating freight transport in the context of smart and sustainable city logistics through the introduction of a System of System (SoS). The project started as a result of the EU-funded Novelog project and was subsequently expanded as it became part of a state-funded project to which Volvo Group, Rise and IVL, and Nordstan have taken part.

The main problem from which the idea of the project was originated is that the 90% of trucks are loaded for one third of the capacity (Malmek et al., 2019). The SMOOTh project is indeed intended to counteract the amount of trucks' traffic within the city by approximately 40%, consequently reducing fossil fuel vehicles for goods transport in pedestrian areas by 75% (Malmek et al., 2019). The solution is being tested and demonstrated through a living lab through which the project idea is progressively implemented.

A turning point for the project has been represented by the establishment of the Nordstan Cargo Bike Hub. Nordstan, being the largest business hub in Sweden with 200 shops and 6000 office workplaces, contributes by offering cargo capacity available along the 1.5-kilometer-long lower floor. The initiative has caught the interest of Pling, Gothenburg's oldest box bike operator, first, and of DHL Express later. The aim of the project is to put in place the conceived model, shown in Figure 2, according to which goods follow a multimodal transportation: parcels being prepacked at Urban Consolidation Center (UCC), out of the city center, will be driven out to the city hub in Nordstan through electric trucks. Parcels will be finally delivered by DHL, Pling and Best from the city hub by smaller zero-emission delivery vehicles, such as cargo bikes and smaller electric vehicles. As a result, the model will allow parcel consolidation by multiple transport providers to use trucks loaded at a high rate. Data will be at the center of the business model since through a dynamic decision-making algorithm case-by-case logistic decision will be undertaken, therefore determining on whether the goods would benefit from consolidation as opposed to end-to-end deliveries.

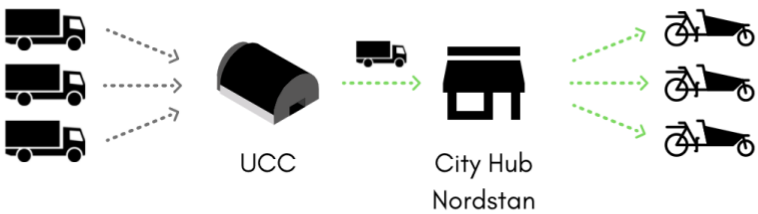

Figure 2 - SMOOTh model

Now the consortium consists of 11 members active within the transportation industry, including traffic administrators. From now on, Nordstan's Service Center has taken over the last mile delivery for Swedish Post "Postnord", resulting in the delivery of all goods to inhouse offices and shops after a short stop in Nordstan. However SMOOTh project is not already functioning as visioned by the stakeholders. Currently, indeed, the IT system is inexistent, and the business model is being defined.

SMOOTh vision implies the creation of a scalable SoS able to combine transport solutions, logistics and politics. Consequently, SMOOTh project intends to act as a model that could inspire other cities around the world, aiming also at shaping national policy, serving as the foundation for a new European Commission directive.

2. LITERATURE REVIEW

The following chapter presents a comprehensive review of the existing literature on smart city logistics and scalability. The chapter opens with an introduction to the concepts of smart city and city logistic. Next, a definition of upscaling is outlined to proceed to the identification of the key factors highlighted in the existing literature.

2.1 Background

A review of the area being researched corresponding with smart city logistics projects is provided in the background. These include definition of smart city logistics and the key stakeholders involved.

2.1.1 Smart City Logistics Definition

Smart city projects are emerging to address and solve the efficiency and environmental problem that are characterizing the logistics industry. Smart city can be defined as an ecosystem of stakeholders, which develops in the form Public-Private Partnerships (PPPs), engaged in a process aiming at address public issues through the use Information and Communications Technologies (ICT) (Eskelinen et al. 2015; Smart City Institute, 2017). Smart cities create an active involvement of different actors, including the citizens themselves, transforming them from mere observers to key contributors to innovation (De Waal and Dignum, 2017; Preeker and De Giovanni, 2018).

The smart city logistics solution applies smart city approach to meet city's logistics purpose. Optimization of logistics activities is therefore achieved by leveraging on connectivity between different players. This optimization process aims at meeting customer needs minimizing monetary cost and associated externalities, which includes climate change, air pollution, noise, vibration, congestion, and accidents (Ooishi and Taniguichi, 1999, p.2).

Smart City Logistics main elements can be consequently summed up in the following’s trends:

- **Digitalization and Big Data Analytics:** Improved data sharing is fundamental to extract maximum value from the available transport big data, contributing to wider data sharing amongst the transport stakeholders, and lead to improved products and services (Schönberg et al., 2020). Intelligent Transport System (ITS), which represents an advanced system of combination of technology, infrastructure, service and planning, and operation methods, supports real-time data collection related to track and trace (Coronado Mondragon et al. 2012; De Giovanni, 2021). Tolls which are deployed for ITS includes sensors, actuators, controllers, GPS devices, mobile phones, could computing and IoT (Coronado Mondragon et al. 2012). These tools enable ITS to offer secure, economic on demand services. The resulting increase in vehicle productivity would produce positive effect in terms of CO_2 emissions (Omidvarborna et al., 2015a).

- **Collaboration across stakeholders:** the change of paradigm which is undergoing in transportation sectors also had an effect and enhanced the importance of a collaboration of a multiple and diverse stakeholder (Eskelinen et al. 2015). The aim in this case for a successful collaboration is increasing transparency and communication between player through process digitalization (Schönber et al., 2020). The main stakeholders and its relationship will be deepened in the paragraph 2.1.2.

- **Flexible deliveries through multimodal transport:** multimodal transport indicates transportation of goods, performed under the terms of a single contract, that exploit more than one different mode of transports (Barnhart and Laporte, 2007). Multimodal logistic allow more efficient and sustainable delivery and is therefore become an important logistic component worldwide. Its use has been encouraged by government directives and shaped by the ITS (Coronado Mondragon et al. 2012). In addition, flexibility which characterized dynamic decision-making approach is fundamental to control real time changes.

- **Urban Consolidation Center:** Urban Consolidation Centers (UCC) or Urban Freight Centers are defined by Browne et al. (2005) as logistic facilities located in relatively proximity of the geographic area it serves. UCC arose as a potential solution for reducing pollution from last-mile freight transportation (Nordtomme, 2015). These centers collect packages from many logistics companies, consolidate them, and then proceed with delivery to the city customer (Taniguchi et al., 2016). Consequently, UCCs serves as a terminal for multimodal transport, previously introduced. UCCs aim at contrasting the disadvantages deriving from the lack of holistic system which generates travel routes exaggeration and consequent cost increase and negative impact on the environment. The deriving freight flows integration allow citizen to access goods, while supporting cities' sustainable development (Malindretos G., 2018). Nevertheless, UCC still represents a concept for multiple urban stakeholders (Grandval, 2019). At this regard, Vaghi et al. (2016) identified the KSFs for an UCC based schemes corresponding to: (1) concertation and political support, (2) supporting regulations, (3) governance and financing viability, (4) strategic location and (5) organization of the last-mile transport.

- **Specialized fleets:** electrified fleets and pedal-powered vehicles represent an additional key component able to decrease carbon footprint of the society. These vehicles are particularly suitable for small parcels, contrarily to big parcel which may need higher volume and traction power.

In conclusion, smart city logistics projects combine digital technologies able to integrate stakeholders, systems and means of transport that interacts with users, aiming at a sustainable, safe, accessible environment that meets citizens' mobility needs.

2.1.2 Stakeholders Involved

Urban Transport, as mentioned, involves collaboration between many stakeholders, driven by different aims and goals. The environment takes the name of multi-agent systems (MAS) (Nimtrakool et al., 2018). These heterogenous conjunctions of autonomous decision-making agents must facilitate, communicate, and exchange knowledge to make the holistic collaboration work (Nimtrakool et al., 2018).

The stakeholders can be divided in four main categories: shippers, carriers, customers, and administrators (Taniguchi et al., 2001; Boerkamps et al., 2020); each of which belongs to a different portion of the city's logistics, remaining closely linked to each other (Taniguchi et al., 2001).

The first category defined by Taniguchi et al. (2001) is the one of the **shippers**, which includes manufacturers, wholesalers, and retailers. They can be either owner or receiver of the goods. Shippers sends goods to other companies or person, and they are often not located in the cities. The study points out that shippers' goal is to maximize the quality of the service offered, that depends on accessibility, delivery speed and cost management (Taniguchi et al., 2001). In the event of receipt of goods, limited time windows are established.

The second category, the one concerning **carriers** or Logistic Service Providers (LSPs), concerns the companies specialized in transporting freight and parcel within the city to the final customers (Taniguchi et al., 2001). Taniguchi et al. (2001) indicate that objective of carriers includes cost minimization and maximization of the financial performance. A trade-off exists between high level of service and the efficiency of freight vehicles loads. Their efficiency is influenced by boundaries sets by other stakeholders, such as administrators, who have the power of putting increasing restrictions on urban area traffic system, or opening hours of stores (Taniguchi et al., 2001).

City resident category includes people living, shopping, or having activities in the city. Their interest can be compared to those of authorities due to concern about environment and traffic reduction (Taniguchi et al., 2001).

