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The Economic Considerations of a Sustainable City Logistics-based Business Model

The Economic Considerations of a Sustainable City Logistics-based Business Model

Konstantina Katsela

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Abstract

City logistics initiatives are often conceived as enablers to address the challenges related to the supply and disposal of goods in city centres. Several such city logistics initiatives have been tested to address these challenges. A majority of these initiatives have used urban consolidation centres to bundle deliveries within cities, and several of the initiatives include environmental zones, access restriction schemes, use of environmentally sound vehicles and non-road modes such as light rail systems for freight movement. Despite their potential, a large proportion of the city logistics initiatives have failed to become permanent. The lack of sustainable business models and the limitation of their components are barriers to implementing city logistics initiatives in the long run.

The research consists of the findings of two studies presented in three appended papers. This constitutes the basis of the thesis. The first study is a literature and practice review that provides insights on the content of the components of a conceptual city logistics-based business model and on the components' interrelations. The study also provides a graphical representation of such a model. The second study is a participant observation study that examines an actual initiative, SamCity, in Malmö, Sweden. It investigates the stakeholder groups involved in SamCity and the potential of obtaining an economically sustainable business model.

The research contributes to the area of city logistics by specifically describing and explaining the components of a conceptual city logistics-based business model and their interrelations. The research takes the generic logistics business model of Osterwalder and Pigneur (2010) and adapts it to apply to city logistics. The research reports the changes/adaptions that were carried out to come up with a proposed city logistics-based business model and some of its components. The graphical representation of the model maps the components and allows one to see possible changes that may occur. The business model components and their interrelations can be seen as a starting point to broaden and unify the research for sustainable city logistics initiatives. Future research areas are proposed to extend and complement these findings.

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The Economic Considerations of a Sustainable City Logistics-based Business Model

Konstantina Katsela

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Dedicated to my heavenly uncle

Content

Content viii
List of figures and tables x
Terminology and abbreviations xi
Abstract xii
Acknowledgements xiii
Appended papers xiv
1 Introduction 1
1.1 Background and definitions 1
1.2 Research problem 3
1.3 Research purpose and research questions 4
1.4 Research focus and demarcations 4
1.5 Readership 5
1.6 Thesis outline 6
2 Research methodology 7
2.1 Scientific reasoning and positioning 7
2.2 Research design and strategy 8
Literature and practice review study (Paper 1) 10
Participant observation study (Papers 2 and 3) 11
2.3 Scientific reflections on research quality 12
2.3.1 Reliability and validity 13
2.3.2 Respondents' and researcher's bias 14
2.4 Research process 15
3 Frame of reference 16
3.1 Economic perspective of logistics and city logistics 16
3.2 Research areas in city logistics 17
3.3 General business model 18
3.4 City logistics business model 20
3.4.1 Stakeholders 21
3.4.2 Key activities and key resources 21
3.4.3 Value proposition 22
3.5 Summary and point of departure 23
4 Summary of appended papers 24

4.1 Synthesis of the appended papers 24
4.2 Paper 1 based on the literature and practice review study 25
Objectives 25
Findings 25
Implications 26
4.3 Paper 2 based on the participant observation study 27
Objectives 27
Findings 27
Implications 28
4.4 Paper 3 based on the participant observation study 28
Objectives 28
Findings 28
Implications 29
5 Discussion of research findings 30
5.1 The economic aspects of the components 30
The importance of the city logistics-based business model components and interrelations 31
Stakeholders management 32
The economic performance of a business model in city logistics 33
6 Conclusions and future research 36
6.1 Concluding remarks 36
6.2 Contributions 37
Theoretical contributions 37
Practical contributions 38
6.3 Future research 39
Business model perspective 39
Business model for e-commerce 39
Stakeholders validation 40
Environmental evaluation 40
References 42
Appendix A: The SamCity Project 50
Appendix B: Literature and practice review study (Paper 1) 55
Appendix C: Interview guide for the participant observation study (Papers 2 and 3) 62
Appendix D: List of stakeholders 65

List of figures and tables

Figure 1. Research design.....10
Figure 2. Overview of the research process 15
Figure 3. The nine components of the business model canvas by Osterwalder and Pigneur (2010).....18
Figure 4. The proposed city logistics-based business model: business areas and components.....26
Figure 5. SamCity's heavy vehicle.....51
Figure 6. SamCity's electric vehicle.....52
Figure 7. SamCity's serviced area: Malmö city centre.....53
Figure 8. Methodology of the study 56

Table 1. The selected city logistics initiatives.....57
Table 2. Example of one of the coding and categorisation levels 61

Terminology and abbreviations

AHP, analytical hierarchy process
BSS, Binnenstadservice.nl
CBA, cost/benefit analysis
CCO, City Co-operation Organisation
CR, Customer Relations
CSE, Confederation of Swedish Enterprise
CH, channels
CS, cost structure
CSeg, customer segments
CZ, citizens
HO, Haulier Organisation
ICT, information and communication technology
ITS, intelligent transportation system
KA, key activities
KP, key partnerships
KR, key resources
M, municipality
PO, property owner
RCO, Retail Consumer Organisation
RP, research proposal
RQ, research question
RS, revenue streams
TP, transport provider
S, stores
UCC, urban consolidation centre
VP, value proposition

Abstract

City logistics initiatives are often conceived as enablers to address the challenges related to the supply and disposal of goods in city centres. Several such city logistics initiatives have been tested to address these challenges. A majority of these initiatives have used urban consolidation centres to bundle deliveries within cities, and several of the initiatives include environmental zones, access restriction schemes, use of environmentally sound vehicles and non-road modes such as light rail systems for freight movement. Despite their potential, a large proportion of the city logistics initiatives have failed to become permanent. The lack of sustainable business models and the limitation of their components are barriers to implementing city logistics initiatives in the long run.

The research consists of the findings of two studies presented in three appended papers. This constitutes the basis of the thesis. The first study is a literature and practice review study that provides insights on the content of the components of a conceptual city logistics-based business model and on the components' interrelations. The study also provides a graphical representation of such a model. The second study is a participant observation study that examines an actual initiative, SamCity, in Malmö, Sweden. It investigates the stakeholder groups involved in SamCity and the potential of obtaining an economically sustainable business model.

The research contributes to the area of city logistics by specifically describing and explaining the components of a conceptual city logistics-based business model and their interrelations. The research takes the generic logistics business model of Osterwalder and Pigneur (2010) and adapts it to apply to city logistics. The research reports the adaptions that were carried out to come up with a proposed city logistics-based business model and some of its components. The graphical representation of the model maps the components and allows one to see possible changes that may occur. The business model components and their interrelations can be seen as a starting point to broaden and unify the research for sustainable city logistics initiatives. Future research areas are proposed to extend and complement these findings.

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Lund, April 2018
Konstantina Katsela

Appended papers

The research presented in this Licentiate thesis comprises three papers that are listed below. The list also includes a description of the researcher's contribution to each paper. A summary of the results of each paper can be found in Chapter 4, while the full version of each paper is appended to the thesis.

PAPER 1:

Katsela, K. (2017). The City Logistics-based Business Model: A Series of Components. Published in the Proceedings of the 22nd ISL Conference, 2017, Ljubljana, Slovenia.

Paper 1 was orally presented and published in the Proceedings of the 22nd ISL Conference, 2017.

PAPER 2:

Pålsson, H., and Katsela, K. (2016). A Multi-criteria Decision-model for Prioritising Stakeholder Motives in City Logistics. Published in the Proceedings of the 28th NOFOMA Conference, 2016, Turku, Finland.

Paper 2 was orally presented and published in the Proceedings of the 28th NOFOMA conference, 2016. Henrik Pålsson produced drafts of the text as well as the research design and performed the data analysis. Konstantina Katsela contributed to the writing of the text and performed the interviews, which are the main data source and resulted in an update of the analysis.

PAPER 3:

Katsela, K., and Pålsson, H. (2017). Evaluation of a City Logistics Business Model: Impact of Cost, Revenue and Goods Flow on Profitability. Published in the Proceedings of the 29th NOFOMA Conference, 2017, Lund, Sweden.

Paper 3 was orally presented and published in the Proceedings of the 29th NOFOMA Conference, 2017. Konstantina Katsela produced drafts of the texts, which were critically revised by Henrik Pålsson who provided experienced advice and suggestions. Both researchers, who shared data collection and analysis, were responsible for the research design and writing of the text. The propositions and final version of the paper were developed in agreement by both researchers.

1 Introduction

Chapter 1 starts by defining what logistics, urban logistics and city logistics are in order to distinguish them. Subsequently, the research problem, purpose and questions are presented followed by the research focus and demarcations. Then the thesis readership is presented followed by the thesis outline.

1.1 Background and definitions

The twenty-first century is the century of rapid urbanisation with half of the world's population living in urban areas (United Nations Survey, 2010). Rapidly growing cities promote extra attractive opportunities for employment, education and cultural as well as many other activities (Taniguchi et al., 2005). Urban freight transportation has become more important for the development of cities, the supply of their residents and the maintenance of a better environment in urban areas (Taniguchi, 2014). This is because it manages to keep the balance between economic and environmental growth (Taniguchi and Thomspon, 2015). This implies that as cities grow rapidly, they become more reliant on sustainable supply chains and thus on logistics in order to plan and co-ordinate the movement of products timely, safely and effectively. (OECD, 2003).

Logistics is the part of the supply chain process which *"plans, implements and controls the flow and the storage of goods, services and related information from the point of origin to the point of consumption in order to meet customer's requirements"* (Council of Logistics Management, 1998). The freight transport and streams in urban areas are correlated to the supply of freight to city centres, and is commonly referred to as **city logistics** (Barceló and Grzybowska, 2005). City logistics is a distinct part of logistics in the sense that it defines the importance of transportation, consolidation and distribution of goods from shippers to city centres. However, freight transport has confronted several issues in the last few decades including negative environmental, social and economic impacts. The concept of city logistics has the potential to provide solutions for several of these issues (Ruske, 1994; Köhler et al., 1997; Taniguchi and van der Heijden, 2000a). City logistics is defined as, *"The process for totally optimising the logistics and transport activities by private companies in urban areas while considering the traffic conditions, congestion issues and combustible consumption, with a view to reduce the number*

of vehicle on the cities, through the rationalisation of its operations." (Taniguchi et al., 2001).

However, the scope and focus of the research about city logistics has changed over time. In the early 1970s, a group of researchers started to investigate urban freight transport in terms of the distribution, movements of trucks and the flows of goods in urban areas. Then in the 1980s and 1990s, the environmental impact came into particular focus. During the same period, researchers in Japan and the Netherlands carried out research on policy development, such as optimising vehicle routing problems, the locations of urban consolidation centres (UCC) and terminals, and on co-operative freight transport systems based on technology. A few years later, the Best Urban Freight Solutions consortium targeted European city logistics initiatives in order to study partnerships and stakeholders, global interest, transferability, company engagement and e-commerce (BESTUFS, 2007). Recently, scholars and practitioners have highlighted the importance of business models in city logistics (Quak et al., 2014; Browne et al., 2011; Benjelloun et al., 2010; Macário et al., 2008). Although, the business model plays a key role in making city logistics initiatives economically sustainable (Quak et al., 2014), economic considerations in most city logistics initiatives are weak (Quak et al., 2014). Several initiatives did not survive once the public subsidy support stopped (Gonazlez-Feliu, 2008) or due to low profitability, while others started without considering economic continuity, making them economically unsustainable (Gonzalez-Feliu, 2012).

Based on an initial literature review (carried out in the initial phase of the author's doctoral studies), the focus of city logistics research can be summarised in four areas: policy development, technical solutions, evaluation models and frameworks, and business models. In the review, several researchers concentrated mainly on policy development and its effects on city logistics systems (Marcucci and Musso, 2010; Stathopoulos et al., 2012; Ville et al., 2013), along with the development of an efficient freight distribution system (Stathopoulos et al., 2012). In terms of technical solutions, researchers are interested in several of them that concentrate on the actions taken to implement a decision in a city logistics initiative. In line with this, several researchers have created frameworks to evaluate city logistics and their solutions. Finally, regarding the business model area, several researchers report that the long-term survival of city logistics initiatives requires economically sustainable business models (Quak et al., 2014). It is thus concluded that the need for a business model specifically designed for city logistics is high (Benjelloun et al., 2010) because a majority of city logistics initiatives have failed to expand their scale of application beyond the initial pilot implementation, while only a minority have succeeded.

1.2 Research problem

Empirical studies show that only a minority of city logistics initiatives manage to expand their scale of application beyond the initial pilot implementation (Yamada and Taniguchi, 2006; van Rooijen and Quak, 2008) while 96% of them failed to become permanent (Browne et al., 2006). One of the main reasons for failure is due to the lack of sustainable business models (Quak et al., 2014; Malhene et al., 2012). Two other reasons for failure are the lack of aligned motives and goals of the stakeholders, and the absence of collaboration between the public and private sectors (BESTUFS, 2007). Additional reasons for failure are related to the location of UCCs, strict policy measures, reluctance in the transport industry to use the UCCs, economic problems, and rules and regulations that allow companies to start their own initiatives (Schoemaker, 2002).

Understanding the business model in city logistics, its components and their interrelations is rather limited in the current literature. While there is extensive reporting on its importance (Malhene et al., 2012; Quak et al., 2014), there is a lack of knowledge about what obstructs and drives the development of economically sustainable business models in city logistics (Benjelloun et al., 2010; Quak et al., 2014). A successful example of such a business model implementation is Binnenstadservice.nl (BSS). BSS needs to be more broadly investigated regarding its other components, since the only ones that have been clearly addressed so far are the cost structure and revenue streams. These two components along with goods flow variables measure the economic conditions and provide insights into the economic performance and profitability opportunities for business models in city logistics. BSS also addresses the stakeholders' roles that result in the value proposition and focus on serving the customers.

