SCHOOL OF ECONOMICS AND MANAGEMENT

Inducing sustainability innovations through public procurement

An empirical study of the impact of Swedish market-based procurement on sustainability innovations in the public transport industry

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Abstract

Aim of the study: The study aims to investigate the theoretical gap on how sustainability innovations can be induced through demand-side innovations within public procurement.

Theoretical perspective: This paper utilizes transaction cost economics theory to describe the contractual relationship between PTAs and PTOs within public procurement in the public transport industry. By analyzing barriers and enablers within demand-side innovation, the study describes the dynamics of sustainability innovations within public procurement.

Method: To answer the research question, a qualitative single-case study of public procurement within the Swedish public transport industry is conducted, utilizing an abductive approach. The empirical material was gathered through eleven semi-structured interviews with representatives from PTAs, PTOs and an industry organization, which were examined using thematic analysis.

Empirical analysis: The empirical findings elicited several barriers towards sustainability innovations, namely issues with designing tender documents and including innovation in quality evaluations. Regarding non-economically motivated sustainability innovations, the findings revealed goal conflicts and lack of incentives as barriers with political will acting as an inducing force. Lastly, the empirical material emphasized the importance of close collaboration between PTAs and PTOs to induce sustainability innovations.

Discussions and conclusion: The findings underlined that there is a market failure in the provision of non-economically motivated sustainability innovations which can be addressed by demand-side innovation measures. Within the refined conceptual model, a key insight revolved around the crucial role of quality evaluations in the procurement process around innovation, which was only described marginally in previous research. From a practical perspective, the findings elicited three levers available to managers aiming at inducing sustainability innovations in the procurement process, namely a contractual, relational, and organizational lever.

Keywords: Public transport, demand side innovation, public procurement, sustainability innovations

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Abbreviations

PTA - Public Transport Agency

PTO - Public Transport Operator (private)

KPI - Key Performance Indicator

TCE - Transaction cost economics

R&D - Research & Development

OECD - Organization for Economic Co-operation and Development

EU - European Union

PCP - Pre-commercial procurement

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1. Introduction

1.1 Background

In the current situation of accelerating climate change and associated rising sustainability challenges, there is consensus on a high need for action to address these very challenges. However, when it comes to selecting the most suitable approach to tackle the challenges, there is still an ongoing debate. Martin & Kemper (2012) summarize the two overall approaches to this question as the Malthusian worldview arguing for restraint and responsibility and the Solowian worldview emphasizing human ingenuity and innovation as solutions to address environmental challenges. While there are merits to both lines of thought, the Solowian argument highlighting the importance of innovation to solve sustainability challenges is followed within this thesis. In this context, several scholars point out that while the climate crisis in itself poses a tremendous challenge to businesses and governments, the field of sustainability can be likewise perceived as a trigger for a new wave of sustainability innovations and change (Hart & Milstein, 1999; Nidumolu, Prahalad & Rangaswami, 2009). To define the occasionally vague term of sustainability innovations, the definition of Hermundsdottir & Aspelund (2021) is utilized who describe sustainability innovations as "*innovations wherein all sustainability dimensions, including environmental, social, and economic, are considered during the whole innovation process*" (p.3). Moreover, in the further course of the thesis, there will be a distinction made between these sustainability innovations and sustainability innovations that lack economic viability, later referred to as non-economically motivated sustainability innovations.

Even though sustainability innovations are described as a trigger for change, there is an ongoing debate on the compatibility of sustainability innovations and the competitiveness of a firm. While there is increasing research pointing towards a positive relationship between sustainability innovations and competitiveness (Suat & San, 2019; Qiu, Jie, Wang & Zhao, 2019; Bacinello, Tontini & Alberton, 2019), the long-held view that sustainability innovations represent a factor driving up costs and are not necessarily connected to increased value (Dey, Malesios, De, Chowdhury, Abdelaziz, 2019; Hojnik & Ruzzier, 2016; Cai & Li, 2018) continues to persist in some cases and consequently impedes the willingness to innovate around sustainability. This alleged contradiction between sustainability innovations and competitiveness leads to a market

failure to provide sustainability innovations on a scale that is societally needed to address the climate crisis, which evokes the question of how these innovations can be fostered and supported.

An important aspect within this context revolves around the role of governments and public actors in fostering sustainability innovations and the tools they can utilize to do so. While the level of involvement of governments in innovation policies fluctuated throughout history, within the current debate about sustainability voices are growing louder that demand governmental actors to pursue a more active role in inducing innovation since a large common effort is necessary to reach sustainability goals. When it comes to tools to foster innovation from a governmental point of view, the academic literature generally distinguishes between supply-side and demand-side innovation policies (Rothwell & Zegveld, 1981), with the former one focusing on providing financial resources to fund R&D activities and the latter one aiming to increase the demand for innovation, e.g. through public procurement (Edler & Gheorgiou, 2007). While supply-side innovation policies were used more frequently in the past, there has been an increasing focus on demand-side innovation measures such as public procurement recently, due to the assumption that the strong public purchasing power can steer the demand for innovation into a direction that is aligned with societal goals, such as a need for sustainability innovations (Edler & Gheorgiou, 2007). Thereby, demand-side measures such as public procurement, which will be in focus within this thesis, are attributed with the potential to counteract a lack of sustainability innovations coming from the market, particularly regarding innovations that are not directly tied to efficiency gains or cost reductions but nevertheless societally needed.