Finally, Taniguchi et al., (2001) classified **city administrators** as those players establishing the guidelines within the environment. Along with finding the balance between business satisfaction, and public benefits they have the power to enhance projects able at expanding mobilities aiming at enabling more intelligent, sustainable, and accessible solutions (Noye and Givoni, 2018; Schiller et al., 2010). A favourable environment to innovation can indeed make the difference in smart city logistics projects development and success.

2.2 Scale up of Smart City Project

A literature review regarding scale up of smart city projects is here provided. Initially the different typologies of upscaling are evidenced and analyzed. The paragraph then proceeds with an analysis of the key factors associated with the scale-up of smart city projects already highlighted in the existing literature.

2.2.1 Typologies of Scaling-Up

Scale up or scalability has been defined by Philippe and Hansman (2008) as the ability of a system to improve its scale aiming at meeting growing volumes demand. Different upscaling typologies were defined by Cooley and Kohl (2005), which distinguished among expansion, replication, and spontaneous diffusion. Winden (2016) has subsequently elaborated on that, by substituting the spontaneous diffusion typology with roll-out.

The scale up phase emerges as a major problem for smart city project initiatives, as previously illustrated. Projects, which tend to be designed to satisfy a particular demand in the city of interest, encounter a serious of issues when attempting to broaden the impact of the initiative. Obstacles includes competing interests from existing stakeholders, non-supportive legislation or policy mechanisms, and a lack of resources in terms of personnel, expertise, processes, or findings (Winden, 2016).

Furthermore, different scholars underlined the fact that pilot project design plays a fundamental role, being influential in determining the scale up success. Hartman and Linn (p.16, 2008) affirmed that: *"pilots should be designed in such a way that they could be scaled up, if successful, and so that key factors which will be necessary for a scaling up decision—with what dimensions, with which approach, along which paths, etc.—are already explored during the pilot phase."*

According to the literature when talking of upscaling two main dimensions exists: scalability and replicability (May et al. 2015, Bosch et al. 2016). The first of the two, scalability, has been further broken down in expansion and roll-out by Winden (2016). Therefore, in the next paragraphs three main categories of scale up, corresponding with roll-out, expansion and replication will be considered.

2.2.2.1 Overview of the scaling-up typologies

In general, upscaling can be described as a multi-layered process, which allows the coexistence of different dimensions (Hartman and Linn, 2008; Winden and Busse, 2017). Hartmann and Linn (2008) argued that the type of path toward upscaling will depend on the nature of intervention. Expansion is more likely to be an effective solution where hierarchical interventions are required, while replication is more suitable where non-hierarchical methods are required (Hartmann and Linn, 2018).

The three-upscaling type are shown in the Figure 3 below, which highlights their relationship ranking them based on the level of context sensitivity. Replication represents the one with highest context sensitivity level, while roll-out the one with the lowest (Winden, 2016). Focusing on a project perspective the expansion and replication typologies are the ones that are most relevant (Winden and Busse, 2017).

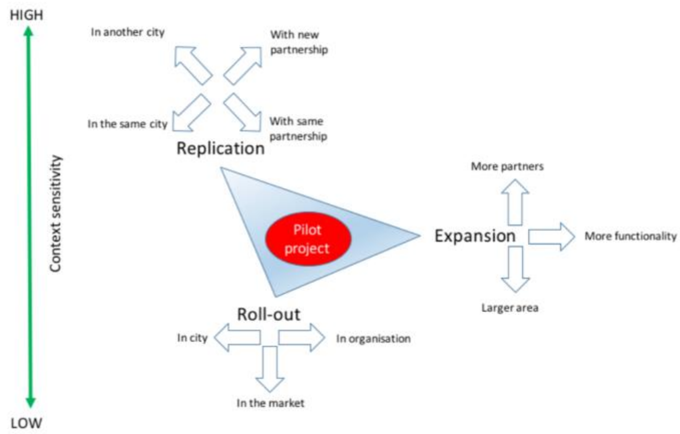

Figure 3 - Types of upscaling. Reprinted from Winden (2016, p. 8).

2.2.2.2 Scalability: Roll-out

To establish the groundwork for the roll-out definition, it is considered pertinent to shortly provide a definition of spontaneous diffusion, being the scalability typology that in Cooley and Kohl (2005) framework substituted roll-out. Cooley and Kohl (2005) defined spontaneous diffusion to indicate the spread of good practices which occurs by means of its own initiative. Winden (2016) in its own frameworks instead substituted it with the concept of roll-out, which development cannot be considered as spontaneous. Roll-out scale up occurs when a smart city solution, successfully tested during the pilot phase, is made available to consumers or the B2B market (**market roll-out**), or otherwise it is applied to the entire organization (**organizational roll-out**) or city (**city roll-out**) (Winden, 2016). Winden (2016) declares that the transition toward scale up can be achieved without performing major changes to the product or solution, therefore it does not require any new partnerships or significant changes that impact the organization. Normally, control during this phase is exercised by the company that initiated the pilot study, which is responsible for defining a profitable business model that includes a funding strategy and viable value proposition (Winden, 2016). Funding will require more effort if the pilot was financially supported primarily by grants. The major complications arising from this phase are related to the need for the organization to be ambidextrous (Winden, 2016). This means that both exploration and exploration is necessary at this stage.

2.2.2.3 Scalability: Expansion

Expansion involves scaling up the pilot within the organization(s) that developed it (Cooley and Kohl, 2005). This phenomenon occurs during a phase in which the pilot project is not closed or dissolved (Cooley and Kohl, 2005). Moreover, expansion is related to co-production which require the close collaboration of different stakeholders. Winden (2016) identified three ways through which expansion can occur: the first refers to expansion in terms of geographic area (**geographic expansion**), secondly this can happen through the recruitment of new partners (**quantitative expansion**) and finally through the addition of functionality (**functional expansion**). This form of upscaling applies for co-production process that relies on the near alignment of several stakeholders (Winden, 2016). This typology is particularly valuable for mobility project for which collaborating partner create added value (Winden, 2016). Differently from roll-out, expansion is naturally more complex: transaction and coordination costs are high because there is no clear oversight over the mechanism and many autonomous organizations are involved (Winden, 2016).

2.2.2.4 Replication

The last and more complex typology of scale up concern's replication. This scale up dimension implies the reproduction of the model developed through the pilot project in a different context, such as a new city or part of a city. Cooley and Kohl (2005) argued that this occurred at the hands of organization distinct from the one that originally developed the pilot project. Differently from them, Winden and Busse (2017) sustained that replication can occur also by the original pilot partnership. Replication can occur as a proxy or exact replication of it (Winden and Busse, 2017). In general replication can indistinctly be applied within all kind of smart city solutions being tested and developed during pilot projects (Winden and Busse, 2017). Replication implies having to deal with a different environment, characterized by different regulations and partners. This represents the reasons why most of the time it entails a non-exact replica of the original pilot. New partners, indeed, must commit to readjusting the project based on the rules dictated by the new context (Winden, 2016).

2.2.2 Conditions for Scaling-Up

Few existing literatures defined frameworks to identify factors that can help determine the success of transition from pilot phase to scale up. Main existing framework specifically tailored for smart projects are the one provided by May et al. (2015) and Winden and Busse (2017). These frameworks will be shortly introduced to proceed with a comparison between the factors addressed within.

May et al. (2015) highlighted the factors relevant to scalability and replicability separately, focusing on smart grid projects. The research results into the creation of three categories of factors: technical, economic, regulatory & stakeholder acceptance related factors. A summary of the factors in subject is provided in Table 1 below. In addition, the research provides a methodology suitable for assessing the factors and the scalability of the single project. This implies a prioritization of the factor's categories, according to which technical factors should be built upon economic factor, which will act as a prerequisite for stakeholder acceptance. Ultimately, all categories need to exist as a prerequisite for the potential scalability of the project (May et al., 2015).

Areas	*Scalability factors*	*Replicability factors*
Technical	Modularity	Standardization
	Technology evolution	Interoperability
	Interface design	Network configuration
	Software tools integration	
	Existing infrastructure	
Economic	Economy of scale	Macro-economic factors
	Profitability	Market design
		Business model
Regulatory & stakeholder-related	Regulation	Regulation
	Consent	Acceptance

Table 1 - Summary of factors. Adapted from May et al. (2015, p. 2)

In light of this changing landscape, researchers have become increasingly interested in smart city projects scalability, and Winden and Busse (2017) elaborated on the model just listed above by defining a framework consisting of six requirements for performing a successful scaling process. The elements are: 1) the prospect of reaching economies-of-scale; 2) the presence of knowledge transfer mechanisms and incentives; 3) management of ambidexterity in exploration-exploitation activities; 4) the presence of enabling regulatory, legal, and policy frameworks; 5) interoperability between systems, data, and standards; 6) the inclusion of standards to measure returns on investment. Once the elements were properly defined, Winden and Busse (2017) categorized those factors according to the referenced upscaling types. Unlike the previous framework, all three categories (expansion, roll-out and replication) are mentioned here. However, it is important to highlight the fact that the only difference between the first two categories lies in data interoperability, which is not considered as a fundamental requirement for roll-out. On the other hand, replication, differently from roll-out and expansion, needs an effective knowledge transmission mechanism, which is particularly crucial in case the replication it is managed by different stakeholders than those who have previously applied the solution in the original environment.

