Urban Logistics in Smart Cities: Business Model Development

Masterarbeit

zur Erlangung des akademischen Grades „Master of Science (M.Sc.)" im Studiengang Wirtschaftsingenieur der Fakultät für Elektrotechnik und Informatik, Fakultät für Maschinenbau und der Wirtschaftswissenschaftlichen Fakultät der Leibniz Universität Hannover

vorgelegt von

Name: Michalsky Vorname: Lukas

██████ ██████ ██ ██████

Prüfer: Prof. Dr. Michael H. Breitner

Hannover, den 10.04.2018

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1 Introduction

1.1 Motivation and Relevance

When looking at challenges that future cities face, there are two main trends that have a significant impact on the development of future urban living: urbanization and the rise of e-commerce (Choe et al., 2017). Today, already more than half of the world's population lives in cities. Forecasts predict, that this number will constantly grow to well over 60% by 2050. In industrialized countries the number is already much higher with three out of four people living in a city (United Nations, 2016). Getting around in those places is becoming increasingly more difficult and time consuming since 64% of all travel (in 2015) is taking place in urban areas (Van Audenhove et al., 2015).

URBANIZATION

E-COMMERCE

64%
Share of all travel that occurs in cities (United States)

75%
Share of people that live in cities (Germany)

3M
Number of shipments in 2016 (Germany)

<48h
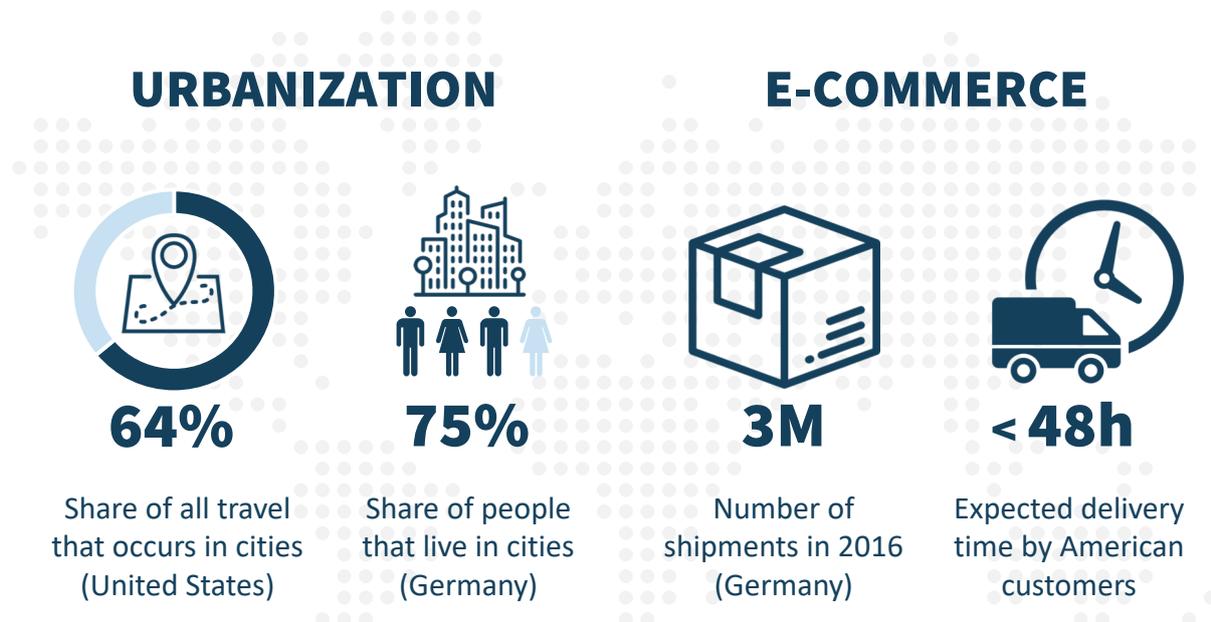Expected delivery time by American customers

Figure 1: Statistics regarding urbanization and e-commerce

That increasing travel demand is not only attributed to direct personal mobility of citizens but likewise on the indirectly caused transportation through the consumption of more goods, the demand of more services, and the production of more waste. In other words, commercial transportation increases at least equally to passenger mobility. An outstanding driver for that development is the rise of e-commerce.