One public sector, which is often perceived as a frontrunner in sustainability and is considered to play a crucial role in achieving sustainable development goals, is the public transport sector due to its various impacts on environmental, social, and economic factors (Miller, De Barros, Kattan & Wirasinghe, 2016). Within the field of public transport, Scandinavia and particularly Sweden are often described as being at the forefront of change. Providing an overview of the Swedish public transport industry, which is the subject of the case study within this thesis, Svenskkollektivtrafik (2021) outlines that the market share of public transport, in relation to the total usage of motorized vehicles, is at 17% in 2021. This figure dropped down from 27% in 2019, with the pandemic lowering the demand for public transport. Another important aspect of

public transport is the cost coverage, which lies at around 50 % in Sweden compared to around 75% in Germany for instance (Vigren, 2015; Statista, 2022). This means that public transport is strongly subsidized by the government in order to provide accessibility to lower-income groups (Bondemark, Andersson, Wretstrand & Brundell-Freij, 2021) and offer sustainable solutions as an alternative to car usage. Hence, public transport can be perceived as a social good which incurs costs on society and thus fuels a debate about financing, cost efficiency, and the cost and benefits of public transport. In order to address these issues, Sweden uses a mixture of private and public elements in public transport provision: The market-based public procurement approach utilized in Sweden relies on a tender system that assigns private companies to deliver new products and services and thereby also innovations (Region Stockholm, n.d). Through this procurement mechanism, the local public transport authorities (PTAs) have extensive power over the direction and requirements of the tenders, while the private transport operators (PTOs) have to follow suit for instance when shifts in requirements such as for sustainability occur. Due to the mentioned power relations, public procurement can therefore be utilized as a lever for change and sustainable development (Aldenius, Tsaxiri, & Lidestam, 2021). This market-based approach however also has implications for the transaction costs associated with the procurement of innovations, such as search, bargaining and monitoring costs, which have to be considered when reflecting upon an optimal setting for inducing sustainability innovations.

Overall, since public transportation is a major contributor to worldwide greenhouse gas emissions and moreover has a societal role to play, it is of high importance to enable innovations within this field to transform the industry towards more sustainability. However, as the public sector and thereby public transport are associated with path dependence and barriers to change due to various reasons (Hrelja, Isaksson & Richardson, 2013; Torfing, 2009), this poses a real challenge to the industry.

1.2 Problem statement

The apparent need for change and innovation due the outlined market failure to provide sustainability innovations on a scale needed to solve the climate crisis, leads to the question how public actors can organize themselves to foster these sustainability innovations. Since public procurement is described as a potential driver for change (Edler & Georghiou, 2007), there is a

need to investigate the current procurement practices in public transport to understand how the process could be organized and improved from the public perspective. In this context, several scholars (Uyarra, Edler, Garcia-Estevez, Georghiou & Yeow, 2014; Amann & Essig, 2014; Georghiou, Edler, Uyarra & Yeow, 2014) point towards barriers and enablers of demand-side innovation measures such as public procurement between the public demand side and the private supply side, which impede or facilitate the occurrence of innovation. However, these scholars present their evidence from different national, legislative and industrial contexts and study the occurrence of innovation in general, thereby leaving a theoretical gap on how these barriers, enablers and the whole process unfold in the case of sustainability innovations. Thus, there is a need to investigate how the relationship between the PTAs and PTOs and the associated barriers and enablers unfolds regarding sustainability innovations. Moreover, since public procurement and respective legislations are country and industry-specific and there is a lack of academic literature on barriers and enablers to innovation and sustainability innovations in the Swedish public transport industry, an investigation of the Swedish case is motivated.

From a strategic point of view, the different forms of organizing the public provision of goods and procurement from a vertical integration perspective and the implications for innovation and associated transaction costs are particularly interesting. Here, the dominance of a market-based procurement solution in Swedish public transport creates a need to understand the innovation process and associated transaction costs to derive implications of the chosen level of vertical integration for the facilitation of sustainability innovations. Especially in light of statements from Williamson (1985), who notes that increasing complexity leads to increased transaction costs and that a market solution is suitable for non-complex products, there is a potential incongruence with the complex character of innovation procurement conducted through the market within the public transport industry in Sweden, which further motivates this research. Lastly, there is practical relevance for managers, who have to take strategic decisions on how to organize the process and the collaboration between PTAs and PTOs to foster innovation and make it less costly from a transaction cost perspective, which could reveal insights valuable not only to the public transport industry but also other public sectors and their procurement processes.

1.3 Aim of the study

Hence, motivated by the background and problem statement, the research is aimed at understanding the public procurement process between PTAs and PTOs regarding innovations in the Swedish public transport industry as well as the barriers and enablers to sustainability innovations between the two actors. This is executed by an abductive qualitative case study analyzing barriers and enablers in regard to innovation in the Swedish context and investigating differences to sustainability innovations simultaneously. Here, the abductive design allows the researchers to corroborate or adjust previous findings in regard to barriers and enablers to innovation while allowing for new insights regarding the respective dynamics in the specific case of sustainability innovations in Sweden. Moreover, the theoretical gap of what impact the currently chosen level of vertical integration in the procurement process has on sustainability innovations is addressed by exploring the specific context of the market-based procurement solution in the Swedish public transport sector and its implications for sustainability innovations. These insights will subsequently be used to make derivations on how PTAs can act and organize themselves to drive sustainability innovations within the current market-based approach to procurement in Sweden. Moreover, considerations on different levels of vertical integration and their impact on transaction costs in innovation procurement are presented shortly.