There is extensive literature on the implementation of general business models, such as Osterwalder and Pigneur (2010). They describe such a model as a series of components that create a business model canvas. The general business model consists of the following components: value propositions (product/service offering that creates value), key activities, key resources, key partnerships (or key actors), channels (delivery), cost structure, customer relationships, customer segments, and revenue streams (physical and virtual channels).

To increase the understanding of business models in city logistics, this research addresses the importance of the components of such a model. The main challenges associated with obtaining sustainable business models are explaining the content of the components and establishing that interrelations between them exists (Demil and Lecocq, 2010; Magretta, 2002; Chesborough and Rosebloom, 2002). According to Zott and Amit (2010), the economic considerations of a sustainable business model are expressed through its components and their interrelations. Obtaining a sustainable business model in city logistics is a challenge according to Browne et al. (2005).

1.3 Research purpose and research questions

Derived from the above discussion, the purpose of this research is:

> To describe and explain the components and their interrelations of a conceptual economically sustainable business model in city logistics.

In light of this, the following research questions were formulated:

> RQ1. What is the conceptual content and the interrelations of the components of a city logistics-based business model?
>
> RQ2. How can a city logistics-based business model address the challenges of the varying motives and goals of stakeholders in city logistics?
>
> RQ3. What are the relationships between variables related to costs, revenues, the goods flow and the economic performance of a business model for city logistics?

1.4 Research focus and demarcations

The research presented addresses the field of city logistics. This thesis explicitly describes and explains the content and interrelations of the components of an economically sustainable business model in city logistics. Hence, before starting, it is important to clarify the research focus and demarcations, which lie between the considerations of the business model and the terminology used.

From the early stages of the thesis research, it became clear that there was no definition of what a city logistics-based business model is; nor a description of the components it should include. Nor was there a description of the content and the interrelations of the components of the business model. As a result, it was soon determined that a city logistics-based business model should be defined as follows: *"A city logistics-based business model is a conceptual tool consisting of a series of components and describing how a city logistics project creates, delivers and captures values by totally optimising urban freight transport activities in urban areas, prioritising stakeholders and their motives in order to express the business logic of a specific project"* (Katsela, 2017). This definition is used and applied to the business model in this research. In line with this, a stakeholders' analysis in the business model was conducted within the context of SamCity, a Swedish city

logistics project (see Appendix A) to progress towards a more sustainable project. This empirical investigation was carried out within the context of SamCity. The novelty of this project was to create a sustainable and co-ordinated UCC that meets users' needs for efficient transportation and services with minimal environmental impact for an attractive urban environment in interaction with urban development. While the environmental considerations were broadly investigated in the project by the municipal environmental agency, they are not the focus of this research. Finally, the economic considerations are extensively considered and evaluated in this research.

Regarding terminology, it should be noticed that not all the terms were consciously defined when this research started. Consequently, in the appended papers, synonyms (*projects, initiatives* and *sustainable, feasible, viable*) were used more as a matter of style in the text rather than as specific concepts related to theory. This means that no specific terms were preferred despite the fact that the focus of the research was declared prior to the papers being written. However, after starting the introductory chapters of this thesis it seemed logical to define these terms clearly. Accordingly, the terms *city logistics initiatives* and *city logistics projects* were used initially to describe an act intended to resolve city logistics challenges or improve a situation. *Initiative* is a plan or process to achieve something or solve a problem in city logistics. *Project* is a planned activity intended to achieve a particular purpose within a time plan. Therefore, the term *city logistics initiative* is used in this thesis to speak about the process and the planned activity with a particular focus. The term was used to avoid confusion and to be in line with several researchers in the field.

1.5 Readership

The problems discussed in this thesis come from real world challenges, such as the requests for traffic-free cities and cost-effective distribution of goods. Real world problems are sources of inspiration for research. Hence, this thesis is expected to be read by primarily academics doing research in city logistics and business models. Secondarily, this thesis is expected to be read by stakeholders and initiative owners and managers involved in city logistics.

People reading this thesis might not only gain an awareness of business models in city logistics, but also about how to achieve more successful initiatives in city logistics through business model components. The background to city logistics is that the proportion of people living in cities and their consumption is continuously increasing, while environmental demands and requests for traffic-free cities also are increasing. There is a big challenge for cities of the future to achieve a cost-effective and environmentally efficient distribution of goods. Along with the three appended papers, the components and their interrelations of a city logistics-based business

model were studied. The knowledge gained from the papers will contribute to more successful city logistics initiatives.

1.6 Thesis outline

The thesis is structured as follows. Chapter 2 introduces the research methodology, which includes the scientific reasoning and positioning, the research design and strategy, the scientific reflection on research quality as well as the research process. Chapter 3 presents the frame of reference and the identified research gap. Chapter 4 summarises the main objectives, findings and implications of the appended papers. Chapter 5 discusses the research findings. Chapter 6 concludes the thesis and presents the major theoretical and practical contributions of the research. The chapter concludes by highlighting directions for future research.

2 Research methodology

This chapter presents an overview of the research methodology. It starts with the scientific reasoning and positioning of the research, and defines the research approach. This is followed by a discussion of the research design and strategy. The design includes two studies, which address one or two research questions, and the studies' respective methods. The scientific reflection and the research quality are then discussed in terms of reliability and validity as well as the bias of respondents and the researcher. The chapter ends with a description of the research process.

2.1 Scientific reasoning and positioning

The research presented follows the tradition in logistics of using a systems approach to provide an answer to the research questions (Aastrup et al., 2008; Hellström, 2007; Gammelgaard, 1997; Gammelgaard, 2004). To gain insights into the system under study, which is city logistics, the boundaries of the system should be clarified. City logistics is the sum of several components that interact with each other (Awasthi and Proth, 2006). These components are stakeholders, consolidation, distribution, handling, storage, and economy (Awasthi and Proth, 2006). A change in the city logistics system occurs whenever a change in the components takes place. For instance, a conflict between a group of stakeholders affects the entire city logistics system because this conflict can become a barrier to communication between the private and public sector (Taniguchi at al., 2014). In addition, the system can be challenged and enhanced by changes that occur in external interventions, such as policies, rules, regulations and infrastructure that interact with the components of the system being studied.

The systems approach allows both inductive and deductive reasoning (Arbnor and Bjerke, 1994). Mangan, Lalwani and Gardner (2004) state that scientific reasoning ranges between two general approaches: deductive and inductive. This research called for a start with inductive reasoning, with observations coming from the field. A participant observation study was carried out to identify the stakeholders' needs and motives for participating in a city logistics initiatives. This study relied on empirical data gathered by the researcher. The empirical data were

supported by an initial literature review[1] of the theoretical stances and frameworks in multiple domains of knowledge that compose the field of city logistics. Accordingly, the research started by searching for empirical contexts and findings in previous studies on stakeholders' motives and goals for participating in city logistics. It then moved on to search for a research gap.

Regarding my philosophical stance, there are many constructed city logistics realities that can be studied, measured and described. These realities change among stakeholders based on their motives and goals, and among city logistics initiatives due to their different characteristics, rules and regulations. In practice, this research is highly applied with the objective of describing and explaining the content of the components of the business model. At the same time, I am aware that the knowledge generated about city logistics is influenced by the reasons for failure of the initiatives, the need for research, as well as my perception of reality.

2.2 Research design and strategy

Research can be conducted in a number of ways. The scientific area that is studied and the type of research questions determine the research strategy and the appropriate methods. Considering the scientific systems approach, a qualitative research strategy fits this research better. The research consists of two studies – a literature and practice review study and a participant observation study – and three appended papers. All were conducted within the framework of one project: SamCity (see Appendix A). The studies and appended papers address the three research questions.

The literature and practice review study provides insights into the content of the components of a city logistics-based business model and explores their interrelations. The data were collected from academic literature and examples of best practices in city logistics initiaves. More precisely, a content review of the existing academic literature with examples from practice was carried out to identify the components of a city logistics-based business model that were primarily/only related to city logistics.. The importance of this study then is in its explanation of the components and their interrelations in a city logistics-based business model, since the components are the basis for a sustainable model. The study defines the scope and the owner of a city logistics-based business model. RQ1 is addressed in the literature and practice review study that resulted in Paper 1.

The participant observation study is explanatory and studied the actual SamCity project. Participant observation studies are uncommon in logistics research (Pålsson, 2007). This study investigated the stakeholder groups involved in the

[1] This literature review was carried out by the author at the beginning of her doctoral studies. Its methods and results are not fully reported here, but more details are presented in section 2.4.

SamCity project and the potential of obtaining an economically sustainable business model. The participant observation study was designed for data triangulation by collecting data not only from direct observations but also from semi-structured interviews, notes, archival data, meeting minutes and events. RQ2 and RQ3 are addressed in the participant observation study. It aimed to investigate two of the components of the business model: stakeholders and value proposition. Specifically, RQ2 (which resulted in Paper 2) required a design that permitted the use of a multi-criteria decision model that utilises the analytical hierarchy process (AHP) to rank alternative motives and their importance in a stakeholder value matrix. The purpose of Paper 2 was to provide a structured method for prioritising among the diversity of motives and goals of the stakeholders involved in city logistics. Applying this method also showed the relative importance of the stakeholders involved in city logistics and their motives and goals for the long-term success of an initiative. Thus, Paper 2 presents evidence that a combination of stakeholders' motives and goals needs to be fulfilled to achieve a sustainable business model of city logistics. The main data source of Paper 2 was the semi-structured interviews with the stakeholders of SamCity. It allowed the collection of comparable information regarding the stakeholders' motives and goals in a short period.

The participant observation study also addressed RQ3 and resulted in Paper 3. Paper 3 is based on a quantitative data and cost/benefit analysis (CBA) and generates knowledge about the value creation and value capture in business models for city logistics by describing the relative importance of various cost, revenue and goods volume variables. As such, Paper 3 provides insights on how to obtain economically sustainable business models in city logistics. A CBA was chosen since it is the process by which the decisions and activities of the SamCity project are analysed (Gonzalez-Feliu, 2012). Therefore, a CBA is the most comprehensive and theoretically sound form of the economic evaluation of SamCity, since it seeks to place monetary values on both the inputs (costs) and outcomes (benefits) of the city logistics activities of the project. The two studies are an integral part of the research and are described in the following subsections. Figure 1 details the linkage between the research questions, research methodology and research studies.

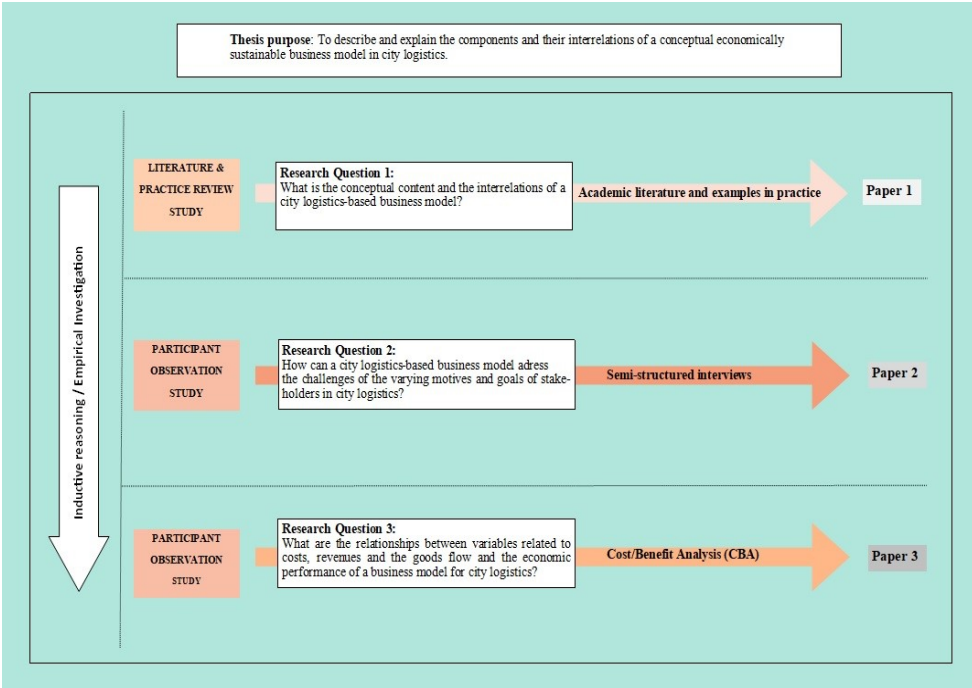

Figure 1. Research design

Literature and practice review study (Paper 1)

As mentioned in the introductory chapter, the knowledge about city logistics-based business models and their components is rather limited. This is why the author needed to design and carry out a literature and practice review study. This method provided insights on what has and has not been investigated as well as on how other researchers in the field have defined and measured the key concepts of the components. This method was inspired by Bocken et al. (2014) and Wee and Banister (2016). Specifically, the process began by examining the practical implementations of the solutions from the city logistics initiatives' research. The study contributes to the field by moving the research forward and describing the content and the interrelations of the business model components. A review of Osterwalder and Pigneur's business model was carried out in which its content and its components were analysed. This general business model was selected because it describes the rationale of how an organisation creates, delivers, and captures value in economic, social, environmental, cultural or other contexts, and was thus considered comprehensive. In this study, the content of the literature was analysed with a focus on the selected initiatives' specific characteristics. This resulted in the

identification of the components of a city logistics-based business model. Digging into the Osterwalder and Pigneur's components and their contents helped the author to understand the content of the components of business models in the framework of city logistics. The study then describes the adaptions that were carried out to come up with a proposed city logistics-based business model. This provided the author with valuable insights into the components, their content and their interrelations. A city logistics-based business model should define the owner of the model (Björklund et al., 2017), the mission of the initiative (Cagliano et al., 2016) and the clear content of its components and their interrelations.

Paper 1 is based on the literature and practice review study. Paper 1 discusses how the components of the city logistics-based business model and their interrelations are developed based on the academic literature and examples in practice. These examples are a crucial addition as they provide insights into the actual implementations of the business model in the initiatives Paper 1 provides a brief but rather straightforward description of the applied method. The data were analysed through several levels of coding and categorisation. As part of this process, the author conducted several rounds of individual coding and the entered the results into several Excel sheets to support the categorisations. This process was repeated until saturation was reached on the final categorisation. Appendix B provides a detailed description of the method, data collection and analysis of the study following the guidance of Wee and Banister (2016) on *How to Write a Literature Review* and Bocken et al. (2014) on how to performs a practice review.