Now that an overview of the factors identified by the existing studies has been provided, a in depth description of the different drivers and their interrelation will be provided. The key factors provided by the literature have been categorized in technical, economic, organizational and stakeholder related factors redefined based on the subdivision offered by the study of May et al. (2015). Table 2, at the end of the chapter, provides and overview of these factors.

2.2.2.1 Technical factors

Technical factors aim at evaluating if the solution offered by the project is inherently scalable and/or replicable (May et al., 2015).
Modularity has been identified by May et al. (2015) as a factor influencing the roll-out and expansion success. Modularity refers to the possibility to divide the solution into interdependent functional units (May et al., 2015). This has been defined by May et al. (2015) as the basic precondition for scaling up, thanks to the flexibility deriving from it. In addition, on a technical factor perspective, the collaboration between different players creates consequences in terms of **data and system interoperability** requirements (May et al., 2015; Winden and Buuse, 2017). The factor is particularly relevant for smart city projects, being based on ICT and data that are part of it (Winden and Busse, 2017). In multi-stakeholder collaborations willingness of partners to engage in data sharing is of crucial relevance (Winden

and Busse, 2017). This willingness is characterized by a positive relation with trust and mutual collaboration, which is key in inter-organizational collaboration (Winden and Busse, 2017; Nedović-Budić and Pinto, 2000; Zaheer et al., 1998). Data and system interoperability creates consequences not only for privacy concerns but also for what regards interface design or the ability of the platform to handle data originated by each stakeholders' system. **Interface design**, for example, can become overly complex and redundant when the scale increases (May et al., 2015). Consequently, suitable **software tools**, able to cope with increases size, should be exploited (May et al., 2015). Furthermore, according to May et al. (2015) **existing infrastructure** can represent a limitation depending on the maximum capacity that it offers.
In specifics of replication, the use of published **standards** in terms of the technical solution represents a success factor (May et al., 2015). Nevertheless, many standards exists and therefore interoperability with a system which operate according to a different standard should be equally achieved (May et al., 2015).

2.2.2.2 Economic factors

The economic factors are necessary to establish whether scaling up or replication is economically feasible on an investment and business model perspective (May et al., 2015).
Having a vision of potential **economies of scale** is critical for a successful scaling up and indeed is an element contained in all the frameworks previously mentioned (May et al., 2015; Winden and Buuse, 2017). Economies of scales are indeed correlated with the economic viability of the solution on the intended scale (May et al., 2015). Specifically, it is critical that this vision is already defined in the pilot phase, as the phase will serve as groundwork for potential upscaling, therefore scale up dimensions, and the approach to be used should already be properly defined (Hartmann and Linn, 2008). Furthermore, detailed information on how larger volume is positive correlated with lower unit costs and higher profits can act as valuable incentives for those who want to capture them (Winden and Busse, 2017). Winden and Buuse (2017) defined economies of scale as a driver for each single scaling up typology, but especially relevant in case of roll-out where a single firm can capture the benefits of scaling. On the contrary, May et al. (2015) mention economies of scales as exclusively correlated to scalability keeping the factor aside in the case of replicability. Furthermore, according to May et al. (2015), the project should be characterizing by a positive **profitability** to be considered as an attractive financial opportunity. Regarding the search for funds, establishing **standards to measure returns on investments** (ROI) can have a positive impact on the willingness of funders to support a project (Winden and Busse, 2017).
On a replicability perspective it is necessary to evaluate whether the solution is still profitable within a different environment, by conducting an analysis of **macro-economic factors** (May et al., 2015). Replication, indeed, make the project success dependent on the new market design (May et al., 2015). Finally, May et al., (2015) claimed that the modification of the original business model should be properly considered to allow the adaptability of the original idea to new context.

2.2.2.3 Organizational factors

Organizational category includes factors related to project management during the transition from pilot to exploitation phase.
Pilot phase is mainly characterized by explorative activities focused on innovation, experimentation, and R&D. On the contrary, large scale production require for exploitations of old certainties aiming at efficiency, implementation, and execution. Through **ambidexterity** the organization must find the right balance between exploration and exploitation (Winden and Busse, 2017). This balance can be reached through three main alternative paths: (1) temporal

separation (Eisenhardt and Brown, 1997); (2) organizational separation (O'Reilly and Tushman, 2008), and (3) pure and contextual ambidexterity (Eisenhardt and Brown, 1997).
Knowledge transfer mechanism and contextualization are crucial elements for making upscaling happen (Winden and Busse, 2017). This is particularly true when dealing with replication type of scaling. Lack of trust between supply chain players acts as main obstacles for data sharing (Schönber et al., 2020). The main challenge arises from enabling tacit knowledge transfer (Buratto et al., 2019).

2.2.2.4 Stakeholders

This category includes factors which impact on the degree to which the current environment and its stakeholders are ready to adopt a scaled-up version of a project (May et al., 2015).
Incentives are fundamental to maximize the upscaling potential. These incentives can be mainly offered by policy makers. The latter together with **regulators** are included in the stakeholder category who, as such, have an influential role in facilitate the project expansion (May et al., 2015). Positive effects would affect stakeholder motivation in participating in smart city project (Winden and Busse, 2017). As already evidence, regulation can have a relevant influence on Smart City Pilot Project destiny. Scaling-up will indeed be facilitated in city with high ambitions related to CO_2 emissions reduction, increasing use of renewables energies etc. Nevertheless, Winden and Busse (2017) also evidenced the role of public procurement policies, whose regulation may act as a launching customer for a pilot project on one side or as an obstacle on the other side. In some cases, projects fail to scale up due to isolation from real world legislation and market forces (Winden and Busse, 2017).
Stakeholder acceptance represents a further fundamental element for upscaling success (May et al., 2015). This affects regulators, stakeholders, and authorities (May et al., 2015). The fact that organizations which take part to a project may be characterized by heterogeneous ambition and perspective regarding upscaling reinforces the need for incentives, previously outlined (Winden and Buuse, 2017). It is relevant that the key stakeholders accept the proposed solution in all the three types of up-scaling categories (May et al., 2015).

Categories	***Factors***	***Roll-out***	***Expansion***	***Replication***	***Source***
Technical	Data Interoperability		✓	✓	May et al. (2015) & Winden and Busse (2017)
	Modularity	✓	✓		May et al. (2015)
	Existing infrastructure	✓	✓		May et al. (2015)
Economic	Economies of scale	✓	✓	✓	May et al. (2015) & Winden and Busse (2017)
	Profitability	✓	✓	✓	May et al. (2015)
	Standards to measure ROI	✓	✓	✓	Winden and Busse (2017)
Organizational	Knowledge transfer mechanisms and incentives			✓	Winden and Busse (2017)
	Effective management of ambidexterity	✓	✓	✓	Winden and Busse (2017)
Stakeholders	Enabling regulatory, legal, and policy frameworks	✓	✓	✓	May et al. (2015) & Winden and Busse (2017)
	Acceptance	✓	✓	✓	May et al. (2015)

Table 2- Factors influencing projects scale up

3. METHODOLOGY

The following chapter outlines an overview of the methods applied to conduct this research and the rationale behind it. The chapter begins with an introduction of the research strategy and research design. Next, the methodology related to data collection and analysis is presented.

3.1 Research Strategy

The elected research strategy is an **inductive approach** as it focuses on discovering new patterns and themes based on current phenomena, rather than analyzing a previously stated theory (Marshall and Rossman, 2006). The application of smart city logistics has indeed not been widely covered in the existing literature. Contributing at identifying key factors related to smart city logistics project scaling up appear indeed as more significant than attempting to fit into the current analytical structure. This can be obtained through inductive research strategy, which is suitable for new research areas (Bryman and Bell, 2011).

To address the research purpose and answer the research question, a **qualitative approach** is deemed suitable for this study. The rationale for adopting this research strategy is that it primarily emphasize words rather than number, which is necessary to gain in-depth real-world knowledge by various stakeholders involved in smart logistics projects, collecting their opinion while identifying social connection and the network between them. In addition, because academic analysis on the subject and market implementations is very limited, it is preferable to take a qualitative approach to better explain scientific evidence, to derive conclusions from various angles, and to make the research relevant for the purpose of the study.

3.2 Research Design

A **single case study** is the selected method that will be applied to address the research question and to dictate direction of this research and the choice made within (Bryman and Bell, 2011). In essence, this implies that empirical findings are produced by thorough and intensive review of a single case (Bryman and Bell, 2011). The case study makes it possible to achieve the previously established goal of building theoretical ground for future research (Eisenhardt, 1989).

To elect the research design, the relationship between it and the research method has been considered. The fact that the case study research design is in line with the qualitative research strategy was considered of crucial importance. Case study allows indeed to reach depth exploration of a case of interest, fundamental factor when it is necessary to understand a novel field as in the case of smart city logistics and address the inductive approach purpose, obtaining strong internal validity (Bryman and Bell, 2011). Bryman and Bell (2011) indeed suggest that a case study is an appropriate research design in case the objective of the research is to understand how and why something occurs. This is in accordance with the elected research question which aim at identifying the key factor which may maximize a project upscaling potential.