In sum, the study aims at assessing and extending existing research on barriers and enablers to innovation in public procurement processes and further gain new insights into the specific dynamics of sustainability innovations in this regard. Secondly, implications of the currently chosen level of vertical integration in Sweden, i.e. market-based procurement, on transaction costs and the occurrence of sustainability innovation will be examined. Motivated by the outlined problematization and research aim, the following research question is posed to guide this thesis:

How is the relationship between PTAs and PTOs within the Swedish market-based approach to public procurement affecting sustainability innovations in the public transport industry?

2. Literature overview and theory

Given the research question of *How the relationship between PTAs and PTOs within the Swedish market-based approach to public procurement is affecting sustainability innovations in the public transport industry?,* several components of the problem are reviewed which are relevant to address the research question. First, the concept of transaction cost economics, as well as the adjacent concept of incomplete contracts, are presented to provide the reader with a sound understanding of the theoretical framework the thesis is based on and frame the research from a strategic perspective. Subsequently, the interconnections between public procurement and innovation are investigated by exploring relevant perspectives on this interrelationship. Since public procurement is very context dependent and differs among countries, the particular context in Sweden is reviewed. Moreover, the emerging concept of demand-side innovations is outlined, which perceives public procurement as a means to foster innovation and induce change. Furthermore, the barriers to demand-side innovation in the context of public procurement from both supply and demand perspectives are discussed. Lastly, the academic literature on incentivizing and enabling innovation through public procurement is reviewed, to provide a holistic view of the topic. The chapter is concluded with a chapter summary and a conceptual model, which illustrates the relationships between the concepts and aspects discussed.

2.1 Transaction cost economics

The concept of transaction cost economics was first introduced by Coase (1937), who critically questioned why organizations rely so heavily on internal activities while the generally acknowledged assumption is that the market is efficient. Coase's explanation for the need for internal activities was that there need to be some costs associated with using the market. This in turn was elaborated by Williamson (1985) who summarizes that due to the costs of creating and enforcing legal contracts as well as due to the existence of incomplete contracts, it can be more beneficial to use a higher level of vertical integration instead of the market. One key assumption within the theory is that actors are opportunistic and therefore will try to exploit shortcomings in the contract for their own good. Besanko, Dranove, Shanley & Schaefer (2017) outline that there are three main concepts within TCE: relation-specific assets, quasi-rents, and the holdup problem. Relation-specific assets describe the fact that some assets only fulfill their full value in

their specific relationship and an actor cannot extract as much value if the assets were to be used in another setting. The existence of these assets results in the occurrence of quasi-rents which delineate the extra profit an actor can obtain from using the relation-specific assets within its intended use. Lastly, Besanko et al. (2017) describe the concept of the holdup problem. As outlined before, the existence of relation-specific assets creates positive quasi-rents. When these quasi-rents increase, the risk that the party with higher bargaining power starts exploiting the situation through a re-negotiation of the initial, incomplete contracts increases likewise, which leads to higher transaction costs. Since the involved parties expect the hold-up problem, it consequently leads to an investment that is below what would be efficient. As a solution to this set of problems, Williamson (1985) suggests using vertical integration, meaning executing more stages of their operations in their supply chain internally, to reduce transaction costs. However, Williamson (1985) emphasizes that the extent of vertical integration should be balanced upon the context since for different transactions there are different optimal levels of vertical integration. For instance, Williamson (1985) claims that repetitive and low complex transactions should be executed through the market, whereas more complex transactions yield a higher performance when done in a more internal setting.

Regarding the connection between TCE and the public sector, Williamson (1999) argued that there is a need to understand how such a dominant organizational form operates in connection to transaction costs. Although the author explicitly tones down procurement in this context, he states that public procurement could be perceived as a way to use the market to buy instead of make. In a recent article, Rokkan & Haugland (2022) applied the TCE approach to public procurement and developed a conceptual framework that includes several propositions, such as "A public agency will rely more extensively on market governance (rely less on non-market governance) of supplier relationships than private companies for exchanges with similar transaction attributes" (Rokkan & Haugland, 2022, p.6). Moreover, the authors state that procurement contracts involving innovation are benefitting from having a non-market governance structure. Lastly, the authors claim that public procurement will likely perform better for less complex transactions (Rokkan & Haugland, 2022). In light of these assertions, the market-based approach to public procurement utilized in Sweden is to be critically reflected upon when procuring innovation.

2.1.1 Incomplete contracts and implications of difficulties of contracting

Another central part of TCE is the notion of incomplete contracts, which is a term from economic theory meaning that contracts do not include every possible outcome in all future states of the world (Hart, 1995). Having incomplete contracts implies that these contracts can be exploited by an opportunistic actor, which is an issue that needs to be addressed. Initially, the concept was made famous by Grossman & Hart (1986) who described how incomplete contracts lead to lower performance and are therefore to be avoided. It is argued that while contracts can be written to include many different outcomes in a world that is complex, it is anyhow hard to anticipate every contingency (Hart, 1995). Hart (1995) further outlines that even if an individual has an idea of what will happen in the future, it is difficult to negotiate this with another party and to write it down in a way that a third party can understand and mediate any disagreements. This in turn leads to a world where contracts are incomplete and therefore not an optimal solution in all circumstances. The theory has gotten criticism, particularly from Maskin & Tirole (1999) who argued that if actors can calculate the probabilities and adjust their payoff in accordance with their risk preferences it is possible to have contracts where the transaction costs are not relevant. Replying to this criticism, Hart & More (1999) states that the theory holds true, especially where re-negotiation is not possible, and that incomplete contracts hold relevance when actors are to decide on their relationship.