Participant observation study (Papers 2 and 3)

The participant observation study explored empirically the stakeholders and the potential of obtaining an economically sustainable business model in city logistics.

The study involved a wide range of methods for data collection, the combined results of which are presented in Papers 2 and 3. Participant observation is not simply showing up at a site and writing things down (DeWalt et al., 1998). The study included many methods, such as semi-structured interviews, direct observations, meeting minutes, notes, archival data and events (Pålsson, 2007). Although the method is normally characterised as qualitative research (Yin, 2014; Howell, 1972), the research presented in this thesis also includes quantitative dimensions, such as data about cost and revenue structure. For this quantitative dimension of the study, we examined a six-month pilot implementation of consolidated transportation and value-adding logistics services from a UCC to public establishments and private stores in the centre of Malmö, Sweden between March and August 2015. The purpose was to explain the impacts of cost, revenue and goods flow variables on the economic performance of a business model for city logistics.

The participant observation study lasted one year. Two researchers carried out the data collection: my main supervisor, who was involved for three years, and myself, who was involved for one year. The data from the participant observation study were documented in a protocol as suggested by Yin (2003), which logged data regarding meeting minutes, notes, events, direct observations, interviews and archival data. The main data source for Paper 2 was the semi-structured interviews. The interviews were conducted in October-November 2015 with a representative of each of the stakeholders of SamCity. Throughout the project, each organisation was represented by at least one participant in SamCity. These participants were responsible for the project in each organisation and were accordingly selected as respondents in the interviews. During the one-year period and together with the guidance of my supervisor, I was, as a researcher, able to obtain more detailed and accurate information about the stakeholders involved in the SamCity project, as well as to obtain accurate data about how the UCC of the project operates. Some of the observable details were the reasons why the stakeholders were interested in such a project or their expectations for their own company's benefit. The strength of the study was the inclusion of two researchers with different backgrounds: Two perspectives helped to more accurately select what was relevant and important.

However, although the thesis author was present in both the implementation and consortia meetings during the year and received invitations to all the events, her role was still that of a bystander. The author mainly listened and observed how the stakeholders behaved and thought by watching for verbal cues and keeping notes. Thus, it was passive participation, as Spradley 1980 suggests.

A limitation of a participant observation study is the risk of losing all levels of objectivity due to personal bias. To obtain rigor, the study involved investigator triangulation in order to ensure that the interpretation and evaluation of the data were not influenced by the authors' personal views, which is in line with Douglas and Johnsson (1977). Therefore, the investigator triangulation was a form of crosschecking information between the two aforementioned researchers. In addition, while conducting the interviews, feedback from participants on the observations was requested to ensure that the author was accurately depicting their experiences and the accuracy of the conclusions drawn from the data.

2.3 Scientific reflections on research quality

The following section evaluates the research quality of the licentiate thesis as a whole. Specifically, the criteria for ensuring quality in research are covered: reliability, construct and external validity. Section 2.3.2 discusses the bias of the thesis, since the findings of any research are subject to the choice of methods and bias as well as mistakes in the execution of the studies.

2.3.1 Reliability and validity

Quality of research is usually discussed in terms of reliability and validity. Reliability is concerned with how consistent the results are in cases of repetition of the research (Yin, 2014; Merriam, 1994). Validity is concerned with both construct validity, which shows whether a study measures what it states is to be measured (Mentzer and Kahn, 1995), and external validity, which shows the generalisability of the results (Bryman and Bell, 2011; Merriam, 1994).

Reliability is achieved during data collection and demonstrates that the research procedures are consistent and can be repeated with the same results (Ellram, 1996; Yin, 2014). The processes and designs of this research are well documented. To support reliability, the data from the literature and practice review study were documented in Excel spreadsheets that covered the selection, categorisation and coding phases of the study and were updated often. The data from the participant observation study were documented in a protocol as suggested by Yin (2003), which logged data regarding meeting minutes, notes, events, observations, interviews and archival data. In order to increase reliability, all interviews followed guidelines for conducting them. The respondents were also given the opportunity to comment on the transcription of their interviews, but no comments were returned to the author. From a data perspective, all interviews were both audio-recorded and documented in writing. The interview guide used for the interviews is presented in Appendix C.

Construct validity identifies the correct operational measures for the concepts being studied during the data collection phase (Ellram, 1996; Yin, 2014). Construct validity was strengthened in the participant observation study by collaborating with the co-author of Papers 2 and 3 in several phases of the data collection and data analysis in order to minimise misleading conclusions. The co-author of Papers 2 and 3 was involved in the data analysis for both papers but not in the interviews. In the literature and practice review study, the construct validity was strengthened by the choices of the author to use both academic literature and examples from practice to study the city logistics initiatives and implementation of the general business model.

In terms of internal validity, though, the participant observation study was used to increase its validity, since the direct observations provided the researcher with a better understanding of the phenomenon studied. According to DeWalt et al. (1998), the goal of a research design that uses participant observation is to develop a comprehensive understanding of the phenomenon studied. In the participant observation study, validity was stronger since several other data sources were used including semi-structured interviews, meeting minutes, notes, events and archival data as well as a CBA, which is a quantitative method. In terms of external validity, this study indicates that the method can be used by several other initiatives to achieve the same findings. Our participant observation study provided a new context for a validated model.

In order to increase internal validity, the literature and practice review study set the criteria for facilitating the process. Future reviewers might come up with

different results, since the research in the field can change and evolve in unknown directions. The review presented here ended in March 2017. In terms of external validity, this research permits conceptual replicability since researchers aiming to conduct a very similar literature and practice review have a defined protocol to follow, presented in Paper 1. During the whole process, several levels of coding and categorisation were conducted followed by the generation of several Excel sheets to support the categorisations. This process was repeated until saturation was reached on the final categorisation for the business model components and their interrelations. The details are presented at Appendix B. This literature and practice review was based on mixed methods studies, but did not aim to provide statistical replicability.

2.3.2 Respondents' and researcher's bias

The results of a participant observation study can be influenced by the interview respondents' bias and by the observer's personal bias. At least one participant represented each organisation throughout the SamCity project. These participants were responsible for the project in their respective organisations and were selected as respondents in the interviews. Thus, the interview material only contains the respondents' perceptions of the project. Regarding my personal bias, I tend to lean in a certain direction so there was a risk that I was looking for data that support the way I tend to think. To minimise bias in the data collection, I followed specific interview guidelines as described by Brinkmann and Kvale (2015) to develop the interview guide used for the semi-structured interviews (see Appendix C), and focused on getting complete answers from the respondents and not analysing any data during the interviews. All the interviews were audio recorded and then transcribed by the author. Specific coding was created while reading the interviews to identify common statements from the respondents. The common statements were grouped together in a category and compared to the secondary data sources. Secondary data sources were used to support the outcomes of the interviews. These included the data from the direct observations, meeting minutes, events and archival data. Subsequently, the literature was reviewed after conducting the interviews so emergent concepts could be grounded in data as far as possible (Cutcliffe, 2000). In addition, I analysed the data several weeks after I concluded the interviews, so that the influence of the respondents no longer had as big an effect on me.

To avoid personal bias, criteria and boundaries were set for the literature and practice review. However, it is important to keep in mind that this review has its limitations in terms of verified sampling bias, for instance, in the language criteria and choice of database.

2.4 Research process

The research process started in 2015 with my enrolment as a PhD student at Lund University. It started with a direct participant observation, which was supplemented by an initial literature review. This review helped to identify the research gap in business models in city logistics. The participant observation study along with this initial literature review led to the research proposal, where the idea for the methodological approach for future papers was briefly described. This review also included the current knowledge and substantive findings, as well as theoretical and methodological contributions to the topic of city logistics. This shows that the initial literature review is the basis of the all the research and that both the literature and practice review study, and the participant observation study are based on it.

The semi-structured interviews were conducted during October-November 2015. The data from the interviews along with the other data from the participant observation study resulted in Paper 2. Afterwards the empirical data on costs and revenues of SamCity were collected. The analysis of these data resulted in Paper 3. The identified research gap for a business model in city logistics together with the results from the participant observation study finalised the idea of Paper 1, which was to perform a full-scale literature and practice review study of city logistics initiatives, and identify the content of the business model components. The direct observations were supported by the initial literature review.

The research process is illustrated in Figure 2. As noted there, the order of the three papers appended to this licentiate thesis does not follow their chronological order. The disposition of the papers is due to my intention of starting with a clear focus on the content and the interrelations of the components of the business model and then moving on to the potential of obtaining an economically sustainable business model.

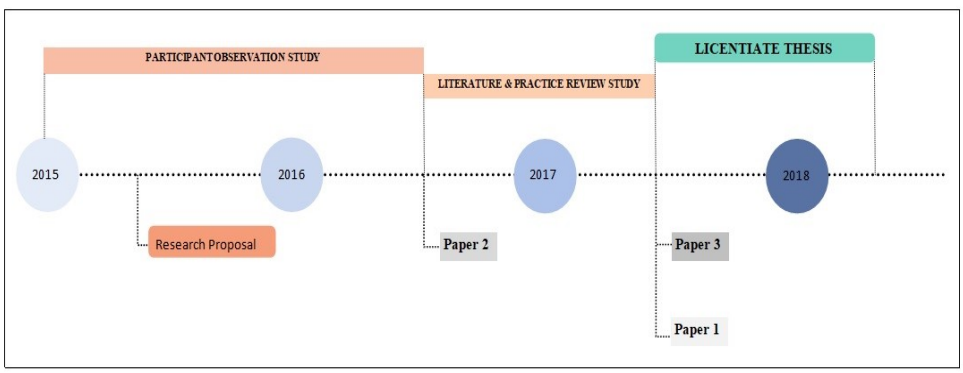

Figure 2. Overview of the research process

3 Frame of reference

This chapter presents the theoretical frame of reference for the research. It starts with a brief description of the economic perspective of logistics and city logistics. It continues with a brief description of the research area of city logistics and moves on to the general business model of Osterwalder and Pigneur's (2010) which is the foundation of the city logistics-based business model. Most of the city logistics initiatives have implemented Osterwalder and Pigneur's (2010) general business model, which is why it was chosen. The chapter then reports on the adaptations that were carried out to come up with a proposed city logistics-based business model and some of its components. The chapter concludes by presenting the point of departure.

3.1 Economic perspective of logistics and city logistics

Logistics studies the allocation of resources of the economy to satisfy all the requirements of the goods flows from the point of origin to the final destination (Council of Logistics Management, 1998). It deals with the process of managing the procurement, storage and flow of goods to the final consumption point via freight transportation organised in an efficient way (Christopher, 1998).

Freight transportation is essential for the development of cities and of supply chains as several supply chains start, end or bypass an urban area through the transport operations. Mega cities depend on sustainable freight transportation systems to ensure their economic power. According to Hesse (1995), urban freight transportation is characterised by a growing diversity of products and distribution channels, increasing distances and vehicle miles travelled, and a growth in the volume of transported goods in total (Hesse 1995). City logistics aims to improve urban freight transportation by integrated analyses of transportation infrastructure, resources, and economic environment. More precisely, city logistics involves collaboration between several stakeholders, resulting in a demand for more sustainable distribution systems. Advanced planning systems are required especially for the operation of UCCs. These planning systems need to integrate information about customers, orders and about the expected state of urban traffic networks.

3.2 Research areas in city logistics

City logistics is a research field that includes several research areas ranging from models and frameworks to innovative solutions. Four research areas in city logistics were identified in the initial literature review: policy development, technical solutions, evaluation models and frameworks, and business models.

Policy development is a comprehensive framework for planning and developing efficient freight distribution systems in city centres (Stathopoulos et al., 2012). Planning is divided into city logistics planning (Nuzzolo and Comi, 2014; Jiang and Liu, 2016; Awasthi et al., 2006) and transport planning (Betanzo-Quezada et al., 2013), both of which are crucial to achieve long-term objectives. Several researchers concentrate only on policy development and endeavour to recognise its characteristics and influences on the city logistics system (Marcucci and Musso, 2010; Stathopoulos et al., 2012; Ville et al., 2013). Authorities develop policies and it is important to investigate how city logistics initiatives implement them. Implementation measurements are divided into two subsets regarding the policy's application: regulations related to city logistics are defined by local authorities (the public sector) to restrict access to the urban area (Ville et al., 2013).

Several *technical solutions* have been proposed and implemented to mitigate the complex issues of city logistics initiatives in the last decade. Most of these solutions are based on collaboration between stakeholders, the use of light goods vehicle (Browne et al., 2010) or electrical vehicles (vanDuin et al., 2010), off-hour deliveries (Holguín-Veras et al., 2016; Verlinde and Macharis, 2016) and vehicle routing problems (Cattaruzza et al., 2015; Heng et al., 2015; Lin et al., 2014). Technical solutions are all the actions taken to implement a decision. There are also a large number of agent-based and multi-agent models and frameworks developed to solve city logistics problems by concentrating on different aspects of the problem. Several of these models try to improve some of the innovative solutions, but some of them require considerable infrastructure support in order to be carried out (Nowicka, 2014).

In line with this, several researchers have created *frameworks for evaluating* UCCs. For instance, van Duin et al. (2016) came up with a framework that showed that UCCs should generate enough revenues to cover the costs by setting the right price for their services. However, this will only happen when the services offer something that has real benefits for the buyers (van Duin et al., 2016). This is notably attractive in European and Japanese cities where urban centres are highly dense with congestion, and where rental space is very limited (Browne et al., 2005).

Another research area identified is the implementation of a *business model* in city logistics. Several researchers have focused on this because of the absence of business models, which has been identified as a major barrier to implementing city logistics (Quak et al., 2014).