The research project on which the case study was developed had been identified in collaboration with the Swedish consultancy company First to Know. The author sent to the company a research proposal in which the aim of the study and the main elements of the methodology were contained. First to Know has then carried out an identification of a company or a project that could fit the request within its own network. The choice fell on SMOOTh, an ongoing smart city logistics pilot project in the city of Gothenburg coordinated by Volvo Group. The decision to study a project, which is currently in the pilot stage has been justified through the literature, which emphasized that key factors should be investigated since from the pilot stage (Hartman and Linn, 2016). On the other hand, the decision to focus this research on Sweden, specifically in the city of Gothenburg, is because this city pays particular attention to environmental issues, and in fact hosts several transition projects towards a more sustainable mobility that improves connectivity while being environmentally friendly. Furthermore, Gothenburg is undergoing an exceptional situation with construction work that will last for the next 20-30 years, that making the city more connected and urbanized will also prompt the need for an adequate transportation system.

The project can be considered as a *"broadly" revelatory case study*, being conducted predominately through the implementation of an inductive approach through which the phenomenon of smart city logistics will be in-depth analysed. Additionally, the novelty of both the SMOOTh project and of the phenomena, further strengthens the elected research design decision; indeed, according to Brown (2006) this approach is preferred when a lack of prior theorizing about the subject of study have been carried out. Given that, this research design was evaluated as the most adequate in relation to the study purpose and qualitative research strategy, being mainly associated with generation of, rather than testing of theory (Bryman and Bell, 2011).

3.3 Research Method

3.3.1 Secondary Data Collection

To provide a theoretical background to the study, the review of secondary data was performed as part of the literature review. The literature review is described by Bryman and Bell (2011) as a helpful tool for building the basis on which the researcher justifies the research question and selects the research design. The method through which literature review was conducted is a **systematic literature review**. Differently from narrative review, the systematic review has the purpose of identifying the literature gap and find out what the research project can add on existing knowledge about smart logistics (Bryman and Bell, 2011). Systematic review is therefore more focused on wide-ranging scope than narrative review and therefore more suitable for this study. The main advantage deriving from this choice is linked to the fact that biased are minimized. This is obtained through the adoption of an approach which is characterized by explicit procedure. This implied the definition of inclusion and exclusion criteria adopted when deciding which existing literature to consult. The elected criteria are reported in the Table 3 below. Secondary data collection is preliminary step for development of new theory and therefore need to be performed at beginning of the research process and eventually be iterated towards the end of the process.

Inclusion Criteria	***Exclusion Criteria***
Papers related to: • Smart City Logistics definition • Scale up definition • Scale up key factors related to Smart City Projects	Paper in which: • KSFs are related to smart city in general and not to projects scale up phase • The focus was on stakeholder collaboration • Smart logistics is analyzed on a technical level

Table 3 - Inclusion and Exclusion Criteria

The search for existing literature occurred through the utilization of some **Keyworks**. Individuation of the latter has carried out following the research topic and objective. The main keywords are: “Smart Logistics”, “Smart City Project”, “Pilot Project”, “Scale Up”, “Key Factors”. **Sources** from which articles and reports were collected includes Google Scholar, Gothenburg online Library and Luiss online Library.

3.3.2 Primary Data Collection

Data were collected through **semi-structured interviews**. This data analysis method appears consistent with the choices made so far regarding methodology. The qualitative analysis indeed focuses on word rather than number. Furthermore, in depth information are necessary to fill the literature gap and perform the elective inductive approach’s purpose.

This method has been evaluated as the most suitable one for two additional main reasons. Firstly, the method makes possible to gather detailed information from key informants together with obtaining deeper understanding of the subject. Secondly, the method offers a structure for the interviewers provided by the interview guide which make possible to cover all those relevant arguments for the research question, while assuring freedom to the interviewee choice in reply. The interview guide, displayed in Appendix A, allowed the interview to be more consistent, creating the main structure to exert data from. Additionally, interview guide also increased study replicability. Since the elected method are semi-structured interviews, the order of the question suffered deviation, depending on the previous answer. At this regards, semi-structured interviews give space for the interviewer to interpret and respond to the questions, while ensuring that the overall purpose of the interview is not lost.

To identify a sample which would be strategically relevant to the posed research question, a **purposive sample** was considered as appropriate. The criterion applied to select the sample is that of relevance, which is based on the knowledge and expertise of the respondents. To meet this requirement, it was established that any respondents should cover relevant role within the SMOOTh project and the company for which he/she is working. Furthermore, to facilitate the respondents’ identification process, a snowball approach has been complemented to it. In the Table 4 below specifics about interviewees and interview dates are shown.

Respondents	***Role and Company***	***Medium***	***Date***	***Length***
Ronja Roupé	Business Designer, Volvo Group	Zoom	4/01/2021	45 mins
Magnus Zingmark	Project Partner, Nordstan	Zoom	4/01/2021	41 mins
Johan Erlandsson	Project Partner, Velove	Zoom	4/13/2021	46 mins
Sönke Behrends	Researchers, SSPA	Zoom	4/15/2021	43 mins
Michael Browne	Reference Group Member	Zoom	4/27/2021	45 mins
Magnus Jäderberg	Project Partner, Trafikkontoret	Zoom	5/04/2021	55 mins
Christoffer Widegren	Logistic consultant, CW Logistic	Zoom	5/11/2021	30 mins

Table 4 - Interviews overview

Interviewees were contacted with due advance via mail to schedule an interview date. The interviews were carried out during formal online meetings. Even if online meeting potentially limits the personal engagement which characterize the face-to-face interviews, they were the preferred modality due to current pandemic and geographic distance. At the beginning of each interview process the author gave a brief introduction to the interviewees to better explaining the research purpose and their main role within the research. During the interview process the author took advantage of the interview guide. All interviews were recorded for transcript purpose. Fully transcription presents significant advantages including the possibility of capturing every single detail that would be significant for the analysis, ensuring the minimization of bias (Bryman and Bell, 2011). Validation of the reported information was finally asked to the interviewees to further increase research validity.

3.3.3 Data Analysis

Data analysis followed a process of preparing the collected data that subsequently allowed for the development of a thematic analysis. This process was chosen since it facilitates the interpretation and breakdown of information gathered during the data collection process, leading to qualitatively rigorous demonstration of link among codes toward an induction of a new concept. Thematic analysis indeed offers an opportunity to develop inductive research of qualitative rigor (Gioia et al., 2012). This is indeed one of the most common approach adopted to perform a qualitative data analysis (Bryman and Bell, 2011).

The first performed step includes the coding process. The coding process was performed through Word, in which phrase or words in the transcripts referring to the same concepts were highlighted using different colours depending the matter addressed. In the second step, a comparison process among related code was performed in order to identify similarities and differences among the several "concepts" in the coding table. The third step consists in further condensation of concepts in broader topics, called as "aggregate themes" in the coding table. Themes were defined through the identification of similar concepts referring to one key specific factor and therefore paying attention to the degree of relevance with regards of the research question. Categories have been developed by elaborating on the categories previously identified through the literature. The resulting aggregate themes are four: business model factors, technical factors, stakeholders related factors and legislative factors. The resulting coding table is shown in Appendix B.

The methods claim to be as relatively flexible and easily applicable (Bryman and Bell, 2011). The process was performed during and subsequently the interview phase. The results of the thematic analysis are shown through a coding table. Sources gathered from interviews will be noted in the Chapters 4 as "p.c." for "personal communication".

3.4 Research Quality

To assess the research quality four main criteria will be considered: credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985; Bryman and Bell, 2011). Those are indeed the criteria specifically suitable for qualitative studies.

3.4.1 Credibility

Credibility assesses the trustworthiness of the research (Bryman and Bell, 2011). Credibility was reached by being transparent of the scope of the interviews beforehand. At the beginning of each interviews the research was communicated. Furthermore, respondents were asked for validating the summary of the interview. Finally, integrity is also established by sharing final research to all the interviewees.

3.4.2 Transferability

Bryman and Bell (2011) describe transferability as the degree to which the results can be generalized. At this regard, qualitative research is characterized by disadvantages in terms of lack of objectivity compared to quantitative strategy (Bryman and Bell, 2011). Furthermore, others main problematics regarding thematic analysis are related to data reduction. Loose of context in which data were generated and data fragmentation results from it. These downsides were mitigated through the implementation of an iterative process. Similarly, the case study design concentrates itself on the uniqueness of the case and develop a deep understanding and complexity, undermining generalizability (Eisenhardt, 1989). To mitigate this the author provided a detailed description of the case study in Chapter 1, as well as of the description of the environment of City of Gothenburg in Chapter 3, enabling the reader to evaluate possible complementarities of the specific environment of interest.

3.4.3 Dependability

Dependability defines trustworthiness and entails that all interview records, transcript, and email conversation are kept during all research phases in an accessible manner (Bryman and Bell, 2011). During the drawing up phase, indeed, all information related to this thesis were preserved by the author and are available in case of request.

3.4.4 Confirmability

According to Bryman and Bell (2011), confirmability assess the extent to which the researcher was influence by its own values in collecting data and reporting findings. Specifically qualitative research may suffer of high level of subjectivity related to judgements of the researcher who interpret interview data (Bryman and Bell, 2011). This subjectivity was minimized by making using of following-up questions aiming at capturing the real meaning of the answers and asking at the end of the interview if the interviewee felt it necessary to add any other information that had not emerged from the questions already asked.

4. EMPIRICAL FINDINGS

This chapter includes empirical findings from the SMOOTh project case interviews structured into themes. This chapter begins by providing an overview of the category of key factors identified, which are subsequently analyzed one by one.