In Germany alone, three million deliveries have been shipped in 2016[1]. According to Choe et al., 2017, 2018 will be the first year where people plan to spend as much online as in stores while 64% of them expect a delivery within two days and to not pay anything for shipping. Additionally, people appreciate to have full disclosure and transparency when tracking their deliveries to make sure everything is secure.

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[1]Biek: `http://www.biek.de/index.php/pressemitteilung_detailansicht/items/kep-studie-2017.html` last visited on 1/25/2018

With the evolutional process of people consuming more and more goods, cities face multiple challenges in the pursuit of retaining an attractive environment while satisfying all needs. Congestions as well as air and noise pollution increase and cause negative impacts on traffic safety, urban economic competitiveness and most important quality of living (Van Audenhove et al., 2015). Moreover, instant deliveries promoted by retailers to reduce shipping times create an environment in which logistics providers have difficulties to optimize their delivery schedules. As a result, undesirable economic and ecologic effects arise. In other words, the improvement of urban logistics plays a vital role in the process of overcoming the mobility challenges of todays and future cities.

Especially in recent years new technologies in the form of e.g. drones, robots and alternative propulsion systems push into the market attempting to solve the issues caused by the underlying fields of tension. Those contradictories result from divergent interest of the associated stakeholders. Retailers seek flexibility while logistics providers prefer stabile quantities to optimize delivery journeys. Cities attempt to reduce traffic and comply with ecological regulations while citizens demand high service levels and short delivery cycles. The amount of involved parties and their interests in the urban logistics value chain creates a complexity without a distinct solution.

That is why, this thesis attempts to turn the underlying complexity in urban logistics into opportunity for a brighter future in a connected world while including the latest developments in technology, regulations and digitization.

1.2   Research Background and Objective

Following the motivation and relevance of the topic, a literature review based on Webster et al., 2002 is conducted. That provides the opportunity to obtain an overview of the knowledge, that is found in the existing literature. Building a solid academic foundation with the review, the research gap is identified and the research question phrased.

To find relevant literature around the topics of *urban logistics*, *logistics in smart cities*, and *logistics business models*, multiple channels have been utilized. For academic papers and reports the data bases ScienceDirect (`http://www.sciencedirect.com`), SpringerLink (`https://link.springer.com`) as well as EmeraldInsight (`http://www.emeraldinsight.com`) have been searched. Moreover, further papers, books and journals have been found on the mobility engineering resources platform SAE Mobilus (`https://saemobilus.sae.org`) and Google Scholar (`http://scholar.google.com`). For more recent project reports, especially from consulting firms, also the Google search engine has been utilized.
According to Webster et al., 2002, the structured results of the literature review are

illustrated in Table 1 and 2.

Author/s	Urban logistics in smart cities	Future Urban logistics business models	Urban logistics concepts/strategies	Content
Barcelo et al., 2007	x		x	Design of a holistic approach for urban logistics with traffic simulation
Bogdanski, 2015			x	Drivers and objectives for sustainable urban logistics through CEP services
Cagliano et al., 2017			x	Economic comparison of eco-friendly and conventional vans for urban deliveries
Choe et al., 2017	x		x	Influence of new technologies and thinking regarding last mile deliveries
Dablanc et al., 2011	x			Best Practices on sustainable urban goods logistics on authority level
Erd, 2015			x	Development of transportation-based urban logistic concepts for cities
Frehe et al., 2017	x	x		Assessment of a sustainable implementation of crowd logistics
Gammelgaard, 2015	x			Challenges of managing a united city logistic concept
Hesse, 2004			x	Limitations for logistics strategies and possible consequences for policies
Huber et al., 2015			x	Discussion about the importance of logistics transportation hubs for logistics