2.2 Public Procurement & Innovation

With a share of 14,9 % of GDP in 2020, public procurement, which is defined as the "process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies" (European Commission, 2022), depicts an important share of demand in the European Union (EU), which even showed increasing tendencies caused by the pandemic (OECD, 2021). Due to this strong purchasing power, public procurement is described as having a considerable influence on market, technological and consumption developments (Edler & Georghiou, 2007; Amann & Essig, 2014) and hence can be perceived as a driver for change. Consequently, there has been an increasing interest in recent decades in the role of public procurement in fostering private sector innovation and its potential to reduce market failures, which can be summarized under the term demand-side innovations (Uyarra et al., 2014;

Edler & Georghiou, 2007; OECD, 2011). While public procurement is generally aiming to provide the most needed goods and services to citizens in a cost-efficient and timely manner, the debate around demand-side innovations included a broader understanding of the concept: Besides the primary procurement goals of cost-efficient service provision, public procurement is seen as a lever to reach so-called secondary procurement goals such as the promotion of innovation or sustainability (McCrudden, 2007; European Commission, 2012). However, despite its alleged potential, scholars continuously point out various barriers to innovation in the context of demand-side innovations (Uyarra et al., 2014; Amann & Essig, 2014). In order to address these barriers and be able to incentivize innovation in public procurement, it is necessary to first thoroughly understand the procurement process in Sweden, the involved actors and relationships, and how demand-side innovations work.

2.2.1 Public Procurement in Sweden

Since Sweden is a member of the European Union and is therefore bound to EU laws, public procurement is generally supposed to encourage the free movement of goods and services within the European Union. From a legal point of view, the national laws Lag (2016:1145) om offentlig upphandling (LOU), which delineates how public procurement should be conducted in general, and Lag (2016:1146) om upphandling inom försörjningssektorerna (LUF), which handles public procurement of the most critical sections within Sweden, namely water, energy, transport (Region Stockholm, n.d), provide the legal framework for public procurement.

The Swedish government points out that Sweden is using a market-based approach to public procurement while at the same time enabling innovation and including sustainability within the approach (Regeringskansliet, 2018). From their point of view, using the market within public procurement leads to better utilization of public funds since competition is essential for beneficial deals for Sweden (Regeringskansliet, 2018). In the case of Swedish public transport, procurement is organized regionally, meaning that the local public transport authorities (PTAs) are tendering the contracts for the provision of services and public transport operators (PTOs) submit their offers (Aldenius, Tsaxiri, & Lidestam, 2021). Within the public transport sector, the tender system generally works in a six-step process, although there are small regional differences (Region Stockholm, n.d). The first stage includes an investigation into the current and future needs for the public transport system to define the demand of public transport authorities. This

process starts three to four years before the existing agreement ends and includes an evaluation regarding what to change and keep from current agreements as well as to give the right incentives for the traffic operators to conduct the traffic. After the demand is defined, elected officials decide to formally start the tender process in the second step and draft the procurement documentation, which includes specific details surrounding what will be delivered from the operator in the third step. Fourth, the tender is published in EU publications as well as on a digital tender website, while carrying out an initial selection about who will be able to bid for the tender. Fifth, the tender documentation is published and sent out to the qualified traffic operators who henceforth are given a period of time where they are able to ask questions. Lastly, an evaluation and decision are conducted by the traffic committee, meaning the elected politicians at a regional level, which can also include negotiation between the PTAs and PTOs (Region Stockholm, n.d). In regard to the evaluation of tender documents, there are different practices throughout Sweden, with some regions solely evaluating on the best price while other regions include further aspects such as quality criteria in their evaluation. Within this thesis, the whole six-step process is divided into three phases to provide greater clarity: The first phase includes all outlined activities that happen *before* the tender documents are published. The second phase involves the activities that occur *after* the tender documents are published, meaning mainly the question phase, evaluation and negotiations. Lastly, the third phase deals with everything that happens after the tender contract is signed, which will be described as the contract management phase and deals with the collaboration between PTAs and PTOs throughout the whole contract duration to execute the agreed contract.

Overall, Sweden's public transport system is viewed as a model for how to integrate a market economy into a public good and use procurement to run the transport system in cooperation between public and private actors (Molander, 2018). Hence, public transport authorities in Sweden solely use the market to procure new products and services, leading to the derivation that innovation is likewise solely procured through the market. This is an interesting approach that is seemingly not in line with previously outlined assertions of the TCE approach, proposing that the market should mainly be used for non-complex transactions to keep transaction costs low. Since the procurement of public transport projects in general and particularly the procurement of

innovation within public transport can arguably be described as highly complex, this once again poses the question of whether the current setup is optimal.

2.2.2 Demand-side innovations

In the discussion about innovations and how to foster them from a governmental point of view, there are several approaches, which alternate in their popularity over time. Consensus however exists on the fact that latent demand is an important antecedent and must be fomented if innovations are to emerge. Historically, governments were mainly focused on so-called supply-side measures, such as fiscal measures, competition policies, or simplified entry requirements, to create incentives for private companies to enter the market, identify unmet needs and create innovations, which were meeting the demand (OECD, 2011). However, while supply-side measures were utilized and discussed extensively in the past, this thesis will focus on the use of public procurement and thereby demand-side innovation policies to foster innovation. In recent years, the notion of demand-side innovation policies, which focus on governmental involvement in creating demand through public procurement and thereby supporting the occurrence of innovation, has gained traction. Uyarra et al. (2014) describe this approach as *public procurement of innovation*, which is characterized by a public agency ordering or buying a good whose creation requires innovation. Although the approach is not new, the reasons for its momentum and the rekindling debate are manifold:

First, there has been increasing discontent with supply-side policies due to a lack of success in fueling innovations and solving pressing societal issues in areas such as environment, transport and security (OECD, 2011).