4.1 Key Scalability Factors

In Table 5 an overview of the scalability key factors identified through empirical investigation is displayed. The main categories identified are represented by business model related, stakeholders related, technical and legislative factors.

BUSINESS MODEL	TECHNICAL	STAKEHOLDERS	LEGISLATIVE
• Vision of scale • Sustainable business model	• IT system interoperability • Infrastructure capacity	• Consortium composition • Consensus • Co-creation	• Supporting regulation • Political will

Table 5 - Key Factors identified in the empirical investigation

4.2 Business Model Related Factors

Business model factors determine whether the project is addressing its vision of scale and whether it is sustainable in economics and environmental terms to pursue scaling up.

4.2.1 Vision of Scale

Interviewees highlighted that SMOOTh project is driven by a strong underlying motivation. During interviews stakeholders mentioned a detailed future vision of the SMOOTh project as well as the sub-goals which the project sets out to reach. Specifically, the motivation behind upscaling lies in the desire to produce significative magnitude effects deriving from reduced traffic and level of pollution (Roupé R., p.c., 2021). The expansion from Nordstan to Gothenburg inner city is a key prerequisite to reducing the number of trucks entering the city of Gothenburg (Roupé R., p.c., 2021). The project clearly quantified its objective, expressing the will of reducing by 40% the amount of trucks' traffic within the inner city (Browne M., p.c., 2021). In the long-term SMOOTh project intends to replicate the model in different cities all over the world, which has been described as fundamental to prove the reduction of traffic and level of pollution on a global scale (Roupé R., p.c., 2021). The pilot stage is above all intended to verify and test the underlying idea (Browne M., p.c., 2021).

> *"We need a successful small-scale demonstration to show that it works: the systems' tasks must be met (transports delivered on time and without extra damage), traffic must be reduced, a better way to the receiver must be provided, and transportation companies must be able to save money" – Sonke Behrends*

Therefore, the definition of clear vision is necessary also to test that the designed model practically works, and that the underlying system is in place (Behrends S., p.c., 2021). In addition, simulations and potential analysis of large-scale projects can act as a prerequisite for the consequent scale up. These practices can show to decisions makers that the model works in practice and displaying potential risks (Behrends S., p.c., 2021).

4.2.2 Sustainable Business Model

From all of interviews it was pointed out that during the pilot stage SMOOTh project has been committed to define the most appropriate business model. It emerged that the business model should above all be economically sustainable (Roupé R., p.c., 2021). To be more easily scalable, the emerging business model should be characterized by its own revenue streams, that makes it independent from the economic support received from the government (Roupé R., p.c., 2021). During the pilot stage the service is dispensed at small prices or for free, as in the actual case of SMOOTh project (Zingmark M, p.c., 2021). However, to achieve profitability, considerations about the ideal price of the service to be established in the next step should be undertaken as early as possible (Behrends S., Roupé R., p.c., 2021). A sustainable business model should ensure on the one hand the possibility for the system to be profitable and on the other hand offer a fair cost-effectiveness for external logistics service providers who want to access the service offered by SMOOTh (Roupé R., p.c., 2021). LSPs, navigating within a highly competitive environment characterized by high end-customer bargaining power, may show interest in the service by aiming to embrace sustainability to increase their reputation within the market (Browne M, p.c., 2021). However, at the same time the logistic sector represents a cost sensitive business, which make LSPs unwilling to pay high extra costs to access the sustainability service (Browne M., Widegren C., p.c., 2021). Consequently, pricing should be defined in a way that balances this trade-off (Roupé R., Browne M., p.c., 2021). Finally, to be sustainable, the business model needs to be flexible and able to change and readapt to the external environment, as well as able to properly distribute value created among stakeholders as will be deepen in paragraph 4.4.3 (Behrends S., p.c., 2021). The difficulty related to economic sustainability stems from the fact that no financial reward is correlated with the creation of environmental benefits (Browne M., p.c., 2021). Efficient use of capacity, as well as the use of electric vehicles can generate increased costs, disincentivizing increased economies of scale (Browne M., p.c., 2021). On the other hand, trucks intended for city distribution do not require for large batteries, which are the main cost driver (Widegren C., p.c., 2021). Furthermore, electric vehicles are expected to gain cost-effectiveness over time reaching the breakeven in the next future (Widegren C., p.c., 2021).
On the other hand, environmental sustainability can generate a further advantage. Sustainability reports and CSR, differently from financial reports, come to the aid by putting an emphasis on the environmental performance of the project, quantifying its impact on sustainability issues (Roupé R., p.c., 2021).

4.3 Technical Factors

Technical related factors include considerations regarding IT system and the infrastructure capacity.

4.3.1 IT System Interoperability

In SMOOTh project, data has been described as crucial for scale up, especially for what regards the inner-city expansion (Roupé R., Behrends S., p.c., 2021). UCC by itself, indeed, is not sufficient to reach predefined scale vision and reorganization of packages’ flow by the usage of data comes to the aid (Roupé R., p.c., 2021). To accomplish this goal more easily it is desirable for the project that every logistic stakeholder within the consortium would share data regarding trucks localization and trucks load rate, partially opening their own systems (Roupé R., p.c., 2021). The information chain is broken down into sub-parts because of the intermodal transport that occurs from the UCC to the city hub and finally to the end customer (Widegren C., p.c., 2021). For this chain to be recomposed, several IT platforms must be integrated into one single system (Widegren C., p.c., 2021). Data management system can generate advantages, related to the increase of collaboration levels:

> *"It is important to make the collaboration among different players easy and this can be achieved by exploiting an information system"* - *Sönke Behrends*

Although the logistics company Velove did not express true dissent for data sharing (Erlandsson J., p.c., 2021), other interviewees from the management side stated that there may be a reluctance of many companies to share information (Roupé R., Browne M., p.c., 2021); this stems from the fact that companies' perception of gaining an advantage does not offset the potential disadvantages of competitive friction (Browne M., p.c., 2021). Therefore, firm incentives for data sharing should be defined (Roupé R., Behrends S., p.c., 2021).

In addition to incentive definition the system created by the project must appear secure, meaning that it must be ensured that data are not shared with organizations outside the system (Roupé R., Widegren C., p.c., 2021). Once again, the concept of trust plays a role in this sense (Browne M., p.c., 2021). A functioning and reliable business IT architecture should consequently be developed and tested during the pilot stage, being an essential toll to guarantee future scalability (Roupé R., Widegren C., p.c., 2021).

4.3.2 Existing Infrastructure

Infrastructure capacity is a further precondition for scale up. It is therefore opportune for a smart city pilot project to adequately take into consideration how upscaling may affect the existing capacity so that appropriate considerations can be made about how to approach the expansion of existing capacity (Behrends S., p.c., 2021). The capacity involved is not only that related to trucks but also and above all that related to the physical infrastructure through which the transport model is articulated (Behrends S., p.c., 2021).

SMOOTh model, as previously highlighted, exploits a city hub and a UCC. The upscaling perspective therefore should take into consideration the impact on both two infrastructural elements (Behrends S., p.c., 2021). Indeed, if one side Widegren (p.c., 2021) affirmed that Novelog capacity would be enough to manage upscaling volumes, Beherends (p.c., 2021) did not exclude the need to reconsider the enlargement of the infrastructure in the long-term. This would take into consideration the population density of the concerned areas with the purpose of guarantee an appropriate geographic coverage (Behrends S., p.c., 2021). Although practices with more than one suburban hub exists in Europe, the establishments of an increasing number of hubs may undermine traffic optimization (Behrends S., p.c., 2021). During the pilot requirements in terms of the hubs are defined and they can and should be studied through research (Behrends S., p.c., 2021).

4.4 Stakeholders' Related Factors

Stakeholders' related factors include observations about the consortium composition, the establishment of a consensus-based environment and remarks about the co-creation process.

4.4.1 Consortium Composition

Getting stakeholders on board is a prerequisite for scale up, therefore the incentives and mechanism for involvement should be defined during the pilot project (Roupé R., p.c., 2021). Respondents were asked about the composition of an ideal consortium for downtown scale up and this was described as featuring the participation of about three/four large transportation companies, about two/three real estate companies, and administrators (Behrends S., p.c., 2021). Large logistics companies are needed because of the system they already have in place and because they can provide significant volume and capacity to the project, which is essential for expansion (Browne M., p.c., 2021). Large logistics companies may be complemented by smaller companies that may be involved through business transactions and thus not necessarily be integral to the project (Behrends S., p.c., 2021; Browne M., p.c., 2021). Real estate companies, on the other hand, should participate in the organization, as they cover a key role in terms of providing receivers, intended as offices and stores that are their tenants (particularly in the case of malls) (Behrends S., p.c., 2021). The latter can be involved in two alternative ways: receivers can either pay money directly, or alternatively a fee is paid by real estate (Behrends S., p.c., 202). Finally, administrators are a crucial actor within the scenario because they assume the role of neutral parties, not being directly connected to any organization (Behrends S., p.c., 202). The neutral role is required by the fact that competition normally exists between companies operating in the same industry, such as in the case of the logistics and real estate industries (Behrends S., p.c., 202). Therefore, the consortium should be a good representation of the market, integrating public and private sectors (Widegren C., p.c., 2021).