3.3 General business model

"A business model describes the rationale of how an organisation creates, delivers and captures values" (Osterwalder and Pigneur, 2010). Their business model assumes that the goal of an organisation is to generate revenue streams. They introduce a conceptualising approach to business modelling that they call the "business model canvas". It consists of nine components and four business areas. They conclude that the business model is a tool to constantly interpret and renew the business.

The nine components of the business model canvas are illustrated in Figure 3 and according to Osterwalder and Pigneur (2010), the canvas is a visual design that simplifies the understanding of business model analysis. The business model canvas consists of a visual chart with the nine components that describe the four business areas: value proposition, infrastructure, customers, and finances (Osterwalder and Pigneur, 2010). The canvas presents, to some extent, the interrelations between some of its components, since it assists firms in aligning their activities by illustrating potential trade-offs.

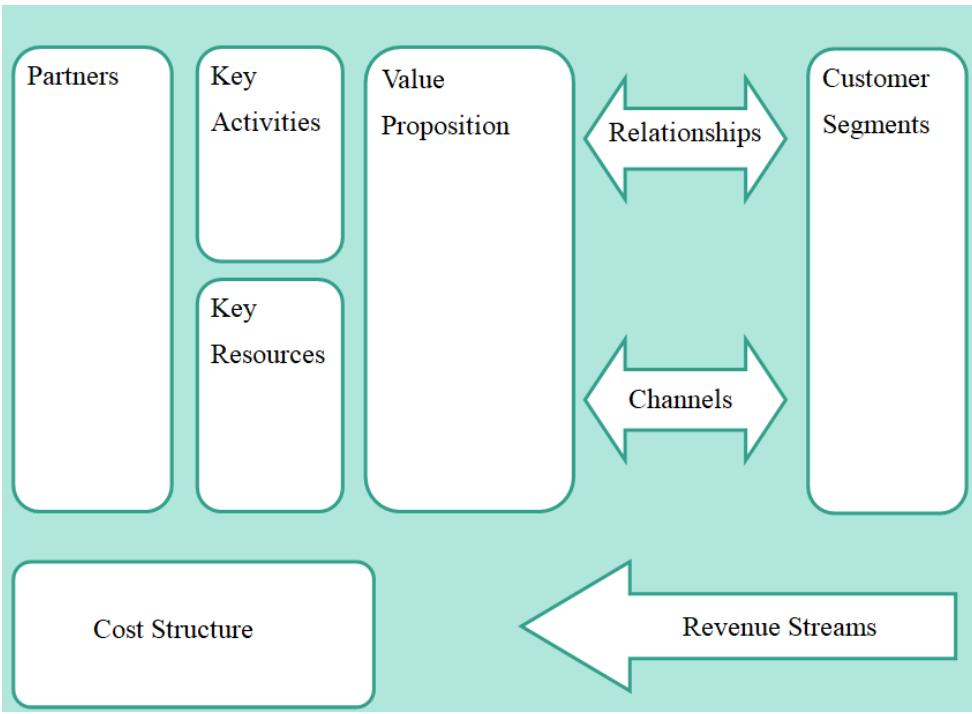

Figure 3. The nine components of the business model canvas of Osterwalder and Pigneur (2010)

The business model consists of the *key partners* that make it work. Key partners develop expertise, methods, processes, policies and structures that will form the business strategy. Since a company or organisation seldom owns all the key resources needed to perform every key activity, it needs to develop relations (partnerships) with key partners (other companies and organisations) that can provide the expertise.

Key activities are the most important activities resulting in the value proposition of an organisation. They include design, manufacturing, quality control, production, problem solving and network.

Key resources are all the necessary resources for a value proposition. They are an asset since they are needed to sustain a company or an organisation and include knowledge, licenses and access to customers. Specifically, they can be categorised into physical resources (manufacturing facilities, machines systems and distribution network), financial resources, human resources (knowledge) and intellectual resources (brands, patents and copyrights).

According to Osterwalder et al. (2005), a *value proposition* is a business and marketing statement that shows why a consumer should buy a company's product or use a service.

An organisation can deliver its value proposition to its customers through *channels*. These channels distribute the value proposition of a company or an organisation in the most cost effective way. It is important to understand which channel is the optimal for a company to reach its customers.

In order to build a sustainable business model, an organisation must clarify which *customers* it tries to serve. Various sets of customers can be *segmented* based on their common needs. Nevertheless, a company or an organisation must define the *customer relationship* they want to create with every customer. Without customers, no profit can be achieved.

Cost structure describes the most important monetary consequences while operating under a business model. There are fixed costs that relate to all the expenses that remain the same regardless of the production volume, and variable costs that heavily depend on the volume of output that is produced. Usually, fixed costs are referred to as overhead costs, while variable costs are referred to as operational costs.

Revenue streams are the profits a company or an organisation makes from each customer. A business model distinguishes its revenues into revenues resulting from one-time payments and recurring revenues, which deliver the value proposition. The revenue streams can be generated in several ways such as from licensing, usage and subscription fees, marketing and advertising as well as from pricing mechanisms.

3.4 City logistics business model

When it comes to city logistics, the term business model is in practice and theory used for a broad range of informal and formal descriptions to represent core aspects of a city logistics initiative, including the scope and the mission of the initiative, policies and strategies. In this context, Cagliano et al. (2016) speak about the mission of a city logistics initiative and pinpoint how crucial the clarity of an initiative's mission is for the implementation of a "business model" for city logistics. Björklund et al. (2017) focus on the owner of the business models. They state that it is critical to address the owner in order to define the roles of the stakeholders and requirements of a initiative. Benjelloun et al. (2010) state that a business model in city logistics needs to address crucial economic issues that are related to a initiative's infrastructure and operations facilities, policies, management and core responsibilities. Turblog (2011) presents a business model for urban logistics that was inspired by Osterwalder and Pigneur (2010) in which they have identified externalities as a new component for the business model. Although, all these researchers have made progress towards a city logistics-based business model, the knowledge about such a model is insufficient, and the knowledge about the content of the components of such a model and their interrelations is absent.

A well-known business model in city logistics that deals mostly with the economic aspects is the Binnenstadservice.nl (BSS). This business model is much more economically sustainable in city logistics than the models of other such initiatives. BSS has a business model with a clear scope resulting from lessons learnt over a few decades of field experiments and a one-year pilot implementation, and is shifting to target small and independent receivers in the service area (Quak and de Koster, 2009). The general business model of Osterwalder and Pigneur, at the same time, was being implemented in city logistics initiatives, and was targeting shippers as customers by providing them with a central consolidation point. Hence, with the BSS business model, a UCC becomes the main gateway to small and independent receivers. It provides basic free last-mile delivery services and optionally paid value-added services to the member receivers. However, shippers who wish to do business with the small and independent receivers must agree to share the cost of the last-mile deliveries with the UCC in order not to risk losing business (Quak, 2008). While this business model is an inspiration for other initiatives to imitate, and has expanded its application to other cities in the Netherlands, it is unclear what the components of the business model are, much less their interrelations. It is also unclear who owns the business model. Therefore, this business model needs to be broadly investigated in the terms of the owner of the business model, its components and their interrelations, as well as the content of the components.

Following this discussion, a description of the stakeholders, key activities, key resources and value proposition is presented because they are the most common components discussed in the city logistics literature.

3.4.1 Stakeholders

In the last 30 years the concept of people and organisations involved in city logistics initiatives are covered by the term *stakeholders* (Taniguchi et al., 2001). Stakeholders are *"any group or individual who can affect or is affected by the achievement of the organisation's objectives"* (Freeman, 1984). In city logistics, stakeholders have an interest or a concern in a initiative's objectives and outcomes. Quak and Tavasszy (2011) and Macário et al. (2008) state that stakeholders are arguably a component of the business model in city logistics. Specifically, stakeholders as a component include all the separate business models of the individual stakeholder groups as well as represent the information sharing between the stakeholder groups and their motives and goals (Awasthi and Proth, 2006).

A synthesis of the categories of the stakeholders in city logistics results in five general categories: shippers, freight carriers, administrators, residents, and others (e.g. Barceló, 2005; Benjelloun et al., 2010; Taniguchi, 2001). The last category can include NGOs and property owners (Pålsson and Katsela, 2016). These categories show that stakeholders in city logistics are both within the urban area (but are not directly involved in the urban freight transport movements, such as administrators, residents and others) and within the supply chain (such as shippers and freight carriers). Each stakeholder has a distinct role to play in city logistics initiatives. For instance, shippers are commonly interested in time and cost-efficient deliveries; freight carriers are interested in business and in performing cost-efficient deliveries; administrators are primarily interested in minimising the environmental impacts of city distribution and in achieving a vibrant and attractive city through economic performance; residents are affected by the city logistics solutions (Benjelloun et. al., 2010); others play a key role in implementing city logistics solutions (Pålsson and Katsela, 2016). All these stakeholders interact with each other in a city logistics initiative and with the customers involved. The stakeholders' interactions are significant for implementing the key activities of a city logistics initiative (Awasthi and Proth, 2006).

3.4.2 Key activities and key resources

A business model can be seen as a set of key activities (Afuah, 2004). Certain activities are carried out in a city logistics initiative in order to perform and create value for its customers (Afuah, 2004). A business model should also address which activities a given initiative should perform, how they should be performed, when and why (Afuah, 2004). Usually, the first activities to be considered are distribution, transport and planning. After that, the activities taking place in UCCs are normally considered. These include warehousing, handling, and distribution (Browne et al., 2011).

Key resources are the main inputs that a initiative uses to create its value offer and value proposition. The key resources of city logistics initiatives are largely related to UCCs and focus on planning and information systems as well as the sustainable distribution of goods. Specifically, they are related to the use of more environmentally friendly vehicles such as electric vehicles (Allen et al., 2014) and intelligent transportation systems (ITS) or information and communication technology (ICT) systems (Ehme, 2012). Consequently, UCCs provide optional value-added logistics and retail services such as off-site stockholding, consignment unpacking, preparation of products for display and price labelling which are all significant for the business model, since they generate a flow of finances for the UCC (Browne et al., 2011; Malhene et al., 2012).

3.4.3 Value proposition

A business model in city logistics provides insights into the value proposition and strategic choices of a initiative (Pålsson, 2014). Benjelloun et al. (2010) also focus on the value, but investigate the value network and identify three major approaches to business models for city logistics. The first approach corresponds to private initiatives. These involve unconstrained co-operation regarding consolidation and distribution among carriers with little involvement of governmental regulations and no subsidies and are supposed to become profitable due to increased logistical efficiency. The second approach is based on strict licensing practices where local and central governments play leading roles. The third approach is to make city logistics a public service where large trucks are not allowed in city centres. Goldman and Gorham (2006), and Russo and Comi (2011) focus on processes to create value, while Allen et al. (2010) address the business model component capture value in UCCs. They emphasise that a key to capturing value and having economically sustainable UCCs is that the stakeholders are willing and able to meet the financial costs of the UCC in return for the benefits they receive. According to Johnson et al. (2008), a business model is described by four components that lead to a value proposition; the components are the customers, profit, key resources, and key activities. Allen et al. (2014) and Triantafyllou et al. (2014) demonstrate that the value proposition for customers is in generating revenue streams that cover all the costs from key activities and resources. The component of value capture is addressed in the UCC. A key to value capture is that the stakeholders are willing and able to meet the costs of the UCCs in return for the benefits they receive (Allen et al., 2010). In this context, van Duin et al. (2016) state that the UCC should generate enough revenues by settinddrg the right price for its services in order to cover the costs. However, this will happen when the services offer something that have real benefits for the buyers (van Duin et al., 2016).

3.5 Summary and point of departure

A sustainable business model is required to make city logistics really work in practice. By using the general business model (described in 3.3), several authors discuss the business aspects that need to be considered when implementing or scaling up city logistics. The field demonstrations of the general business model clearly show improvements in operational efficiency, flexibility and environmental impact. However, the initial review of the city logistics literature shows that the need is high for an appropriate business model that recognises and includes the economic aspects. The review also showed that it is critical to recognise the complexity of the system and to be able to design a business model for city logistics, considering all its complexity. By considering the general business model presented in section 3.3 as the starting point of the research, and by conducting the more extensive literature and practice review study, the results contribute to both research and practice by identifying the components and their interrelations. More accurately, the research on which this licentiate thesis is based is focused on providing a description and explanation of the content of the components of a city logistics-based business model and their interrelations because there currently is no definition of a city logistics-based business model nor of its component.

4 Summary of appended papers

The appended papers have different emphases in relation to the overall purpose of the thesis. Based on a literature and practice review study of city logistics initiatives and on the general business model of Osterwalder and Pigneur (2010), Paper 1 presents the city logistics-based business model as a series of components. Paper 2 clearly focuses on how the business model can address the challenges of stakeholders' motives and goals in the participant observation study. Paper 3 examines the impacts of cost, revenue and goods flow variables on the economic performance of business models for city logistics.

4.1 Synthesis of the appended papers

The emergence of business models is a popular phenomenon for city logistics (Benjelloun et al., 2010, Quak, 2011, Quak et al., 2014). However, business models are significant and possibly one of the most broadly discussed and yet least understood terminologies in city logistics (Björklund et al., 2015). This reflects a theoretical problem that complicates the implementation of business models for city logistics initiatives, resulting in a practical problem: the lack of successful initiatives. Thus, there is a need to clarify the city logistics-based business model (Benjelloun et al., 2010).

The three papers in this thesis have in different ways and from different perspectives elaborated on a city logistics-based business model. Paper 1 describes the components of the business model and their interrelations. Two of its components are stakeholders and value proposition, which are addressed in Paper 2 and Paper 3, respectively. Paper 2 deeply examines stakeholders' motives and goals and found that the challenges occur mainly from the heterogeneity of their motives and goals, and elaborates on how the business model addresses them. Paper 3 is principally inspired by one of the main reasons for failure of the city logistics initiatives: the lack of economically sustainable business models. In this context, Paper 3 develops knowledge for the value creation and value capture in business models for city logistics by analysing the relative importance of various cost, revenue and goods volume variables. Paper 3 shows the potential of implementing an economically sustainable business model. A key to capturing value and having economically sustainable initiatives is that the stakeholders are willing and able to

meet the financial and economic costs of the initiative in return for benefits they receive. Together the three papers show a coherent picture of the economically sustainable-based business model. The framework that combines the results from the papers and places them in the larger context of city logistics is presented in Chapter 5.