Second, demand-side innovation measures such as public procurement offer the opportunity to steer the demand in a direction that is aligned with political and societal goals. For instance, governments and local municipalities can translate the societal wish for more sustainability into a tangible market demand through public procurement choices which can help induce sustainability innovations (Edler & Georghiou, 2007).

Thirdly, there has been a paradigm shift in the way the innovation process is perceived academically: For the majority of the 20th century, the linear model of innovation, which

describes innovation as a chronological process from basic research to applied R&D and finally diffusion, was highly influential and often accompanied by high R&D expenditures and subsidies, and thus reflected a supply-side measure (Godin, 2006). In contrast, the currently academically prevalent *innovation system*s perspective describes a more holistic and cyclical innovation process, involving manifold innovations actors on both the supply and demand side, whose interactions and feedback loops need to be facilitated by innovation policy for successful innovation to occur (Edler & Georghiou, 2007; OECD, 2011). Hence, within this new paradigm, demand-side measures are added to the existing supply-side measures and their complementary character is emphasized (Edler & Georghiou, 2007; OECD, 2011).

Lastly, Edler (2013) describes the justification for demand-side interventions as threefold: For once, he outlines system and market failures that impede suppliers from innovating, "despite an overall social benefit of the innovation" (Edler, 2013, p. 13). Underlying reasons are adoption externalities, stemming from high entry and learning costs and furthermore path dependencies, information asymmetries and technological lock-ins, which can be countered by demand-side measures. The second rationale is motivated by the assumption that demand-side interventions not only have the potential to mitigate market failures but simultaneously trigger local economic benefits by providing favorable demand conditions (Edler, 2013). Connected to this line of thought is the concept of lead markets, which aim to provide favourable demand conditions locally in order to foster innovation, which in turn have the potential to become successful internationally and thereby improve the likelihood of local suppliers to strive economically (Beise, 2004). Thirdly, Edler (2013) emphasizes the aforementioned aspect of demand side interventions aiming at solving a societal challenge such as regarding sustainability, where the markets lack incentives to provide innovations to the extent needed to solve the respective challenges. Hence, demand-side innovation measures, such as public procurement are described as having the potential to solve several market and system failures and drive change in areas important to society.

Despite the growth in popularity of demand-side innovation measures and the potential to positively influence innovation, Uyarra et al. (2014) point out that it is important to understand "how and under what conditions" (p. 632) public procurement can positively influence

innovation since previous efforts have resulted in medium success. Hence, it is crucial to comprehend the barriers to innovation through public procurement from both the supply and demand side and moreover how contracts, relationships, and processes have to be designed within public procurement so that innovation is incentivized.

2.2.3 Barriers to innovation - Supply side

In their UK study on the occurrence of innovation within public procurement, Uyarra et al. (2014) elaborate on the barriers for *suppliers* to innovate concerning contracts, relationships, processes and capabilities within public procurement. While the authors note that there are notable differences regarding different regions, industries, sizes of suppliers or their R&D intensity, five main barriers stand out in particular.

The first barrier revolves around a lack of interaction between the suppliers and the procuring organizations (Uyarra et al., 2014). This is problematic since the aforementioned innovation systems approach emphasizes the significance of close collaboration and feedback loops between all innovation actors for innovation to occur (Breschi, Malerba & Orsenigo, 2000). Particularly in light of the previously discussed concepts of incomplete contracts and transaction costs, close collaboration within the process is crucial: Due to information asymmetries and the complex nature of innovations, active cooperation is necessary to keep transaction costs low and compensate for the unattainability of complete contracts.

Secondly, the study revealed that tender specifications of procuring organizations that are too narrow and rigid represent a barrier and hamper suppliers' potential to innovate. While outcome-based specifications allow suppliers the leeway to provide new and innovative solutions to reach these outcomes and are therefore better suited from an innovation perspective (Geroski, 1990), tight and specific requirements impede this very ambition. The reasons for this narrowness and counterproductively formulated tenders are manifold and range from general inertia to transaction costs of change and path dependency within public agencies (Uyarra et al., 2014; Byatt, 2001).

The third barrier deals with the low capability levels of public actors regarding the procurement of innovations. While most procurers are used to identify the projects and goods with the lowest possible price that fit the given criteria, the situation is more complex with the procurement of

innovations and hence, greater levels of competence are needed (Rothwell & Zegveld, 1981). This barrier is described as particularly prevalent in smaller and more decentralized governing bodies (Uyarra et al. 2014).

Fourthly, the study outlines the management of risk within the public procurement process from the public actor side as a barrier to innovation. Due to high expectations concerning accountability and transparency as well as the handling of taxpayers' money, risk aversion is described as a key problem when procuring innovations (Tsipouri, Edler, Rolfstam & Uyarra, 2010; HM Treasury, 2005). Hence, public procurers might be unwilling to select innovative solutions and stick to offers representing the status quo due to path dependency. According to Georghiou et al. (2014), several public agencies within the OECD introduced action including insurance guarantees or financial incentives for public procurers, which are supposed to mitigate the perceived risks and induce innovation-friendly procurement. However, to date this barrier to innovation is still prevalent and results in a vicious circle since procurers are avoiding risks in procurement, which discourages suppliers to invest in R&D and propose new solutions, ultimately impeding progress and innovation (Uyarra et al., 2014).