Table 1: Literature Review Part 1/2

To begin with, it is to mention that most of the relevant literature has been published within the last five years as stated in Tables 1 and 2. Relevant papers that have been found, cover concepts and holistic approaches of urban logistics, business models for specific industries, sustainability topics in city logistics, and regulatory influences. Only few, however, explicitly mention business models. In most articles scholars elaborate on concepts or strategies with focusing on a specific technology or regulation.

Author/s	Urban logistics in smart cities	Future Urban logistics business models	Urban logistics concepts/strategies	Content
Kuhn, 2014	x			Interdependencies between urban logistic systems and city development tasks
Lange et al., 2013	x		x	Exploration of a delivery bundling system for urban retailers
Lerner et al., 2012		x	x	Strategic imperatives for city management and business models for mobility providers
Melo and Baptista, 2017	x			Usage of cargo bikes to improve the sustainability of inner city logistics
Nowicka, 2014	x			Cloud computing model for a smart city logistics infrastructure
Patier and Browne, 2010	x			Introduction of a methodology for urban logistics innovations
Pletscher et al., 2016	x	x		Disruptive business model and strategy of the Swiss postal service
Schrampf et al., 2013			x	Overall concept for efficient freight transport in urban areas
Sxoinaraki and Panou, 2017		x	x	Impact of green business models on the effectiveness of urban logistics industry
Van Auden-hove, 2015	x		x	Urban logistics strategies on a system level including technologies and regulations

Table 2: Literature Review Part 2/2

One of the main topics within the urban logistics research which receives a lot of attention among scholars is the underlying sustainability of transportation concepts (Cagliano et al., 2017; Melo et al., 2017; Sxoinaraki et al., 2017; Bogdanski, 2015; Dablanc et al., 2011). Predominantly, the sustainability aspect is related to the propulsion system of delivery vehicles. Cagliano et al., 2017 explore the benefits of eco-friendly vans over conventional trucks and Bogdanski, 2015 introduces electric powered vehicles for last mile deliveries into the discussion. What often has been a contrary, Sxoinaraki et al., 2017 elaborate on the interdependence of green and eco-friendly propulsion and a sustainable competitive business model. Dablanc et al., 2011 represent sustainability from an administrative point

of view by illustrating best practices from urban logistics projects in Paris. In other words, in academia, fruitful urban logistics concepts are increasingly associated with sustainability aspects.

A second large category that is discussed among scholars, are future delivery concepts. Those concepts can consist of a restructured delivery process in form of distribution hubs (Huber et al., 2015) or introduce entirely new technologies like drones or delivery robots (Choe et al., 2017). The former especially aims at reducing traffic and congestion in densely populated areas by introducing e.g. a micro-depot concept to improve the city's attraction as mentioned by Bogdanski, 2015. Another idea involves highly developed software to control and optimize delivery routes and therewith increase efficiency in the shipping process (Barceló et al., 2007). Most of the alternative concepts, however, are focused on alternative last mile delivery solutions. Melo et al., 2017 mention cargo bikes as delivery vehicles whereas drones and also robots can be found in Choe et al., 2017. Further, Frehe et al., 2017 identified steps to follow when planning on introducing a crowd logistics business model and utilize everyday people to deliver shipments. An equally interesting approach has been introduced by Lange et al., 2013 who were researching the possibilities of bundling shipments in the field of urban retail to avoid late deliveries caused by congestion in the morning commuting hours. In summary, one can state that plenty alternative delivery solutions have already been introduced.