4.2 Paper 1 based on the literature and practice review study

The City Logistics-based Business Model: A Series of Components

Objectives

The starting point of the paper was the application of the general business model. Although there has been a focus on business models in city logistics in recent years in the literature, the components and their interrelations have not been explored or defined. Consequently, the purpose of Paper 1 was to identify and describe the components of the city logistics-based business model. Paper 1 identifies and describes the content of the components through a literature and practice review study of 20 European initiatives and Osterwalder and Pigneur's (2010) general business model. The process contains criteria for selection and multiple levels of data categorisation and coding, which are described in more detail at Appendix B.

Findings

The following components that should be included in a city logistics-based business model were identified: *value propositions*, *stakeholders (shippers, freight carriers, administrators, residents and others: non-governmental organisations and property owners) key activities (distribution, shceduling, policies)*, *key resources (logistics bases-UCCs)*,core competencies, delivery schedule) *customer types*, *customer segments*, *customer relationships*, *the value for society, environment and citizens*, *financial conditions*, *value network*, *value capture*. Figure 4 summarises the components and the four business areas they belong to: *infrastructure*, *offer*, *customers,* and *financial viability*. It also provides an idea of the interrelations between the components. Paper 1 highlights that the scope and the owner of the business model should be clarified before the components and their interrelations. Notably, the scope of the business model helps the owner and the stakeholders to keep track of economic performance throughout the initiative as well as to discuss

and monitor the results. The owner uses the model to design the main objectives, challenges and strategy of the initiatives, and to define the roles and requirements of the stakeholders. However, there is a great possibility that the owner of the business model may not be the owner of the initiative. The initiative owner could be one of the stakeholder groups, such as governments and municipalities, while the owner of the business model can be a governmental organisation that finances the whole initiative. Hence, the scope of the business model of different initiatives can vary depending on that factor.

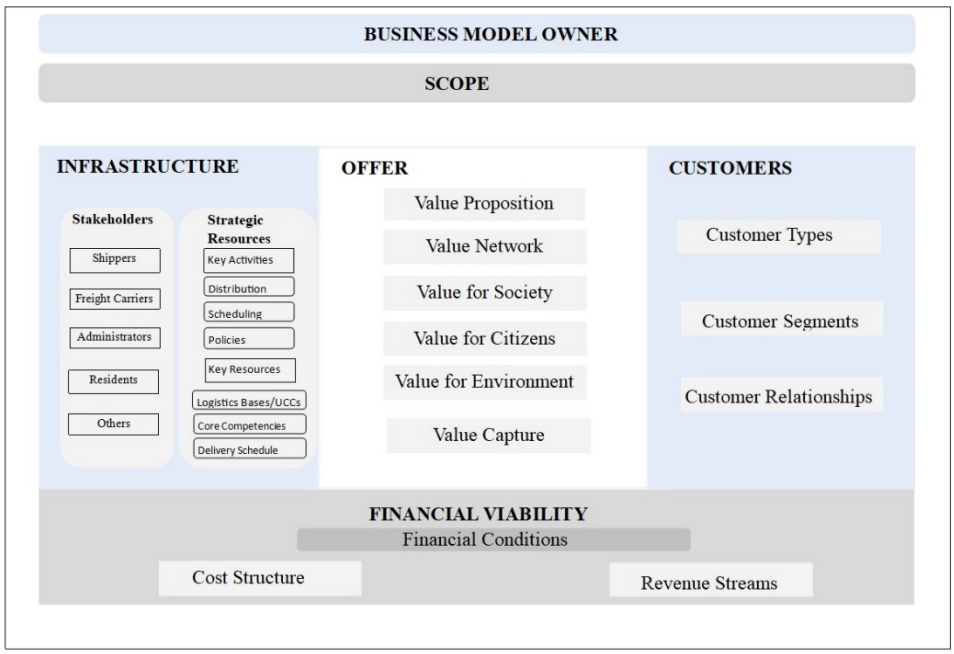

Figure 4. The proposed city logistics-based business model: business areas and components

Implications

Paper 1 clarifies the components of a city logistics-based business model. It highlights the importance of the scope and the owner of the business model. Practically, it shows that the importance of such a business model lies in understanding the components and their interrelations.

4.3 Paper 2 based on the participant observation study

A Multi-criteria Decision-model for Prioritising Stakeholder Motives in City Logistics

Objectives

Although, the diversity of stakeholders and the heterogeneity of their needs is recognised as one of city logistics' principal challenges (Anand et al., 2012b), only a limited number of studies have considered the behaviour of the stakeholders. Thus, this paper presents a method for prioritising the diversity of motives and goals of all the stakeholders involved in city logistics. The paper discusses the relative importance of stakeholders' motives and goals and the value concerns that need to be considered for each stakeholder. This is because a combination of stakeholders' motives and goals needs to be fulfilled for a business model in city logistics to be sustainable. This was numerically evaluated by the AHP method in order to rank alternative motives and their importance in a stakeholder value matrix, which is based on stakeholder theory. The data was gained over three years of the participant observation study and nine semi-structured interviews with the stakeholders of the SamCity project.

Findings

The analysis reveals that the motives and goals of stakeholders cannot always be aligned but can be fulfilled to a certain extent. Paper 2 presents evidence that several stakeholders need to be prioritised and a combination of their motives and goals needs to be met for a business model in city logistics to be sustainable. The value matrix enabled identification of the overall values that needed the most attention, and which values and the extent to which they needed to be considered for each stakeholder. To this extent, the results show that all the stakeholders can be motivated by focusing on diverse value concerns. The results also provide insights on how to balance the different motives and goals stakeholders might have. The analysis thus helped to support the findings from previous research on business models in city logistics, which states that administrators, freight carriers, and receivers are capable of implementing changes in city logistics (Allen et al., 2015; Cherrett et al., 2012). In order to make this more accessible for other city logistics initiatives, the matrix is described thoroughly in Paper 2.

Implications

The implications of Paper 2 can be summarised as follows. The paper provides evidence that a combination of stakeholders' motives and goals needs to be fulfilled for a business model of city logistics to be sustainable. Notably, the paper contributes to the challenge of managing the diversity and heterogenic needs of multiple stakeholders in city logistics. Practically, the findings of the paper can help actors in other city logistics initiatives to find a balance between the stakeholders involved in the initiatives and their motives and goals.

4.4 Paper 3 based on the participant observation study

Evaluation of a City Logistics Business Model: Impact of Cost, Revenue and Goods Flow on Profitability

Objectives

The current literature addresses the limitations of economic considerations in city logistics initiatives (Quak, 2011) and that only 4% of the initiatives provide a CBA (Gonzalez-Feliu, 2012). Thus, the purpose of Paper 3 was to explain the impacts of cost, revenue and goods flow variables on the economic performance of a business model for city logistics. A CBA was conducted on the six-month pilot implementation of the SamCity project with data from the transport providers and municipality. A sensitivity analysis, which highlights the impact of goods volumes and pricing on the economic performance of the business model, was also conducted.

Findings

The findings highlight the relations between goods volumes, revenues, costs and profitability for both private and municipal goods. This helps to understand the business model components of creating and capturing value. The findings provide insights on the business model components of creating and capturing value and indicate a likelihood to make the business model work from an economic perspective. This implies that the business model is the interlocking of the components that together create and deliver value. Value indeed constitutes a central aspect of a business model in terms of the value offered to customers and created

by cash flow (Saebi and Foss, 2015). The analysis thus included costs and revenues for delivering private and municipal goods through a UCC and shows the magnitude of costs and revenues and the importance of goods volumes, where costs and revenues arise. Further, the findings show that the terminal costs are much greater than the distribution costs and that the amount of goods is decisive for the total cost per parcel. Finally, the analysis shows that by adding more logistics services to the city logistics initiatives would potentially reduce the delivery prices and hence make the initiative more economically attractive to customers.

Implications

The evaluation advances knowledge of the value creation and capture in business models for city logistics by describing the impacts of cost, revenue and goods volume variables on profitability. Practically, the findings of Paper 3 can help other city logistics initiatives to gain an insight into general cost structures and the effects of goods volumes on the economy of scale. The findings of the paper highlight the need to focus more on terminal efficiency than on distribution efficiency for total cost efficiency.

5 Discussion of research findings

This chapter presents a city logistics-based business model based on reflections on the main findings of the research relative to the research purpose presented in chapter 1.

5.1 The economic aspects of the components

The research provides an overview of a city logistics-based business model through its components and their interrelations, which can aid in the creation of long-term and more successful city logistics initiatives. The research results highlight this by addressing the importance of the economic considerations of the business model. The research also explains the relative importance of various stakeholders' motives and goals. The general conception for city logistics initiatives is that economically sustainable business models are required for long-term initiatives.

The analysis and findings confirm that the city logistics-based business model is complex because it involves many components and their interrelations. The analysis shows that the complexity is related to the ownership of the business model and the scope of the initiative, which are not identified in the current literature.

Research on city logistics business models is still in its infancy. Nevertheless, progress has been made towards the technical and operational feasibility of business models for city logistics (Quak, 2011). However, in order to be able to study the content and the interrelations of the components, business models in city logistics should have conceptual and economic aspects. According to Teece (2010), to retain the focus on the interrelations between business model components, the conceptual and economic aspects of the model need to be highlighted.

Concentrating on the general business model of Osterwalder and Pigneur (2010), the research presented in this thesis aims to deliver particular insights into the content and interrelations of the components of the city logistics-based business model. All the components are explicitly interrelated with each other in the city logistics-based business model, such as the value proposition, which is related to the customer segments through the customer segments and channels.

The rest of this chapter is organised as follows. A discussion about the importance of the city logistics-based business model components and interrelations is presented and RQ1 is answered. Then, the stakeholders' management and its

relation to AHP and the business model are discussed. This answers RQ2. The chapter concludes with the economic performance of a business model in city logistics and answers RQ3.

The importance of the city logistics-based business model components and interrelations

This thesis supports the reasoning of Benjelloun et al. (2010) on the importance of specific business models for city logistics. The importance lies in the model's components and their interrelations, according to the findings of Paper 1. Such interrelations are essential for a full understanding of how the business model in city logistics works. An understanding of the components and their interrelations is also essential so that city logistics initiatives can be better prepared for the economic, political and technological changes they constantly meet. The findings help to understand how the interrelations between the components can theoretically be explained, explored and perhaps even further developed through interpretation.

Practically, the findings support that the components and their interrelations provide guidance to realise new opportunities for city logistics initiatives and can result in more successful ones. The business model is also a great planning tool for city logistics because it provides evidence on how all the pieces in an initiative interact to create and offer value. Thus, it cannot be approached as a simple model.

Several researchers utilise Osterwalder and Pigneur's general business model (2010) to refer to the way a municipality or stakeholders – mainly freight carriers and transport providers – do business in city logistics initiatives. Although the application of this model provides significant insights, it describes the interrelations of some of the components vaguely, mainly through a theoretical perspective. If you lack understanding of the interrelations between the components, you will end up with a business model that is poorly integrated, which explains why some initiatives have failed.

The analysis showed that the content of the components is of equal importance to an understanding of the owner of the business model and the initiative's scope. The owner uses the business model to define the scope, define the roles and requirements of the stakeholders, address the challenges of urban freight systems and define the strategy of the initiative. The analysis revealed that while several stakeholder groups, such as transport operators and municipalities, are the initiative managers and capable of implementing changes in city logistics initiatives, it would be more comprehensive if the owner of the business model was the organisation that owned and financed the whole initiative.

Stakeholders management

We need to understand the behaviour of the stakeholders and the interactions between them before city logistics activities can be implemented and evaluated. Different stakeholders can have different objectives for the same activities since their points of view can vary in terms of how to improve the whole system. As a result, their individual motives and goals may unintentionally be in conflict with the overarching city logistics objectives. Stakeholders have individual objectives, but they still must collaborate to meet common goals and drive the initiatives. The diversity of stakeholders and the heterogeneity of their needs can be a barrier for communication in the private sector. This can result in several strategic and operational decisions being made that affect the urban freight systems and the public sector, which has a major role in developing policies, rules and regulations for city logistics initiatives (Taniguchi at al., 2014). This is why there is a great need for the stakeholder groups involved to co-ordinate and collaborate in order to obtain more sustainable and liveable cities (Banister, 2005; OECD, 2003).

Modelling the behaviour, the objectives and thus the collaboration of stakeholders has become important for planning several city logistics activities (Browne et al., 2005) and achieving city logistics solutions (Taniguchi and Tamagawa, 2005; Anand et al., 2012). This implies that stakeholder collaboration can lead to sustainable growth of a city, appropriate development of urban resources and development of low impact urban planning and transportation systems. Stakeholder collaboration is also required for them to form mutual motives and goals (Bertolini et al., 2005), which is a success factor for implementing city logistics provisions (Awasthi and Proth, 2006). Subsequently, the findings of Paper 2 show that a deeper understanding of the stakeholder's motives and goals is required for their long-term participation in a city logistics initiative.

According to the findings, all the stakeholders can be motivated by focusing on different motives and values. Specifically, the analysis helps to balance the environmental considerations with the economic ones and the other motives so that all stakeholders are satisfied. This explains in part why some city logistics initiatives have failed: they do not focus on other stakeholders' motives and goals, which is required for their long-term participation. This also provides an explanation for the lack of collaboration among the stakeholders and why several conflicts arise. The AHP method, which is based on stakeholder theory, helps to evaluate numerically the relative significance of various stakeholders and their motives and goals. This evaluation provides actual data for an improved understanding of how decision making in city logistics should be influenced by these factors. The patterns of the stakeholder values and the value concerns can be useful for understanding stakeholder behaviour in city logistics. Thus, stakeholder theory presents evidence that several stakeholders need to be managed and a combination of motives and goals needs to be met to achieve a sustainable business model of city logistics.