> *"SMOOTh project has an opportunity related to the involvement of some different actors which is definitely a plus" – Michael Browne*

The degree of diversity in terms of the composition of the SMOOTh consortium is an advantage in counteracting the competitive forces that typically characterize the logistics industry (Browne M., Jäderberg M., p.c., 2021). Furthermore, having a large company such as Volvo Group, which is active in the field of logistics, leading the project was considered of great added value by the participants (Jäderberg M., p.c., 2021).

4.4.2 Consensus

To accomplish long-lasting partnership, it is also necessary that the vision is shared and fully understood by the various stakeholders involved in the project since the early stage of the project (Roupé R., Erlandsson J., p.c., 2021). The establishment of this common idea of the projects may not be an immediate process (Roupé R., p.c., 2021). The related obstacles reside on the fact that a heterogeneous consortium involve different players, to each of which belongs a different view of the world (Roupé R., Browne M., p.c., 2021). This challenge was fully described by one respondent through the following metaphor:

> *"Initially, the team may be associated with a group of blindfolded people who are touching the same elephants while trying to describe it aloud. Someone is touching a foot, and someone is touching an ear etc.… It is the same elephant, but the challenges come from the fact that no one sees the whole picture." - Ronja Roupé*

This difficulty can be countered through communication that is articulated through meetings and workshops (Roupé R., p.c., 2021). Being able to communicate potential benefits to different actors is indeed a necessary step to ensure successful upscaling (Behrends S., p.c., 2021). Moreover, since different actors capitalize on different benefits, the key is to formulate separate types of messages for each category involved (Behrends S., p.c., 2021). Despite this, it emerged that communication must be properly balanced to ensure that it is not perceived as ineffective and unnecessary by participants (Erlandsson J., p.c., 2021).

Once consensus is established, it should be maintained during the evolution of the project, as the business model evolves over time especially during the pilot testing phase (Browne M., p.c., 2021; Erlandsson J., p.c., 2021). The evolution behind the scale up of the SMOOTh project involves business model changes, which can be relatively frightening for the companies currently involved in the project (Browne M., p.c., 2021). Initially, stakeholders recognize that everyone plays their parts, but as the project evolves the business model will undergo significant changes and stakeholders may begin to question whether they will have a role in the future of the project, causing resistance to change (Browne M., p.c., 2021). Moreover, the latter is often not clearly visible, as companies will follow the project without maintaining a real desire for change (Browne M., p.c., 2021). Understanding what can truly trigger this behavior change, during the pilot project, is critical to scale up (Browne M., p.c., 2021).

4.4.3 Co-creation

A sustainable business model has also been linked to the concept of co-creation (Roupé R., p.c., 2021). In fact, to make a business model sustainable over time, it is necessary to put in place a balanced process that allows actors to give and take, consequently allowing the system to create more value than any single company can do separately (Behrends S., Roupé R., p.c., 2021). Trust among stakeholders can establish the foundation for co-creation, as each organization requires trust towards the other to give away resources or knowledge earlier than the moment in which the resulting benefits are received back (Browne M., p.c., Roupé R., Zingmark M., 2021). The basis for trust was defined during an interview by the following statement:

> *"Trust requires understanding of the fact that we are all doing it together for the same reason and for a common goal." - Ronja Roupé*

The organization's role is to facilitate collaborations and the co-creation process (Behrends S., p.c., 2021). Since a SoS includes actors with extra costs, complemented by others who receive large benefits, the system should consequently be designed to be able to redistribute income and system-wide benefits (Behrends S., Browne M., p. c., 2021). In other words, to create an advantage for each of the stakeholders, the benefits for the player in the second category must be reduced and redistributed to players which recorded losses instead (Behrends S., p.c., 2021). By redistributing the value equally, the give and take process related to co-creation can take place (Behrends S., p.c., 2021). In this way, the business model would be able to create a benefit for each party involved, establishing the foundation for a lasting partnership (Behrends S., Roupè R., p.c., 2021).

4.5 Legislative Factors

Legislative factors include external environment related to regulatory and politics perspectives.

4.5.1 Supporting Regulation

Regulation exercises a marked influence towards smart city logistics projects. Traffic and mobility regulation has been described as "carrots and stick" approach (Jäderberg M., p.c., 2021). In case of green projects substantial advantages can be originated by the introduction of vehicle free zone which limit the possibility to drive within the city in predetermined time frames (Jäderberg M., p.c., 2021). Vehicle free zones has the purpose to provide a new mobility solution for freight distribution, aiming at defining a win-win situation (Jäderberg M., p.c., 2021). These initiatives can incentivize the SMOOTh project development, by condensing big trucks traffic within the inner city (from UCC to the Nordstan City Hub) in a limited time window from 5.00 am to 10.00 am (Jäderberg M., p.c., 2021). For the whole day, instead, cargo bikes and smaller electric vehicles will be able to circulate within pedestrian streets, not representing a disturbance or risk for citizen (Jäderberg M., p.c., 2021). Therefore, vehicle free zone would make the use of an UCC more profitable to use, representing in addition a great way to handle stricter regulations (Widegren C., p.c., 2021). In this sense regulation would have the power to speed up the change toward a more environmentally sustainable freight transport, imposing on different players to change their business earlier than they would do under ordinary circumstances (Roupé R., p.c., 2021).

Despite this, complications may arise with regard to regulation and consequently the project cannot rely totally on it (Roupé R., p.c., 2021). Specifically, it is hard to know how regulation will evolve since cities are unsure on what role to play within the freight traffic (Browne M., p.c., 2021). Furthermore, freight industry is treated differently from car industry and regulation do not know if it convenient to promote electric vehicles (Jäderberg M., Browne M., p.c., 2021). SMOOTh want to electrify smaller vehicles, which drive within the inner city and larger vehicles, which connect the UCC to the City Hub, but the latter represents a bigger challenge (Jäderberg M., p.c., 2021).

4.5.2 Political Will

Regulation and politics must be aligned in the same direction to make the establishment of a vehicle free zone possible and favor SMOOTh project future scalability (Jäderberg M., p.c., 2021).

> *"Political will is a critical factor to make upscaling possible and to develop vehicle free zone." – Magnus Jäderberg*

Sustainability issues exert additional pressure on politicians who desire to reach certain air quality goal, together with reducing congestions, traffic noises and pollution levels (Jäderberg M., p.c., 2021). Transportation receives a lot of attention from public authorities, but often the focus is primarily on public transportation, rather than freight transportation (Jäderberg M., p.c., 2021). Politic may be reluctant to approve a vehicle free zone since this will not impact only freight, but also car and public transportation (Jäderberg M., p.c., 2021). To do so the project should communicate to politicians the main project mission, providing data regarding success obtained through the project during the pilot stage, drawing the project as interesting and desirable (Jäderberg M., p.c., 2021). It is very important to perform relevant studies during pilot stage are crucial to show the potential of the project and visualize potential risks (Behrends S., p.c., 2021). The difficulties arise from the fact that communication with politicians is very rigid and boreoarctic (Jäderberg M., p.c., 2021). The risk associated to the political will is that in most of the cases this decision is influenced by the person own knowledge rather than exclusively on its function (Jäderberg M., p.c., 2021). However, sidewalk management urges policymakers to plan the effective management of this resource (Jäderberg M., p.c., 2021).

5. DISCUSSION

In this chapter, empirical findings are analyzed in relation to the existing literature. To provide a complete answer to the research question in the first paragraph a model which define the relation among the defined key factors is presented.

5.1 Key Scalability Factors

To meet the research purpose and answering to the research question, four main categories of factors have been identified. These corresponds with business model related, technical, stakeholders related, and legislative factors. All factors are mutually necessary and should be developed during the pilot project to achieve a successful scale up. A strong linkage between them exists, and an iterative process is required for their full development.

Before beginning to analyze each of these categories specifically, a general perspective on the SMOOTh project upscaling will be introduced. As previously outlined project vision envisages expansion to inner city, follow by replication in other cities around the world in the long-term. Even though project stakeholders have revealed themselves able to visualize key factors for project scale up within Gothenburg inner city, the research revealed that upscaling perspective is rarely openly discussed within the project, nor mechanism which promote the scale up are put in place.

All factors are mutually necessary for project upscaling, but a logical sequence can be defined based on research results, as shown in Figure 4. Each layer determines a well-defined key factor, which is built upon the results obtained in the lower layer, and in turn contributes to the scale up of the project. The pilot project must first focus on the definition of the business model, on the basis of which the technical factors relating to the infrastructure used and the functioning of the IT system will be constructed. Once the infrastructure is in place and data interoperability has been established, the focus of the project would shift to stakeholder engagement. This would allow to establish a consensus-based environment and co-creation process. In fact, to secure consensus from political and regulatory stakeholders, the project would demonstrate that the business model and IT system are in place and stakeholders are engaged. Consequently, the underneath potential in terms of traffic optimization and environmental sustainability would be revealed.
A strong binding exists among those factors, which is represented by the arrow on the right, whose double arrowhead indicates the underlying iterative process. To obtain consistent results indeed, the process may be repeated several times, by improving and solving previous errors to successfully reach the final version of the project.