Since urban logistics is a complex system with multiple stakeholders involved, some scholars mention that a holistic approach is the sole way to improve the quality of inner city logistics (Barceló et al., 2007). Integrated solutions including alternative means of transportation, shared or autonomous vehicles, new supply chain concepts like stationary (smart lockers) and also, dynamic pick-up locations, and decentralized platforms on blockchain technology or cloud solutions for the coordination (Nowicka, 2014) pave the way to future urban logistics, according to Choe et al., 2017. With drivers ranging from regulatory or financial incentives to technology enablers like big data analytics (Van Audenhove et al., 2015).

In conclusion, it becomes obvious that there is a large amount of possibilities and opportunities to revolutionize urban logistics in cities. However, little research has been conducted on what it takes to make different approaches suitable for implementation in a real world urban city environment and, moreover, how those concepts influence the economy and competitive environment. In other words, what are the factors, that decide on a business model's success in the field of urban logistics.
In order to close this research gap, an answer to the following research question is required:

> *What are crucial determinants for successful urban logistics business models in smart cities?*

The objective of the underlying thesis is to find the most promising urban logistics improvement measures and then derive business model determinants by interviewing experts from various affected and involved industries. Through this, an encompassing overview is created with requirements from multiple affected industries that can lead to a successful business model development.

1.3 Structure of the Thesis

The thesis is structured in five chapters in order to answer the research question that has been formulated as the result of the comprehensive literature review.
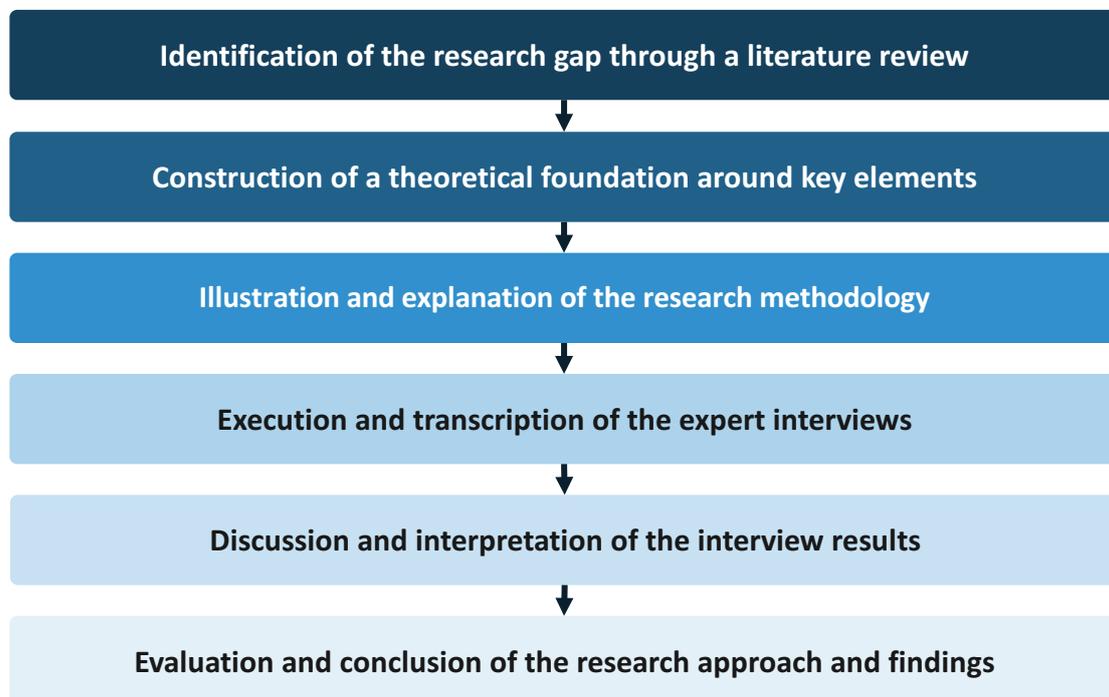

Figure 2: Structure and approach of the underlying thesis

Followed by this section, a theoretical foundation around the key technologies and terminology will be provided. This will help to understand the specifics about smart cities, urban logistics and business models. Next will be the presentation of the research design, in this case, an execution of expert interviews analyzed with the qualitative content analysis approach based on Mayring, 2016. Chapter three will also hold the summary of the transcribed and analyzed interview material as well as the interpretation. Finally, the research results and methodology will be evaluated before drawing conclusions and giving an outlook for further research. Figure 2 illustrates the described approach.