The economic performance of a business model in city logistics

This thesis supports the reasoning of Allen et al. (2012) and Quak et al. (2014) on the absence of economic considerations in city logistics. According to Quak et al., long-term success in city logistics initiatives requires in practice an economically sustainable business model. The findings of Paper 3 suggest that the business model is the interlocking of the components that together create and deliver value. Analysing the relative importance of cost, revenue and goods flow variables increases knowledge for the value proposition in business models for city logistics. The variables are used to measure current conditions and are altered to forecast the economic effects in order to provide insight into the potential for future profitability. As the Paper 3 findings also indicate, stakeholders make a significant contribution to the offer of the value proposition in the business model. Still, as the Paper 3 findings showed, stakeholders should be capable of understanding how to deliver the goods in time and cost-effectively, and to adopt a neutral perspective to outsourcing decisions related to the project.

Practically, the findings of the research presented in this thesis have given some insights into the profitability of SamCity, the city logistics project under study. Its profitability was estimated in order to assess the project's ability to generate earnings compared to its costs during the six-month pilot implementation study. Although a CBA of SamCity was carried out at that time, it provides good insights into the circumstances and assumptions under which the project could be financially successful. The benefits and costs of the valued-added services are transparent to the stakeholders. In that sense, such value-added services are important in terms of business models and are often viewed as a means to generate a flow of finances in the form of payments from stakeholders who benefit from them (Browne et al., 2011). The findings emphasise that a key to capturing value and having an economically sustainable business model is that the stakeholders are able to meet the costs of the project in return for the benefits they receive. For that reason, the CBA can play a supportive role in stakeholder's motives and goals for participating in a city logistics initiative.

The current literature revealed that although several of the initiatives have shown interesting results in the pilot implementation phase, they were unable to survive once the support from public subsidies stopped (Gonzalez-Feliu 2008), making them economically unsustainable. According to Gonzalez-Feliu (2012), several initiatives failed due to low profitability, while others started without considering economic continuity. This is reflected in the poor economic performance of the initiatives.

The analysis of the impact of costs and economic performance on city logistics initiatives shows several economic indicators related to the importance of city logistics. The main economic costs are divided into two categories: 1) initiative development costs, related to strategic planning and new investments and developments; 2) tactical and operational costs, related to the system's monthly and

daily operations. More precisely, the costs include the cost of transportation and distribution (mainly related to routing and scheduling, to platform management and to cross-docking and warehousing operations), warehousing costs, administrative costs and overhead costs (Gonzalez-Feliu, 2012). The execution and maintenance costs are also included and assumed by the transportation system, since in the long term, the costs can assure how sustainable the initiative is and that the initiative can operate without the aid of public funds (Gonzalez-Feliu, 2012).

Our analysis supports the findings of Rodrigue et al. (2009) who demonstrated that part of the final distribution costs depends on the number of users, characteristics of the shipment and reliability as the consequence of traffic congestion. Danielis et al.'s (2010) impact analysis of the initiatives highlights that the results vary mainly from the environmental perspective. Our analysis specifically shows that the delivery time intervals determined the average delivery costs for the retailers in all parts of the city and shopping areas, but also for the entire retail sector. It also shows that the costs for goods delivery for the shopping areas were higher because of the access restrictions (i.e. time intervals and limitations on delivery vehicles). In line with this, the analysis identifies other indicators related to the logistics performance of the logistics system, such as the frequency of deliveries, number of stores and the number treated by the system each month. However, adding logistics services to the initiative further on would potentially enable a reduction in the delivery prices, thus making the initiative more economically attractive for customers. From a practical point of view, Paper 3 shows that the economic evaluation of city logistics initiatives can provide insights into the economic structures. This is a wide subject of research that has many direct applications in urban transport, mainly in infrastructure and public transport planning. The economic evaluation also can alleviate the impact of economic consequences on customers, residents and society because in general, city logistics is one of the key factors of urban sustainability Distribution of goods is a vital function of the city. However, efficient realisation of the supply flows is a necessary but not a sufficient condition of life in the city. Normal functioning of the city requires an efficient realisation of the reverse flows (i.e. the extraction of waste, secondary raw materials and recycling materials).

Our analysis revealed that economies of scale are crucial to achieve an economically sustainable business model in city logistics. Current research demonstrates that the value proposition targets several customers and also attracts the interest of larger groups of customers (Triantafyllou et al., 2014). This is considered crucial in generating the revenue streams necessary to cover costs associated with city logistics operations and activities, and urban freight distribution centre setups, whereas our analysis shows that it is also crucial to reduce costs by achieving economies of scale. This supports the findings of Allen et al. (2014) who stated that you would have to serve enough customers in order to make costs comparable to traditional urban distribution systems. Allen et al. (2014) also pointed

out the need for a sufficient volume of customers in order to deliver the cost per unit generated.

6 Conclusions and future research

This chapter concludes the thesis and outlines its theoretical and practical contributions. As a final step, directions for future research are discussed.

6.1 Concluding remarks

City logistics has become a significant economic issue in terms of sustainable freight transportation systems. Specifically, city logistics addresses the improvement of urban freight transportation systems by carrying out integrated analyses of transportation infrastructure, resources and the economic environment. City logistics induces increasing collaboration among the stakeholders involved in initiatives, which results in a demand for more reliable delivery services. It seems increasingly apparent that a growing number of cities depend a lot on sustainable freight transportation systems to ensure their attractiveness, economic power, and quality of life. For that reason, several city logistics initiatives have been implemented in Europe in the last 30 years. However, several of these initiatives have only been small scale or local demonstrations, the outcomes of which usually show a solution's technical and operational feasibility. They are often subsidised and do not have long-term potential because of their limited business models that primarily neglect economic aspects.

Previous research has highlighted the need for economically sustainable business models in city logistics. In order to be able to retain the focus on the interrelations between business model components, the economic aspects of the business model are highlighted along with the stakeholder collaboration.

The research supports the idea that the components and their interrelations in a city logistics-based business model assist in fundamentally reconceiving an economically sustainable city logistics-based business model. The thesis research also provides evidence that several stakeholders need to be managed and a combination of motives and goals needs to be fulfilled to achieve a sustainable business model of city logistics. From a management perspective, the research shows that the goals and motives of the stakeholders cannot always be aligned, but need to be fulfilled to various extents for the different stakeholders.

This implies that the city logistics-based business model is a great planning tool for initiatives because it focuses on how the components interact with each other. These insights can help in the creation of long-term and more successful city logistics initiatives since the implementation of the business model is more straightforward even in cities with different characteristics.

A potential limitation is that the business model does not take into account the influence that external factors can have, such as changes in the labour market, economy and technology. These are considered important issues when designing and implementing a business model in general. Another limitation is that the business model does not integrate the social and environmental aspects to a broader extend. A future study could thus look into how these aspects are described in the components and their interrelations in order to formulate the strategy of the city logistics concept.

6.2 Contributions

This thesis contributes to the area of city logistics by specifically describing and explaining the components and their interrelations in a city logistics-based business model. The main research contributions are presented below as theoretical and practical contributions.

Theoretical contributions

The business model components and their interrelations presented in this thesis are based on a literature and practice review study, and on a participant observation study. This provides an overview of the business model in city logistics that can assist in the design of future, more successful city logistics initiatives.

Previous attempts to attain a city logistics-based business model address the externalities (Turblog, 2011), the mission (Cagliano et al., 2016), and the owner (Björklund et al., 2017) as important factors of the model, whilst the thesis author recognises the importance of the components and their interrelations to complete the city logistics-based business model. The present research describes and explains the components based on Osterwalder and Pigneur (2010) general business model. It has a theoretical foundation in economics and stakeholder theory, mainly presented in Papers 3 and 2, respectively. The research provides a graphical representation of the model that maps the components and allows one to see possible changes that may occur in the model. The business model components and their interrelations can be viewed as a starting point to broaden and unify the research on sustainable city logistics-based business models.

The research also develops knowledge of value creation and value capture, which are the two core components of a city logistics-based business model. This is because they describe the relative importance of various cost, revenue and goods volume variables.

Further, the AHP method in Paper 2 provides a novel way to understand the multiple stakeholders in city logistics and their motives and goals. The method enables the identification of the overall values that need the most attention, and which values need to be considered for each stakeholder and to what extent. The method can also offer insights on how to prioritise between stakeholders and between their motives and goals.

Practical contributions

One practical contribution of this research is related to iniative owners, managers and stakeholders involved in city logistics initiatives. Initiative owners and managers can implement the business model in their initiatives and assist the managers and stakeholders in exploring the ways of creating value offer. When brainstorming to develop the scope of the initiative and one that is economically sustainable, project owners and managers may preliminary test the business model and develop the scope in a way that provides guidance to new opportunities. This preliminary test will demonstrate the value offer in a stimulating innovative thinking.

The findings of Paper 2 show that the co-ordination and collaboration between the stakeholders are necessary to obtain more sustainable cities. The findings can help city logistics initiative owners and managers find a balance between various stakeholders and their motives and goals. Paper 2 findings also show that by emphasising different value concerns, all stakeholders can be motivated; conflicts between them may not arise as a result, and the management of stakeholders will improve in city logistics initiatives.

In addition, the research results can help managers of city logistics initiatives to gain insights into the goods volumes needed for profitability, the effects of further increases in goods volumes, and the profitability sensitivity for goods volume reductions. Specifically, managers can get support from the findings of Paper 3 regarding the pricing levels and costing structure from this city logistics initiative. Finally, the Paper 3 shows that there seems to be a considerably higher effect on costs by increasing efficiency in terminal handling rather than in distribution.

6.3 Future research

In addition to the theoretical and practical contributions of the research, the thesis also identifies a need for more research. This section provides possible ways to proceed in this research field.

Business model perspective

The research presented in this licentiate thesis does not address the external influences on a business model, such as changes in the economy, market, technology and politics. It is limited to the content of the components and the interrelations between them inside the city logistics-based business model. Given this, future research should focus on providing a framework that would describe the external influences. A starting point for the framework could be to examine how the following elements are influenced by external factors: key resources and competences, stakeholders, the internal and external organisations, and value proposition. The core idea behind this framework is that a modification of one of the components will influence all the others. The framework will depict the external influences and the bi-directional interrelations among the components, which will form a collaborative entirety. By taking the proposed business model and incorporating its components and their interrelations described in the previous chapter as noted in the framework, the future research can seize the opportunity of combining the city logistics-based business model with the framework, aimed at expressing the external influences on the components of the business model.

Business model for e-commerce

The rise of online Internet sales and deals as well as e-commerce (i.e. e-channel and e-trade) has resulted in a major rise not only in retail company sales but also in different business models (DHL 2014, Postnord Report, 2016). The recent development of e-commerce has prompted a huge increase in direct-to-consumer deliveries (mostly in cities and urban areas) and related "last mile" challenges. Estimates reported by the E-commerce Foundation (2015) demonstrate that business-to-consumer (B2C) e-commerce sales worldwide reached $1.9 trillion in 2014, representing a doubling in sales compared to 2011. In addition, results from the Postnord Report (2016) show that on average, 11,283,000 residents of the Nordic countries shopped each month for 2016. Based on the report, the largest proportion of online shoppers live in Sweden, where clothing and footwear are the most popular goods and make up 35% of e-commerce deliveries. Thus, it is important to realise that the need to transport and deliver goods to consumers' homes or workplaces rather than to retail stores is also going to boost the quantity

of freight movement. This increase in e-commerce is strongly connected to the increase in consumption.

In connection with the rapid growth of e-commerce comes the desire for speed of delivery. In recent years, many e-tailers have started to offer their customers the option of same-day delivery and in some cases, even going down to one and two-hour delivery options, as Amazon Prime does in selected US cities. However, the normal situation for e-tailers when delivering from a relatively small number of distribution centres is that these same day or hour delivery options are affordable only when the drop density in a particular geographic area is high. From a city logistics perspective, offering these speedy delivery options will further increase the amount of freight movement in urban areas as well as the number of vehicles in motion. This will make the co-ordination and consolidation of direct-to-consumer deliveries even more challenging. With this in mind, the system for delivering goods to stores and to consumers' homes cannot be different. Hence, the business model presented in the thesis needs to be improved in such ways that it can include the deliveries of e-commerce goods, the actors and stakeholders of e-commerce.

Stakeholders validation

Looking at the results of Paper 2, it seems important to analyse how the business model can address changes in stakeholders' motives and goals in an initiative before new conflicts between or among them arise. An in-depth investigation of this is required, since stakeholders affect the success of an initiative. A potential way to do so would be to study the best-worst method (BWM) in the multi-criteria decision model. The BWM and the pairwise comparison of all stakeholders can be used to evaluate a set of alternatives with respect to a set of decision criteria. The scenario analysis that would then be applied in the BWM would help estimate the expected value concern of the stakeholders, assuming that specific changes occurred such as in the initiative activities.

Environmental evaluation

City logistics concepts facilitate integrated solutions for the fundamental dilemma of urban freight transportation: on the one hand, such transportation is fundamental to serve industrial and trade activities in urban areas, ensuring their competitiveness; on the other hand, any negative impacts of such transportation should be limited. A major problem tackled by city logistics initiatives is the inefficient utilisation of freight vehicles in urban areas, which contributes significantly to congestion and environmental nuisances such as emissions and noise:externalities that cannot be easily controlled. To reduce these negative environmental impacts, city logistics often include UCCs. However, there is limited knowledge about the potential effects

of such consolidation in terms of number of vehicles in a city, congestion and nuisances and emissions. Therefore, a more efficient utilisation of freight vehicles is required. This can be achieved by analysing the transport efficiency effects of bundled transport in city logistics. Accordingly, subsibies aimed at correcting externalities and negative environmental impact can enhance this transport efficiency.

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Appendix A: The SamCity Project

The SamCity project was the basis of the research presented in this thesis and resulted in the studies and the appended three papers, mainly Papers 2 and 3. The SamCity project had a specific timeframe and fulfilled all its purposes.