Lastly, the authors point to a dilemma arising if public demand for innovation is existent, but the suppliers lack the incentive to serve this very demand. This dilemma can occur if the public demand is too fragmented or too small to justify heavy R&D investments, standards are not aligned within markets or tendered contracts are not long enough (Uyarra et al., 2014). Moreover, the topic of intellectual property rights is described as impeding in case it is designed in a way that suppliers lack an incentive to innovate. This is particularly the case if suppliers cannot monetize innovations due to a lack of exclusive ownership or even public ownership of innovations occurring in the procurement process. Such problems particularly arise in R&D-intensive industries but are not limited to the mentioned aspects (Uyarra et al., 2014). Hence, public agencies need to understand the suppliers' needs and aim to incentivize the supply of innovations accordingly.

2.2.4 Barriers to innovation - Demand side

In the current situation in Sweden, innovation is procured through the market in the public transport industry. Consequently, the focus often lies on understanding the supply side of innovation and its barriers to innovation, to adjust accordingly as described in the former section. However, deriving from the innovation systems approach, actors on both supply and demand sides need to be considered to foster innovation, which is why it is crucial to examine the barriers to innovation from a demand perspective as well.

The first barrier for public procurers within innovation procurement revolves around articulating their demand to suppliers. Public actors aim to steer innovation into the desired direction with their procurement and therefore need to first identify a need, describe their demand and issue tender documents with the respective requirements. While this is a mundane task in regular procurement, this is inherently difficult in the case of innovation procurement, due to the unpredictability of innovations and the fact that the needed technologies, markets or products might not exist at the given point (Edler, Ruhland, Hafner, Rigby, Georghiou, Hommen, Rolfstam, Edquist, Tsipori & Papadakou, 2005). Along these lines, Georghiou et al. (2014) point out that procurers often lack the knowledge of what they will need in the future and are moreover unaware of the potential of innovation. This difficulty to articulate their demand in regard to future innovations is further noteworthy in light of the aforementioned concepts of incomplete contracts and TCE since it implies higher transaction costs for instance in regard to search or screening costs.

Another procedural barrier is rooted in the necessary coordination and communication between various stakeholders which are involved in the procurement process on the public agency side, for instance when formulating contracts, tenders, visions or budgets (Amann & Essig, 2015). Edler et. al (2005) describe several internal and external stakeholder groups who are involved in the procurement process and all bring in their agendas. On the internal side, several actors such as the finance, legal and procurement departments as well as the management of the public agency and relevant specialists are involved. On the external side, there are the suppliers as well as the general public who have an interest in the reasonable allocation of their tax money. While the involvement of all these actors and their opinions can mean additional value to the final

procurement decision, it simultaneously results in huge coordination and communication needs and a very time-consuming, costly and complex process (Edler et al., 2005; Lember, Kalvet & Kattel, 2011).

Moreover, the involvement of the various stakeholders and the general role of public agencies also leads to goal conflicts that have the potential to impede innovation. As Amann & Essig (2015) point out, "public procurement goals such as cost efficiency, legal conformity as well as the advancement of environmental protection, and the promotion of innovation often represent competing priorities." This assertion is supported by Yeow & Edler (2012) and Edquist & Zabala-Iturriagagoitia (2012), who stress that the goal of innovation is by definition inconsistent with the notion of cost-efficiency.

Furthermore, the complexity of the process and the aforementioned difficulty to specify their own demand for innovation naturally calls for a close collaboration between public procurers and the respective suppliers (PTOs), which is aligned with the innovation systems approach as well as with the TCE approach, which aims to keep transaction costs low in such situations. However, there is a fine line between the great need to collaborate closely with suppliers to understand each other's needs and foster innovation (Edquist & Zabala-Iturriagagoitia, 2012) and the tight legislative rules in the procurement process, which are intended to avoid preferential treatment and unfair competition (Ahlqvist, Valovirta & Loikkanen, 2012; Oruezabala & Rico, 2012).

The last barrier has its origins in the organizational culture and internal reward structure of public origins. As described in the previous chapter, public agencies are described as being more risk averse compared to their private counterparts when it comes to encouraging innovation and hence they are attested a lack of innovation orientation and commitment **(**Georghiou et al., 2014; Nyiri, Osimo, Özcivelek, Centeno, Cabera, 2007**)** The reasons for this inherent lack of innovation focus are manifold and range from budget and accountability constraints to the fact that successful public procurement is often attributed to other actors such as politicians but procurement failure is blamed on the respective procurement departments as outlined by Lember et al. (2011). As a result of this missing focus on innovation, public agencies and their employees

are considered to lack the capabilities to create and implement an innovation procurement strategy, which is a strong barrier to innovation (Georghiou et al., 2014; Edler et al., 2005).

2.2.5 Enabling & Incentivizing innovation through public procurement

In order to utilize the potential of public procurement to induce innovation and mitigate the barriers outlined on both supply and demand sides, the key is to create incentives for suppliers to engage in innovative activities and enable and encourage public procurers to actively demand and purchase these very innovations (Georghiou et al., 2014). From a public agency point of view, there are generally two ways of approaching this goal, as outlined by Georghiou et al. (2014) in their seminal paper: by *triggering* innovations through increasing public demand for these undeveloped products or by *responding* to already existing innovations by buying them preferentially. In line with the train of thought of this thesis which addresses the fact that the public procurement process regarding innovation should be designed in a way that reduces transaction costs, Georghiou et al. (2014) similarly point out that while inducing innovation is a useful goal in itself, it is nevertheless crucial to gain cost-benefit advantages while working to achieve it. In their paper, the authors put forward a framework in which they categorize different measures seeking to promote innovation. The four overarching categories, namely *framework conditions, organization & capabilities, Incentivizing innovative solutions* as well as *Identification, specification & signaling of needs* will be used to structure this section.