5   Conclusions

Against the backdrop of increasing urbanization and a growing e-commerce business, the mobility landscape in cities is changing. Numbers for individual and personal as well as commercial transportation are higher than ever and thus result in traffic congestions, air and noise pollution, and ultimately a declining quality of living in cities. Due to the boom of e-commerce, urban logistics have become a major lever in the pursuit of improving a city's mobility landscape. New technologies in the form of alternative propulsion systems, drones and robots as well as ICT solutions and other digitization products push into the markets in the attempt of improving the current situation. Consequently, urban logistics are situated in an evolutionary environment with influences from multiple industries and are facing great changes with the introduction of new and innovative business models.

That is why, the purpose of the underlying thesis was to find crucial determinants for successful urban logistics business models for future smart cities. Based on the foundations of smart cities, urban logistics as well as business models combined with the knowledge of experts from the field, measures that improve urban logistics have been identified. In a second step, those measures then led to the desired crucial determinants organized in the structure of the business model canvas.

In order to meet the objective, eight interviews with experts from different associated stakeholder groups (mobility providers, logistics providers and city representatives) have been conducted. Based on an interview guide that has been developed on the foundation of the business model canvas, comparable information was gathered. Those transcribed results were then analyzed according to the method of a qualitative content analysis, supported by the MAXQDA software. Those outcomes have then been interpreted towards improvement measures for urban logistics and ultimately resulted into crucial determinants for each of the business model canvas categories.

The found improvement measures are distinguished into four categories: regulations, technology, organization and behavior. The four categories each consist of four concrete components to improve urban logistics. Regulatory measures generally describe steps that can be undertaken by governmental authorities or official city developers in order to reduce heavy congestions and air pollution in urban areas. Technology measures illustrate promising innovations that improve the delivery value chain in the medium term. The third category introduces measures that are connected to technologies but more on a strategic and conceptual level. Ultimately, category four concentrates on behavioral measures that relate to both the consumer and the provider.

Derived from those categories a set of crucial determinants for successful urban logistics business models have been built. The determinants address the elements of the business

model canvas and deliver guidance in the process of developing a business model. They also reflect the divergent interests of the associated industries and stakeholders. Due to the specific requirements of generating determinants that are of use across multiple industries, the business model canvas structure had to be modified. Consequently, the found determinants framework includes the categories of customer segment and relations, value propositions, channels, key resources and activities as well as key partnerships. It excludes the financial perspective but adds external effects.

In order to verify the results, an examplary urban logistics business model based on the determinants has been developed as part of the critical appraisal. It considers the findings and proposes a combined passenger and freight transportation with eco-friendly electric vehicles in urban areas to maximize efficiency and level of service while minimizing environmental impact. The discussion has also shown, that building the findings on the business model canvas has not been the ideal solution since it had to be modified. Also, the question if the proposed model actually improves the current traffic situation, remains open. Nevertheless, in the process of developing an urban logistics business model, the found determinants proved to be useful.

Due to the broad approach on gathering information through the interviews, a significant amount of open questions have been formulated by the experts that have the potential for further research. Besides the obvious feasibility analysis of the proposed examplary business model, especially service requirements of private consumers have been mentioned. Up to date, little is known about what consumers expect as valuable services regarding urban logistics and if a distinction into certain groups is possible. Since one of the main objectives of the urban logistics development is to improve the quality of living in cities, it is recommended to further research the role of the consumers.