The SamCity idea evolved into a novel business model through a pre-study that included an examination of user needs, stakeholder collaboration and inspiration from public conferences and seminars. The business model implemented in the project together with the research gap was the starting point for studying business models in city logistics.

The purpose of SamCity

The purpose was to test and evaluate a business model in a combined system (municipal and private flows) in the city of Malmö for one year. During the first year, the following factors were investigated: the ability to support the concept of different types of traffic regulations, use of environmentally adapted vehicles, and the joint procurement of operators and distributors for the co-ordinated private and municipal commodity flows. This resulted in lessons from the pilot implementation as well as five different investigations focused on effects, traffic regulation, vehicles and procurement.

SamCity - Sustainable supply system for an attractive city

The City of Malmö with funding from VINNOVA (Sweden's Innovation Agency) developed a business model for a sustainable supply system for an attractive city, known as SamCity. The work was carried out by a group of representatives from the City of Malmö, Malmö City Co-operation Organisation, property owners, shops, the transport industry, and the Division of Packaging Logistics from Lund University (see Appendix D for the complete list of stakeholders). The project is part of Vinnova's challenge-driven innovation. The work was carried out from May 2013 to August 2016; the first stage was carried out from May 2013 to January 2014.

In May 2014, the project was granted additional funds from Vinnova to test the business sampling model in Malmö in a pilot project in 2015. This was stage two of the project, and was carried out between 2014 and 2016 by the same project constellation as stage one. The City of Malmö was the co-ordinator of the project.

Distribution, terminal and micro terminal

Transport Provider 1 (TP1) took the initiative for SamCity's effective co-ordination of transport. The TP1 terminal was used as the terminal for SamCity. The terminal offered an accessible central storage and sortation centre, and was able to reduce the number of deliveries going to construction sites. The unique co-operation is embedded in a smart logistics solution that involves co-load of both private and municipal goods for SamCity. The goods were transported by SamCity's vehicles, driven by renewable fuel (Figures 5 and 6). More precisely, one heavy vehicle (Figure 5) that was suited for urban deliveries because it left a smaller footprint and had a high load factor was used for the delivery of goods from the TP1 terminal to the micro terminal. The usage of this vehicle minimised the trips in the city centre. A similar amount of freight would require more smaller vehicles to deliver the goods. The goods to be shipped in the city centre were collected and run from SamCity's micro terminal in the city centre where an exhaust emission-free and quiet electric vehicle took over (Figure 6). In Paper 3, this vehicle is referred to as a "light lorry".

Figure 5. SamCity's heavy vehicle

Figure 6. SamCity's electric vehicle

Figure 7 presents SamCity's area of service. It shows the city centre of Malmö were the urban zones were developed. Since, the biggest zone is covered by a pedestrian zone, the municipality made an exception and gave permission to drive there. In addition, notification texts and emergency stoplights were used on the vehicles driving in the pedestrian zone.

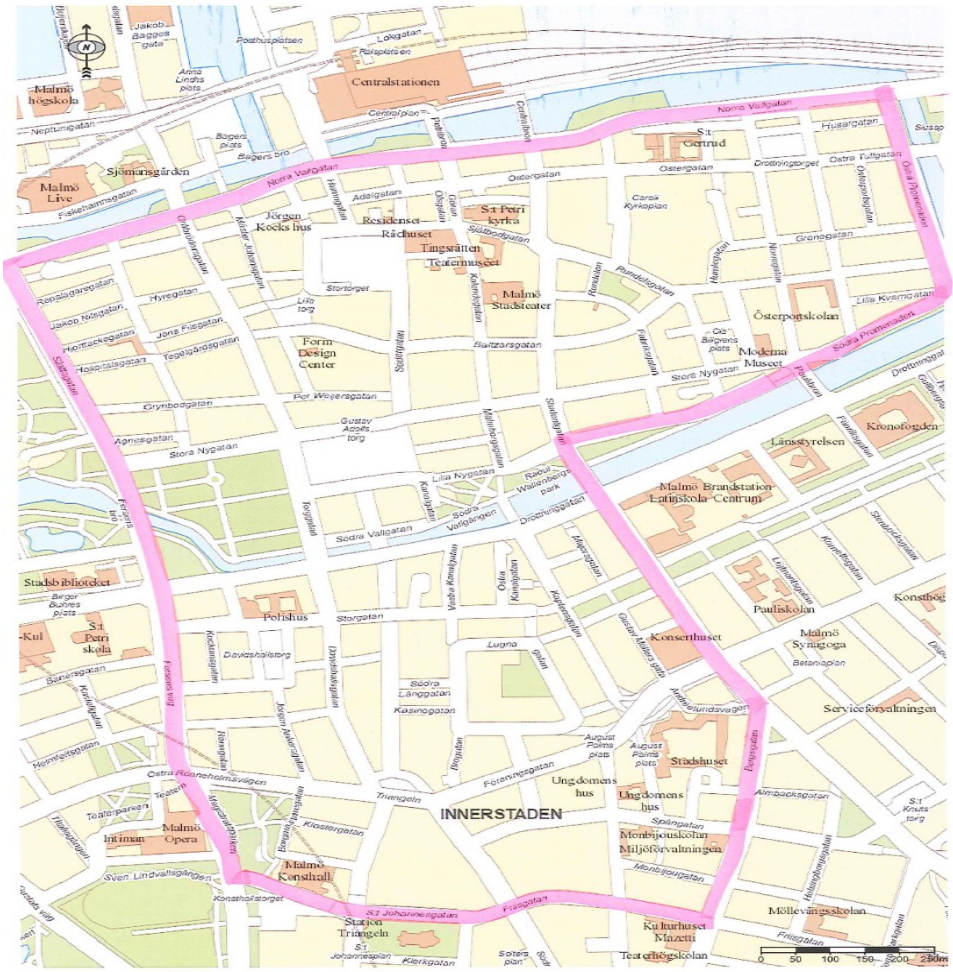

Figure 7. SamCity's service area: Malmö City centre

Expected effects and results

In the short term, the expected project outcome was to complete the pilot implementation process of the six months. The business model that was developed was tested for one year, and opportunities and obstacles were identified. Investigations were carried out that provided more knowledge about the effects of the co-distribution model on the environment, about the opportunities the city of Malmö has to implement regulations that support consolidation, and about the possibilities and limitations that exist regarding a joint procurement of carrier and operator for municipal and private commodity flows.

Scheduled planning and implementation

Five sub-projects were carried out in parallel during the project period. Sub-project one has been the one-year pilot project, which focused on testing a business model for co-relocation. Sub-project two focused on fossil fuel vehicles and their applicability. In sub-project three, a modeling was made showing the effects of the sampling model. Sub-project four, joint procurement, looks at legal possibilities and obstacles to a joint procurement of local/private flow operator/distributor. Sub-project 5 looked at how traffic control can support co-load.

Researcher's enrolment on the project

In January 2015, I enrolled in the SamCity project. One of the first things I did while participating in the implementation meetings and consortia meetings was to observe directly the stakeholders. I also carried out a broad observation of the terminal used in the project and followed the route of the heavy vehicle (Figure 5) used to deliver the goods in the micro terminal.

Although my enrolment in the project was late, I was given access to significant data that were used in the studies on which the appended papers are based. Two researchers carried out the data collection in the project: my main supervisor who has been involved for three years in the project and myself. All the data selected from the participant observation study were documented in a protocol as suggested by Yin (2003).

Appendix B: Literature and practice review study (Paper 1)

Research gap and objectives

The lack of a common source of information on business models for city logistics makes it difficult for researchers and practitioners to gain an overview of the scope of business models for city logistics and their components. This limits research in the subject area, and hence the implementation of business models in city logistics initiatives. A categorisation of the selected initiatives was developed to describe groupings of mechanisms and solutions that could contribute to building up the business model for city logistics and identify gaps that the current literature has not identified.

The objective of the literature and practice review was to identify the components of the city logistics-based business model. The model is expected to lead to initiatives that are more successful because it constitutes a foundation of all the strategic choices of city logistics initiatives.

Methodology

The methodology selected for this paper follows the guidelines by Wee and Banister (2016) on *How to Write a Literature Review*, whilst the coding and categorisation for the selected data follows the guidelines by Corbin and Strauss (1990).

This section describes how the business model components and their interrelations are developed from the literature and the selected initiatives, which consist of examples in practice. Figure 8 visualises the methodology on how the business model components and their interrelations are developed from the literature review on the general business model and on the selected initiatives. Figure 8 also includes the two iterative steps: 1. Criteria for selection of the city logistics initiatives, 2. Categorisation of the selected city logistics initiatives. Multiple levels of data collection, categorisation and coding (iterations to categorise the list of examples in meaningful ways) were used to triangulate the data. More precisely, several rounds of individual coding were created in an effort to understand and support the reasoning behind the categorisations. This process was repeated until saturation was reached on the final categorisation, which led to a list of nine components, most of which are explained in the results section.

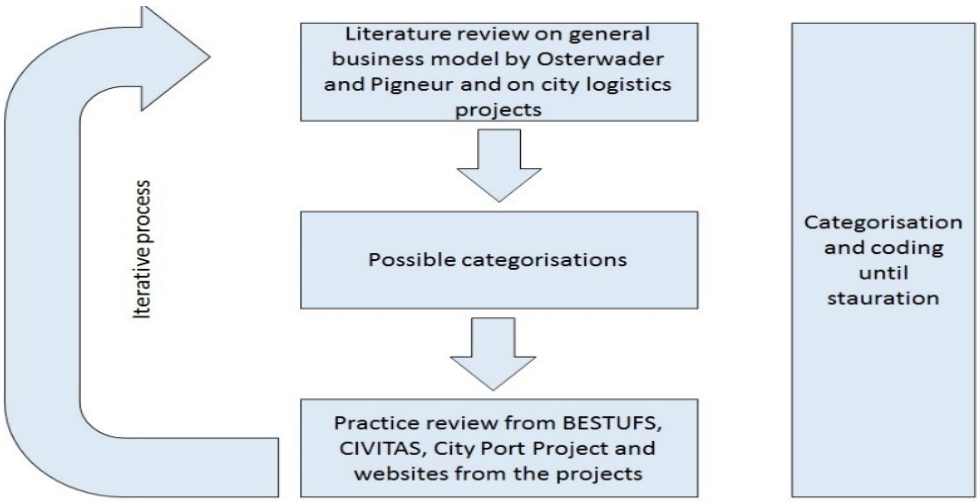

Figure 8. Methodology of the study

The selection criteria for the initiatives were not only set to facilitate the process of collecting initiatives but also used to develop the business model components and their interrelations.

Criteria for selection of the city logistics initiatives

Criteria and boundaries were set to facilitate the process of collecting examples of city logistics initiatives in the literature and practice review. The aims of the selection of the city logistics initiatives are to provide a means of categorising and explaining the business model implementation in city logistics initiatives, and to define a clearer research agenda for business models for city logistics. Hence, the criteria for selection are:

1. The most reported and well-known European initiatives in the city logistics literature.
2. Initiatives that provide exemplars, which explain and communicate how to implement a business model in city logistics.

The selection criteria for the city logistics initiatives were used to develop the components and their interrelations. While some of the selected initiatves are not traditionally associated with the business model implementation, they are included because they all have the potential to change the value proposition for one or more

stakeholder groups including those related to the environment and/or society, and hence potentially modify the business model in some way.

The reason why only European initiatives were selected was due to easy access to relevant publications on European initiatives as well as to author's experience of European publications. Although thirty European city logistics initiatives were initially reviewed, only twenty were selected for Paper 1. This happened because of the limited details and almost no publications on the ten initiatives that were rejected. Some of them consisted of initiatives that were shut down during the pilot implementation and no further details were provided. These and some other initiatives were not considered relevant and the decision to reject them did not affect the results. The twenty initiatives that were considered the most relevant were based on the selection criteria that they would serve as exemplars for other initiatives to imitate. Table 1 shows the twenty European city logistics initiatives that were selected. It provides the name of the selected initiatives, the city, country of implementation, years of operation and the scope of the initiatives.

Table 1. The selected city logistics initiatives

Selected Initiatives	Years of Operation	Scope of the Initiatives
Binnenstadservice (Nijmegen, NL)	2008-present	Eco-friendly goods deliveries to the city centre
City Cargo (Amsterdam, NL)	2007-2009	To reduce the number of vehicles in the city
Cargohopper (Utrecht, NL)	2009-present	To ban heavy vehilces in the city centre due to their enviromental impact
Zero Emission Boat (Utrecht, NL)	2009-2011	To ban heavy vehilces in the city centre due to their enviromental impact and replace them
Hague Urban Consolidation (Hague, NL)	2005-present	To reduce vehicle movements and (un)loading times
Ecostars (Rotterdam, NL)	2011-2014	(Eco)-efficient freight transportation
iLadezone (Vienna, AT)	2010-present	Efficient and effective monitoring of loading zones
Consignity (Paris, FR)	2003-2009	Replace vehicles with eco-friendly ones
Monaco UCC (Principality of Monaco, Monaco)	1989-present	To reduce traffic congestion and improve goods distribution
Elcidis Urban Consolidation Centre (LaRochelle, FR)	1998-2002 2005-2009	To improve the efficiency of city logistics solutions and define methodology for developing a systematic approach to freight transportation
SamCity (Malmö, SE)	2013-2016	To test and evaluate a collaborative model in a combined system (municipal and private flows)
Lorry Routes (Bremen, GE)	2002-2006	To reduce emissions and improve the overall efficiency of goods delivery
City Log (Berlin, GE)	1998-2010	Intermodality between long distance and local traffic and betwee train, road and water
City Logistics Project Kassel (Kassel, GE)	1994-present	To decrease the congestion levels from commercial deliveries, save energy and decrease the costs of distribution
Green Logistics (Nurnberg, GE)	1996-present	To decrease the congestion levels from commercial deliveries and decrease the costs of distribution
Copenhagen's Citylogistik-kbh (Copenhagen, DK)	2002/2003	To improve the environmental quality of the city
Mobile Depot (Brussels, BE)	2011-2013	To avoid extra handling cost with the mobile depot
Gnewt Cargo (London, UK)	2005-present	Efficient, safe and eco-friendly deliverys
Bristol City UCC (Bristol, UK)	2002-2009	To reduce traffic in certain city areas
City Porto (Padova, IT)	2004-present	To reducte pollution and increase vehicle circulation in the city

Literature review

The selection criteria that were set and presented in the previous section were used to add structure to the literature search. The literature search consisted of journal publications.