The first category deals with the potential of adjusting *framework conditions* in order to promote innovation. Framework conditions are referring to the legal and governance environment for innovations, such as national laws and policies as well as international ones, e.g. the European directives from 2014. The focus within this category is to design the legal framework in a way that allows for innovation, e.g by allowing competitive dialogue between buyers and suppliers, managing intellectual property rights more effectively or creating easier access for SMEs to publicly procured tenders (Georghiou et al., 2014).

The second category *organization & capabilities* targets the aforementioned deficiencies regarding lack of innovation focus and awareness as well as the lack of capabilities in articulating demand and procuring innovation in public agencies, in order to foster innovation.

Measures intended at building internal capabilities include introducing a (self-imposed) obligation for PTAs to outline a distinct innovation procurement plan, thereby helping the company to actively think about the process and what capabilities are needed to execute the plan. Moreover, the authors outline the use of guidelines (e.g. European Commission, 2015), training and knowledge networks as potential approaches to building capabilities. In case a cost-benefit analysis reveals that it is more efficient to hire external consultants to provide market intelligence, this can be another valid approach although the longevity of this approach is to be questioned (Amann & Essig, 2014). Lastly, Georghiou et al. (2014) point towards taking advantage of available subsidies, for example from the EU, which covers up to 30% of the procurement costs in the planning phase if PTAs share their experience with innovation tenders, thus reducing the risk for PTAs. Overall, by increasing the levels of capabilities within procuring organizations and recalibrating the focus more towards innovation procurement, the likelihood of innovation occurring can be increased.

The third category, *Incentivizing innovative solutions* deals with incentivizing both supply and demand sides to engage with innovative solutions, despite the risks associated with it for both parties. According to Georghiou et al. (2014), the main risk that suppliers face revolves around generating innovation that is subsequently not procured by the public agency. To mitigate this aspect, the authors propose the usage of innovation requirements in the tender documents to provide clarity and signal demand to the suppliers. Since the public agency side is associated with risk-averse behavior which impedes innovation, Georghiou et al. (2014) present standards and certifications during the procurement process as a solution that reduces uncertainty and transaction costs.

The fourth category i*dentification, specification & signaling of needs,* deals with the effort to improve the communication, coordination and understanding between buyers (PTA) and suppliers (PTO) in the procurement process. As outlined previously, identifying a need and communicating it is crucial to trigger innovation, which adds particular emphasis to this category. Procurement practices that are considered to induce innovation within this category comprise early interaction between suppliers and procurers, including innovation requirements in tender documents, communicating future needs, using functional specifications that describe the

outcome rather than the solution in tender documents and the consideration of full life cycle costs instead of an overemphasis on initial costs (Georghiou et al., 2014). Hence, particularly the close communication and collaboration between PTOs and PTAs are in focus. In order to facilitate this exchange of needs and ideas, there are several relevant types of collaboration models, which are appropriate in different situations.

In a situation where a new solution is needed and the market cannot offer it yet and requires R&D, one collaboration model is *pre-commercial procurement*. Within this model, public agencies select a few private suppliers and purchase R&D activities at an early stage. The selected suppliers then compete under market conditions and come up with prototypes of a new solution, which is followed by a normal but separate procurement process (European Commission (2007). This approach is particularly suitable to mitigate the lack of interaction between buyers and suppliers as well as risk aversion among both parties in the procurement process and can trigger R&D in areas of public agencies' liking.

A second collaboration model introduced by the 2014/24/European Directive is the *innovation partnership*, which is used when there is no adequate solution on the market to meet public needs. Here, the public agency selects several suppliers in the beginning and directly awards them with a contract for both the R&D phase and the procurement phase. Consequently, the innovation is developed in the next stage and finally procured, often in larger volumes, in the last stage (Caranta & Gomes, 2021). Within this process, the collaboration is very close, and the respective risks of each side are mostly mitigated. The suppliers are ensured that the public agency will actually buy their solution in case it meets the agreed requirements while the public agency’s risk that they will not get innovation is reduced. Lastly, due to the close collaboration, communicating demand and refining the requirements is eased. Hence, the model assures close collaboration, mitigates risk and restricting tender documents while focusing exclusively on innovation. This model is to be distinguished from *competitive dialogue*, where the R&D activity and the collaboration take place within the dialogue phase *before* a contract is awarded, hence increasing the risk for the suppliers that their investments into R&D will not be rewarded with a procurement contract (Caranta & Gomes, 2021).

2.3 Chapter Summary

In order to support the research, the concepts of transaction cost economics and incomplete contracts are discussed, to outline that there are differing transaction costs related to the level of vertical integration an organization chooses in a specific context and that incomplete contracts can lead to inefficient situations, due to holdup problems (Williamson, 1985). Particularly in cases of complex transactions, it is argued that fully using the market can lead to high transaction costs. Likewise, it is stated that in the case of procurement contracts involving innovation, it is beneficial to have a non-market structure (Rokkan & Haugland, 2022).