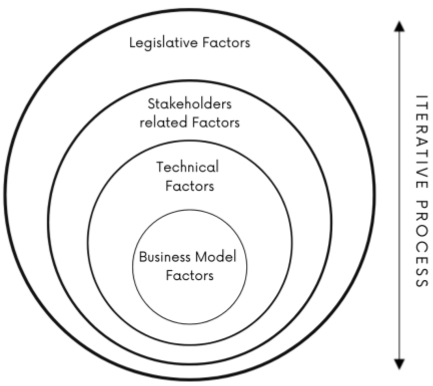

Figure 4 – The relations among key scalability factors

5.2 Business Model Related Factors

This category of factors refers to the extent at which the business model holds at a larger scale. The business model represents the driving force for scale up and the priority number one. It drives indeed the factors related to stakeholder's acceptance and is capable to generate interest at the regulatory and policy level.

5.2.1 Vision of Scale

The establishment of a vision represent the first prerequisite for scale up. This includes the definition of a series of future stages that collectively can build a path towards scale up.
Correspondence between theory and empirical findings exists and can be highlighted through empirical research of Cooley and Kohl (2005) and Hartmann and Linn (2008) which put an emphasis on the definition of a vision, describing it as the first step to be performed to scale up. The definition of a vision, in addition to representing a strategy to be pursued in the next stage (Hartmann and Linn, 2008), generates implications about the actions that should be implemented in the pilot stage itself to ensure future success. As a result, defining clear vision is often needed to verify that the planned model really operates and that the underlying structure is in place. This concept can be interlinked with the one of trialability identified by Bosh et al. (2016), which was defined as an indicator of the scalability potential, referring to the extent to which the solution can be experimented in the local context before full implementation. This factor has a twofold advantage: from one side it allows to give a demonstration of the project potential both to the internal and to the external context and from the other side it identifies and pre-empts risks which may manifest in larger size during the scale up.

5.2.2 Sustainable Business Model

The creation of a sustainable business model represents the second key factor. Sustainability is here interpreted in two different ways: from an economic perspective and from an environmental perspective.
SMOOTh project has resulted to put a particular focus on economical sustainability, aiming at not being bounded by temporary subsidies or grants, that could obstruct the path toward upscaling. The concept of economic sustainability, which emerged from interviews, can be directly correlated with concept of profitability identified by May et al. (2015) and indirectly connected with the factors of economies of scale introduced by Winden and Buuse (2017). According to the first research the project must be characterized by positive returns on larger scales and therefore economically sustainable to be considered as financial attractive on the long term (May et al., 2015). At the same time the goal deriving from economies of scale can be considered interlinked to this. The establishments of economies of scale deriving from project size growth can lower costs, producing significant effects in term of future profitability (Winden and Buuse, 2017). The research's results, however, provide a new insight for what regards economies of scale within smart city logistics projects. The establishment of economies of scale may result more challenging when dealing with environmental sustainability goals. The latter creates the need to achieve a high load rate and the use of electric vehicles, which contribute to increased costs when the number of deliveries increases.
Nevertheless, economically sustainability is not sufficient by itself. The introduction of sustainability reports permitted to increase the prominence of others KPI from the one which are strictly connected with financial performance. Smart city logistics projects which favor the decrease of pollution may consequently benefits from the inclusion of non-financial performances which can support their growth. This adds up on the establishment of standards to measures of ROI which were evidenced by the existing literature (Winden and Buuse, 2017).

Finally, a crucial prerequisite for the business model is flexibility (May et al., 2015). This indeed require for being potentially easily adaptable to external environment responds and successfully perform project scale up.

5.3 Technical Factors

Technical factors are necessary to evaluate whether the solution developed by the project is inherently scalable (May et al., 2015). Technical factors, including infrastructure capacity and IT system are built upon and based on the business model.

5.3.1 IT System Interoperability

The role of data within smart city logistics projects has been remarkably emphasized both in the literature than through empirical findings. Smart city logistics projects need to invest heavily in digitization, the latter of which is necessary to be more agile in the implementation of the multimodal transportation system. Winden and Buuse (2017) underlined the fact that multi-stakeholder scenario, such as the one which characterizes logistic industry, increase the relevance of this factor. IT system is the tool through which the vision of scale and the underlying business model can be put in practice. Firstly, to successfully scale up there is the need to collect data from different stakeholders which will be processed within the IT system. To do so trust must be established and incentive to share data defined (Zaheer et al., 1998). Afterwards, since with the multimodal transport several logistic providers interact with each other, the system must achieve interoperability and therefore be designed as capable to handle data deriving from different sources. In this regard, it is expected that the system is capable to manage an increasing number of interactions in terms of data (May et al., 2015). Only through the establishment of data interoperability the SoS can be harmonized, and stakeholder collaboration can take place.

5.3.2 Existing Infrastructure

Duly take in consideration the infrastructure capacity is necessary. This is line with May et al. (2015), who evidenced in their research the relevance of the existing infrastructure. The infrastructure capacity sets a limit also in terms of service potential, potentially acting as a barrier to future project expansion and restricting chances of success. Infrastructures in logistic industry can be translated in UCC and city hubs, the latter of which corresponds with Nordstan in the specific case of SMOOTh project. Therefore, during the pilot stage, the key infrastructures for the project should be determined. In this sense the involvement of real estate company within the SMOOTh consortium, which will be recalled in the next section, was of crucial importance. In addition, over time it is considered appropriate to assess the capacity dictated by the existing infrastructure. This may have implication especially in the long term. In this sense by making this consideration a smart city logistics pilot projects would visualize what expansion would implies in terms of infrastructure capacity, and eventually plan the actions needed to achieve it. Furthermore, establishing in a concrete way the infrastructure that has a capacity suitable for scale up provides more concreteness to the project allowing the actual pilot test to be carried out.

5.4 Stakeholders' Related Factors

These factors reflect the extent to which the current multi-stakeholder environment is ready to embrace the scale up version of the project (May et al., 2015). Their support is crucial to explore the path toward scale up.

5.4.1 Consortium Composition

Consortium members are responsible for the success of the project and for this reason it is necessary to accurately consider the composition of the consortium.
During the pilot stage the project should be capable to achieve the critical mass in terms of stakeholders taking part to the project. On the contrary the fact that the project is not able engage enough stakeholders may undermine its future success. Involving a minimum number of players is particularly relevant within logistic industry, for which delivery capacity play a role. Furthermore, a degree of diversity within the consortium composition should be ensured. Specifically, big logistic providers, real estate companies resulted to be fundamental, since able to provide the assets needed. On another hand, SMOOTh consortium also involves administrators, representing the neutral player that can help establish a balanced coexistence between different players, together with research institutes. The contribution of the latter is equally essential to support and promote the innovative processes development. It can be deduced that the ideal consortium should involve at least three out of four stakeholders' categories identified from framework defined by Taniguchi et al. (2001): shippers, which corresponds with real estate's tenants, carriers, being logistic service providers and city administrators. Nevertheless overall, no real connection between findings and literature emerged for this key factor. This may mainly derive from being a characteristic correlated to the specific industry. Logistic industry, indeed, represents a landscape which hosts a heterogeneous group of players, one essential to the other. Therefore, the consortium shaping the smart city logistics project should be able to replicate these market forces, so that it is better prepared to deal with external environment during scale up phase.

5.4.2 Co-creation

Companies within the consortium must develop the awareness that they are contributing to a co-creation process that is enabled by the synergies that characterize a SoS.
Co-creation factor has been associated to the process of mutual concessions and compromises which occur within multi-stakeholders' projects. Groundwork of co-creation is represented by trust. Trust is especially relevant for those organizations that face the highest costs, as they must rely on the fact that they will receive remuneration for the value created. This trust and process of co-creation should be fueled by the system arising from the partnership. One way for achieve this is represented by enabling a value exchange system. This mechanism would make possible to collect system wide benefits for redistribute them to those players who sustain the highest costs. This concept is supported by the statement of Nedović-Budić and Pinto (2000, p. 461), which affirmed that "*the nature of the coordination process was in fact the key to establishing an atmosphere of trust and mutual collaboration and for the overall success of each multiparticipant project".* On this basis, the project management body and city administrators should primarily lay the groundwork for this collaborative process by taking the sides of neutral figures who can handle and prevent potential trade-offs.

5.3.3 Consensus

Get stakeholders on board is not sufficient for long-term success and therefore consensus represents a further key factor for project upscaling. The business model will suffer changes over time and therefore it is necessary to preserve stakeholders' interest toward reaching the project' goal and upscaling during all project's length to avoid the generation of internal contrasts. The first step to establish groundwork for consensus includes the clear communication of the project missions and underlying model. Consensus can be traced back to the stakeholder acceptance factors evidenced by May et al. (2015). Scholars affirm it is crucial that key stakeholders, as well as regulators, as we will see later, accept the proposed solution. Furthermore, incentive addressed to those players who may lack of motivation toward scale up may be crucial to maximize the upscaling potential of the solution (Winden and Buuse, 2017). This consensus must be maintained over time, as evidenced by May et al. (2015) and research results, since it is very likely that the original business model will not hold and will undergo changes. At this time resistance to change deriving from the concern deriving from the fact that there may there will be no space for them may undermine consensus.

5.5 Legislative Factors

Legislative factors reflect the extent to which the regulatory and political environments express consensus toward the smart logistics project scale up (May et al., 2015). Legislative factors lie in the outermost layer, as the project potential has to be already expressed to be communicated to institutions.