The following academic databases were used: Web of Knowledge, Scopus, Emerald and Elsevier Journals. These databases were easy to access due to their electronic form. Several relevant keywords were tried. These included various terms from city logistics and urban consolidation to sustainability and business model. The aim of keywords *city logistics (system), urban logistics, urban freight consolidation centres, business models in city logistics, and sustainable urban transport* was to identify research on city logistics initiatives. The scope of this search was to identify the most reported initiatives that consist of example for future initiatives to study. Therefore, the keywords *business models in city logistics* aim to address the research gap in business models for city logistics. In addition, they aim to identify any possible implementation of the business models in city logistics and the reason why the business model is so important for city logistics. Although it was soon evident that some of the selected initiatives did not directly address the business model in the literature, the identification of some of the components was straightforward.

This literature search generated articles on city logistics initiatives (e.g. van Rooijen and Quak, 2010), urban freight consolidation centres (e.g. Browne et al., 2005), sustainable urban transport (e.g. Goldman and Gorham, 2006) and business model in urban areas and city centres (e.g. Macário et al., 2008). Earlier overviews on the business model for city logistics include those by Benjelloun et al. (2010) and Björklund and Abrahamsson (2015) while recent overviews include Björklund et al. (2017).

The author and another researcher from the Department of Design Sciences who specialises in business models, evaluated whether existing conceptual frameworks found in the literature could be used as a basis for the city logistics-based business model as well as the categorisation of the components of the business model for city logistics. Different approaches for categorising the mechanisms were initially explored, based on several pre-existing frameworks from the sustainability, business model and city logistics literature. Hence, various business model frameworks were explored. These included the explanation of Shafer, Smith and Linder (2005) that a business model is not a strategy because strategy is a sequence of choices made over time; and the more detailed description of the components of the business model by Osterwalder and Pigneur (2010) (Customers, Relationships, Value proposition, Delivery Channels, Key Resources, Key Activities, Key Partners, Cost Structure, Revenue Streams). As an additional framework, the Triple Bottom-Line (Economic, Environmental, and Social) by Elkington (1997) was thoroughly explored. However, we soon realised that the reported city logistics initiatives together with the outcomes of research about business models in city logistics, refer to and

implement the business model by Osterwalder and Pigneur (2010). This framework was selected and assisted in the categorisation of the components.

Practice review

The following reports were used for the practice review: BESTUFS, City Ports Project and CIVITAS. These reports consist of summaries of all the European city logistics initiatives and in most cases, they provide a general description of best European practices. In other words, they describe and disseminate best practices of city logistics initiatives, the success criteria of the initiatives as well as addressing the reasons for initiative failures. Hence, the examples of initiatives from practice were a crucial addition to the literature review. The access to these reports was easy due to their electronic form.

The general aim of the practice review is to clarify, as much as the current state of knowledge permits, the empirically-derived findings in the city logistics initiatives and the practical implementations of the solutions. In this type of review article, the author begins the process with the intent of deriving implications for practice from the research and theory that is examined.

A review of secondary literature on practice was conducted to identify the sustainable business models implemented in practice in city logistics. In this review, the websites of the initiatives or of organisations responsible for the initiatives were explored. This generated similar results to the literature review. An additional OECD research on city logistic initiatives was also utilised as a comprehensive source of information on emerging business models for city logistics. The practice review supported the literature review by providing important data on several of the initiatives.

Development via coding and categorisation of the components based on literature and practice

I used multiple levels of coding and categorisation of the initiatives generated from practice and literature to develop the components. The creation and thus the analysis of crucial categorisations makes use of constant comparisons for similarities and differences, to achieve precision and consistency (Corbin and Strauss, 1990). As part of this process, I conducted rounds of individual coding followed by generating several Excel sheets to support the categorisations. This process was repeated until saturation was reached on the final categorisation for the business model components and their interrelations.

Specifically, the first level of categorisation contained the components of the general business model and their contents. This categorisation helped identify the components of business models in the selected city logistics initiatives. This helped with the second level of categorisation, which contained the initiatives from the same country, such as the Netherlands or Germany. In all the initiativess studied,

the components described by Osterwalder and Pigneur (2010) were discovered in the second level of categorisation. By categorising the initiatives, the identification of the components of the general business model in the selected initiatives was easier, since the characteristics of the initiatives were similar because of the same characteristics of the cities and policies. In the case of the Netherlands, the BSS expanded in other cities in the country. However, due to some specific characteristics further components were identified. This initial list of the components includes: *customer segments, value propositions, key activities, key partnerships, channels, revenue streams, customer relationships, cost structure, the stakeholders, the individual business models and strategies of the involved stakeholders, the value for society and citizens, service offerings and customer types, logistics competence, logistics bases and the importance of supporting city regulations, financial conditions, policy.* As some of the characteristics of several of the components were similar and since some of the new components consisted of the content of the nine components of the general business model, this list was refined and concretised to better meet the purposes of the city logistics-based business model. Departing from this point, the third level of the categorisation was created. This level consisted of the components with the same content, for example, description of the involved stakeholder groups, description of the rules and regulations, and even description of the same problems. The development of the content of the components was carried out together with the definitions of city logistics and of the city logistics-based business model. In this category, a new list was created which included the method for the implementation of their solutions and business models. Finally, the fourth level of categorisation included the description of the interrelations of the components.

Table 2 includes an example of one of the coding and categorisation levels of the data analysis. It includes the second level of categorisation that helped the development of the city logistics-based business model. Further, this level was the departing point for the next levels of coding and categorisation, used to develop the components and their interrelations of a city logistics-based business model. More precisely, the table describes the selected initiatives by providing details from the implementation of initiatives. The implementation is related to the implementation of solutions and business models in the initiatives, which gives an insight view of the initiatives.

In the second level, the components of the general business model components were identified. This is demonstrated on the table. However, Table 2 does not show all of the components of the general business model that were identified in the selected initiatives. Furthermore, the details from the implementation of the initiatives helped to identify the content of the components as well as their interrelations. In the beginning, due to some characteristics described in the initiatives, fifteen components were identified. Several of these components were merged due to their common characteristics. Soon it was realised that these that were identified as components were part of the content of the components of the

business model implemented in city logistics. Thus, the city logistics-based business model was formed. The components due to their characteristics and interrelations were formed under the four business areas as described by Osterwalder and Pigneur (2010) in the business model canvas. The figure of the city logistics-based business model, provided in Paper 1 and in section 4.1 of the thesis, was inspired by the business model canvas by Osterwalder and Pigneur.

Table 2. Example of one of the coding and categorisation levels

Initiaves	Exemplars from Practice	General Business Model Components Identified in the Selected Initiatives								
		VP	KP	KA	KR	CH	CSeg	CR	CS	RS
Binnenstadservice	Focus on retailers, Generate profit by offering extra services	X	X	X	X	X	X	X	X	X
City Cargo	Physical key resources. Sufficiently decreasing delivery costs.	X	X	X	X	X	X		X	X
Cargohopper	Only 2 years of operation; shut down because of the low number of companies	X	X	X	X	X	X		X	X
Zero Emission Boat	Similar to Cargohopper with the addition of a few new things: electric 'little trains' of vans, solar panels on the trailer roof	X	X	X					X	
Hague Urban Consolidation	A survey case was conducted for studying similar cases, a survey for the capacity of UCCs, scenarios	X	X		X	X	X		X	X
Ecostars	Ispiration:Binnenstadservice Environmental zone Nighttime distribution	X	X	X	X	X	X		X	
iLadezone	Inspiration: Dresden Pilot test aimed at examining the basic infrastructure required for operating a cargo tram in Vienna, to switch goods traffic from the roads to rail	X	X	X	X				X	X
Consignity	Value proposition to all stakeholders	X	X	X	X				X	
Monaco UCC	The owner is the local administration which is managing as a public service and run by a private company	X	X	X		X	X			X
Elcidis Urban Consolidation Centre	No financially viable yet, better traffic and parking conditions, 61% less vehicles and emissions	X	X	X	X	X				
SamCity	Model through a pre-study including user needs examination, stakeholder collaboration and inspiration from public conferences and seminars, survey, observation, CBA, AHP	X	X	X	X	X	X		X	X
Lorry Routes	Managed by a transport company partially financed by the administration in order to plan smaller city terminals and closer to the city centre	X	X	X	X					
City Log	Disastrous case because of the low number of companies that have entrusted their own deliveries to transport provider of the initiative	X	X	X		X			X	
City Logistics Project Kassel	Difficulty improving the negative environmental impact	X	X	X	X				X	
Green Logistics	Restricted traffic conditions in the city,	X	X	X					X	
Copenhagen's Citylogistik-kbh	Focusing on the retailers. Field test for the minimisation of the environmental impacts	X	X	X	X	X	X		X	X
Mobile Depot	Value finance (modelling information related to total cost of ownership, pricing methods, and revenue structure)	X	X	X	X	X	X			X
Gnewt Cargo	Value proposition offered to the customers with products distribution and services	X	X	X	X				X	X
Bristol City UCC	Users are medium sized retailers with high value products and it is located only 16km away from the service area	X	X	X	X				X	X
City Porto	Environmental and social effectiveness, measured in terms of social benefits vs. costs	X	X	X	X		X			X

Appendix C: Interview guide for the participant observation study (Papers 2 and 3)

The interview guide used for the semi-structured interviews in the stakeholders' analysis is presented below. The interviews were conducted during October and November 2015 with at least one representative of each of the stakeholders of the SamCity logistics project.

Interview Guide, SamCity's Stakeholders

Purpose
This interview guide will result in a representative study of the stakeholders' motives and goals. The information gathered will be analysed using the Analytical Hierarchy Process (AHP).

The interview guide consists of general information questions and questions about activities and processes, the motives, goals and incentives as well as experiences, challenges and problems of stakeholders. These kinds of questions were asked so that the data collected will be highly suitable for the study.

1. **General information**
   Can you please provide the following information:
   Name:
   Your current position:
   How long have you been working with SamCity?
   What are your responsibilities in SamCity?

2. **Company background**
   2.1 Can you please provide the following information:
   The core business of the organisation
   The presence of the company in Sweden
   Number of employees

2.2 Can you please tell me about the company's business? Goals, missions, values?
2.3 What is your own perspective and understanding of city logistics?

3. Activities and processes

3.1 How are the decisions taken within your organisation for SamCity? Are they aligned with the decisions from other stakeholders?
3.2 What is the process like with external stakeholders?
3.3 With whom do you collaborate the most?
3.4 How long does it take to decide on a new policy?
3.5 How long does it take to get approval for a new idea?
3.6 Does the process follow the same flow, with the same stakeholders and actors?

4. Motives, goals and incentives

Describe the motives/goals and incentives for being one of the stakeholders of the project:
What are the main motives:

- Economic
- Environmental
- Marketing advantage
- Benefits/profits
- Development
- Ability to utilise your own idea

4.1 Do the long-term motives and goals of your organisation fit with the purposes of SamCity?
4.2 Are there any common incentives between your organisation and other stakeholder groups for being involved in the project? Or are they heterogenetic and result in conflicts?
4.3 Are there any further goals for achievement?
4.4 Does SamCity help you to be an innovative and responsible organisation?
4.5 Are there any comparisons regarding the other stakeholders' motivation?

5. Experience

Walk us through your experience so far.

5.1 Tell us about the most important moments you have had during your participation in the project
5.2 What did you see as your organisation's strengths by being one of the stakeholders?
5.3 What did your organisation accomplish in SamCity?
5.4 How do you think SamCity will help your organisation improve your skills in your area of focus?

5.5 What is your organisation's core values? Do you have any examples, such as experiences with the stakeholders, experiences from participating in the project and being one of the stakeholders?

6. Challenges/ Problems

6.1 Can you describe the challenges, problems, barriers you have experienced with SamCity:

Time it occurred
Reason
How did you overcome the problem?
What did you learn from that experience?

6.2 Are there any risks to be dependent on?

6.3 What are your expectations in general from this project?

7. Stakeholders

Since the rest of the stakeholders have different objectives and different perspectives from yours regarding urban freight transport, co-ordination amongst you and the other stakeholders is required to make progress towards a more sustainable and liveable city. So can you describe your experiences with the other stakeholders?

7.1 Can you please tell me how the other stakeholders were affected by your decisions and actions? How were you affected by the other stakeholders' decision and actions?

7.2 Do you believe you have had an impact on the stakeholders?

7.3 Do you foresee any benefits from your collaboration with the other stakeholder groups? Do you foresee any benefits for further collaboration?

7.4 Are you able to use their network or are they able to use yours?

7.5 Is there any possibility to make your own decisions?

Appendix D: List of stakeholders

The following stakeholder groups have contributed in several ways to this research, from participation in the pilot implementation of the SamCity project to meetings and interviews. Throughout the project, each group was represented by at least one participant who was responsible for the project.

Municipality
Malmö Stad

Logistics Service Providers/Transport Operators
Malmö LBC
Ragn-Sells

Property Owners
Vasakronan

City Co-operation Organisation
Malmö Citysamverkan Service

Haulier Organisation
Sveriges Åkeriföretag

Confederation of Swedish Enterprise
Svenskt Näringsliv

Retail Consumer Organisation
Coop Medmera

In addition, it should be noted that a number of consultants made valuable contributions to the project: Foyen Advokatfirma, ÅF Infrastructure AB, Miljöbyrån Ecoplan, Sweco Transportsystem, and WSP Analysis and Strategy.