5.5.1 Supporting Regulation

The influence that regulation can exercise through city administration is clear. Regulation can intervene in two alternatives way: by proving incentives or establishing restrictions (De Giovanni, 2016). The establishment of a vehicle free zone within the inner city is included in the second category, which as previously highlighted would contribute to SMOOTh project promotion. Beneficial regulations include also facilitation related to electric vehicles traffic in the inner city. In this sense regulation may be able to speed up the change toward a greener and smarter city logistic environment. Therefore, measure of restriction can vary from case-by-case depending on the geography and cultural context of the city of interest (Vaghi et al., 2016). Consensus from regulators is an essential element to proceed with the scale up of the tested solution (May et al., 2015). On the other side regulations can act as an obstacle to smart city project scale up when it shields the project from real-word market forces and legislation to which it will inevitably be exposed during the scale up phase (Winden and Buuse, 2017). Nevertheless, SMOOTh project results not being excessively shielded from regulations, which would have limited the scale up potential since the beginning.

5.5.2 Political Will

Politicians serves as representatives of city residents, as well as a regulatory body with jurisdiction over traffic rules and freight distribution or owner of areas that may be used for UCC (Vaghi et al., 2016). Consequently, their involvement is essential for the project scale up. Since the initiative of the application a smart logistics system comes from private operators, dialogue with politicians should be aimed at reporting, with data in hand, the potential benefits of large-scale implementation of the project. In line with it Vaghi et al. (2016) in their research affirmed that a detailed and accurate concertation process between the public administration and the stakeholder representatives represents a pre-requisite for the acceptability of the new system. Indeed, visibility of results is a precondition for a constructive communication with politicians (Bosh et al., 2016). In this sense, Winden and Buuse (2017) in their research already evidenced that city realm characterized by high ambition toward goals such as reduction of CO_2 emissions may favor the project development.

6. CONCLUSION

This chapter conclude the research presented in this study by answering at the research question. This is followed by recommendations for future research.

6.1 Answering the Research Question

This work has been driven by the increasing emergence of smart city logistics pilot projects, in which various stakeholders collaborate aiming at increasing the last mile delivery efficiency, while decreasing the deriving negative environmental impacts. The low rate of project upscaling has centered the attention toward the scale up phase, whose stage is capable to transform a local experimental exercise into a real-life industrial scale implementation. This research contributes to the existing academic debate by identifying the key scalability factors for smart city logistics project, focusing on expansion and roll-out type of upscaling. To achieve the research purpose this thesis investigated a three-year research project, named SMOOTh, launched in 2019 in the City of Gothenburg.

Having introduced the theoretical foundation for the study through a systematic literature review, a framework containing key factors resulted from the study. The framework has been developed by combining empirical findings with existing literature. Four main categories of factors have been identified: business model related, technical, stakeholders related, and legislative factors. All factors are mutually necessary and should be developed during the pilot project to achieve a successful scale up. A strong linkage between them exists, and an iterative process is required for their full development.

The *business model related factors* imply the establishment and test of a reasonable project vision of scale, as well as the establishment of sustainable business model. This represents the core priority during the pilot project and the force which drive all the other key factors. Preliminary analysis taking place during pilot stage will allow to clearly identify which is the value that the project can generate, while demonstrating that the underlying model is properly running. This business model should also be sustainable from an economic point of view, to not being bounded by temporary subsidies or grants that could obstruct the path toward upscaling. In addition, environmental sustainability is an added benefit as it allows you to leverage the use of non-financial performance and KPIs that can support project growth.

Technical factors, which include consideration regarding tools or resources needed to achieve the set goals within the vision, are built upon the business model. For the project to be inherently scalable it is necessary to establish an IT system that can embrace an increasing amount of data originated by the various data source. In addition, the expansion of an infrastructure capacity that can address the volumes of scalability should be determined.

Stakeholders involved in the projects are an essential part of the business model and of its path towards the scale up. Key factors related to this category are included in *stakeholder related factors* category. Critical mass in terms of number of players and diversity must be reached during the pilot stage, so that the project can start put in place those mechanism require to involve them. Furthermore, a consensus-based environment should be preserved during the whole project length. This can be done through the establishment of a co-creation environment in which every stakeholder is willing to give and create value to receive it back subsequently.

Finally, *legislative factors*, which includes regulatory and political perspectives, were defined. Regulation covers a considerable role being capable of facilitate scale up, while speeding up its process. The surrounding environment resulted potentially able to exercise positive pressure toward the project development through the establishment of a vehicle free zone. This cannot be reached without the political support, which represents an additional factor crucial for the success. Data and demonstration must be obtained and communicated to politicians during the pilot to facilitate their decisions process. Therefore, to perform an effective communication at that point the business model should have been defined, stakeholders should be on board and data should have been gathered and elaborated.

6.2 Practical Recommendations and Implications

The present study supports previous research regarding smart city pilot project scale up, focusing on the logistic field. Three key recommendations, addressed to smart city logistics pilots, that has an interest toward scale up, can be deducted from the following study.
First, it is essential that smart city logistics pilot projects develop awareness of the factors that can influence their scalability potential. This is crucial to be able to design a business model that can support them during the initial stage. This research can therefore be used as a practical tool to gain specific knowledge. Secondly, projects need to dedicate to scale up from the outset by fully testing key scalability factors. This must be done by applying an iterative process, aimed at realizing the full potential of the project. Data deriving from small-scale demonstration are necessary to determine if the project can be successful on a large scale and to eventually establish the foundations for scaling up. Thirdly, the project must be sustainable intrinsically and in relation to the external environment. With respect to the latter, contacts with regulators and policymakers must be stipulated to establish an external environment that allows for large-scale deployment, overcoming potential political constraints.

6.3 Future Research

This research project could be a foundation for further research that desire contributing to the sparse literature on upscaling of smart city logistics projects. Future research could leverage the potential limitations of this study.

As initially highlighted in the delimitation section, this research does not consider factors related to the replicability of a smart city logistics projects. Therefore, future studies could fill this gap by focusing on replicability by analyzing a project that is in the process of carrying out this strategy or has already done so.
The generalizability of the research is limited by the application of a case study methodology. This thesis focuses exclusively on SMOOTh projects, focusing on the Swedish and European context. Sweden, and in particular the city of Gothenburg, however, unlike other contexts, pays particular attention to environmental issues as it is engaged in a transition towards more sustainable mobility. Future research can therefore conduct studies in different contexts or cultures to increase the generalizability of the results. At this regard, a comparative study could be performed by analyzing different smart city logistics projects around the world. This would be useful to identify elements of commonality and divergence.
The reliability of the data is affected by the choice to analyze a project currently in the pilot phase. This choice, which has advantages on one hand, also encloses limitation resulting from the inability to consider the actual scale up phase. To better understand the implications of these results, future studies could address the study of the SMOOTh project in the future, or alternatively analyze smart city projects that have already performed upscaling. A longitudinal study would enrich and lend support to the present research.

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APPENDIX

Appendix A – Interview Guide

Introduction

- Introducing the author and the research purpose
- Asking a permission for recording and citing interviewee name in the research

Interview questions

Stakeholder overview	Could you describe your work within the organization?
	Which is the motivation that led your organization to join SMOOTh project?
Upscaling	Can you describe the SMOOTh project future vision and desired scale?
	Does your company have the interest towards project upscaling and the capacity needed?
	Which do you think would be the technical, organizational, economic and regulatory critical success factors for project scale up in the inner city?
	Which are the steps that make up the pathway to scale up?
	What do you think are the barriers to upscaling?
	According to you which is the best way to motivate and incentivize the company to stay committed and comply to the main goal of the project over time?
	What kind of incentives would facilitate data sharing within the system for the stakeholders?
	How does communication happen within the project?
Pilot phase	What is necessary to be tested during the pilot study to assure future scalability?
	What are the main difficulties that emerged during the evolution of the project and how would these lessons learned be relevant to the scale up phase?

Concluding questions

- Is it okay if I send you the summary of the interview and maybe you validate it?
- Would you be interested in the final report and results?

Appendix B – Coding Table

Contribution to a better city environment (less traffic and pollution)	*Vision of Scale*	BUSINESS MODEL
Creation of a system of systems		
Inspiration for other cities		
Reducing by 40% the amount of traffic		
Identify proper revenue stream	*Sustainable Business Model*	
Define the ideal price for the service		
Successful demonstration on pilot project scale		
Visualize potentials risks and barriers		
Preserve flexibility		
Put beyond economical KPI		
Sustainability reports		
Define the players that should be involved	*Consortium Composition*	STAKEHOLDER
Define incentives to involve them		
Large logistic companies, real estate companies and administrators		
Vision needs to be accepted by various stakeholders	*Consensus*	
Different interests among players		
Communicate the potential benefits to each stakeholder by elaborating different messages		
Maintain consensus over time		
Establish a give and take process	*Co-creation*	
Trust is necessary		
Create synergies within the SoS		
Properly distribute value created among stakeholders		
Make it easy to collaborate		
Necessity of data for expansion	*IT System Interoperability*	
Define incentives to share data		
The system must appear as secure		
Different data sources must be accepted		

Define the capacity needed	*Infrastructure Capacity*	TECHNICAL
Evaluate the increase in number of city and suburban hubs		
Deal with publicly owned infrastructure may be challenging		
Environmental policies can drive the development	*Supportive Regulation*	
Fossil free cities or restriction on trucks movement		
Vehicle free zones		
Carrot and stick approach		
Politicians may be reluctant to approve vehicle free zone	*Political will*	
Show data to politicians is necessary		
Bureaucracy may make communication more difficult		