Subsequently, the focus was placed on public procurement and its potential role as a driver for change and innovation. Due to its strong purchasing power, public procurement is described as having a considerable influence on market, technological and consumption developments (Edler & Georghiou, 2007; Amann & Essig, 2014), which is why the concept of demand-side innovations was introduced. Despite agreement about the promising potential of demand-side innovations through public procurement, several barriers for the involved private and public actors (PTOs and PTAs in the case of public transport) remain, which impede innovation. For the PTO side, innovation in the procurement process is mainly impeded by a lack of interaction with the PTAs, narrow tender specifications which do not allow for innovative solutions and a lack of capabilities on the PTA side regarding risk management and incentivizing innovation (Uyarra et al. 2014). For the PTAs, barriers to innovation consist of problems in predicting and articulating present and future demand, coordinating and aligning conflicting goals and stakeholder interests and legal barriers to closer collaboration needed for innovation (Georghiou et al., 2014). Lastly, factors and collaboration models enabling innovation within public procurement were reviewed. The academic literature emphasized early and close collaboration, innovation requirements in tenders, the consideration of full-life-cycle costs in procurement decisions and tender specifications formulated in functional terms as supporting aspects for innovation in procurement. Moreover, collaboration models for different contexts such as innovation partnership and pre-commercial procurement (PCP) were reviewed and described as mitigating certain barriers. The utilized theoretical concepts as well as their interrelationships are outlined in the preliminary conceptual model below.

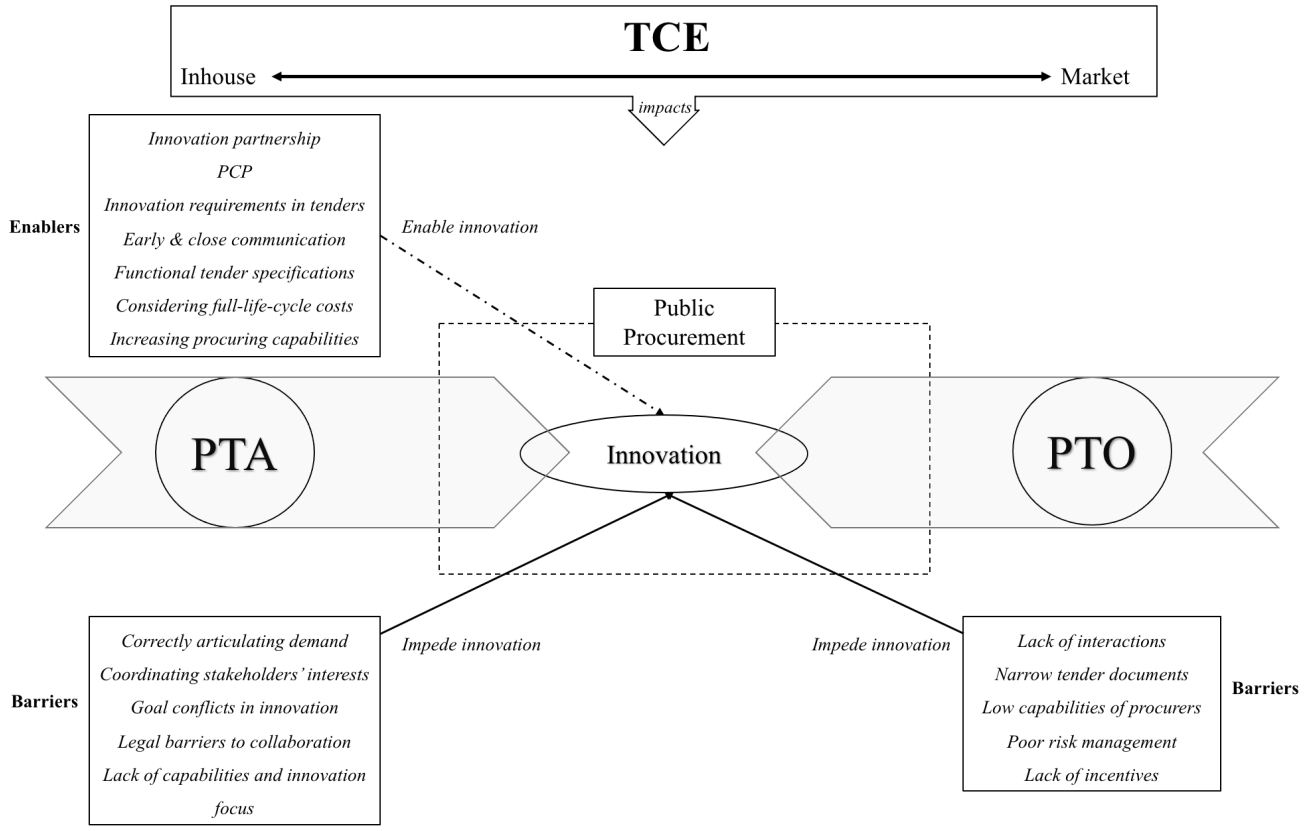

Figure 1 - Conceptual Model

Visualized in the preliminary conceptual model is the relationship between PTAs and PTOs that unfolds within the public procurement process as a place of action within the scope of this thesis. While the mutually formulated goal is to foster innovation within the procurement process, there are several *barriers* on both sides which impede that very ambition which are outlined on the left and right sides below the respective PTA and PTO circles. Additionally, there are several factors described as *enabling* innovation in the procurement process, which are located above the PTA circle on the left side. The reason why these enablers are located on the PTA side and there is no equivalent on the PTO side is that this thesis focuses on demand-side innovation measures. This means that the role of PTAs and their scope of action when it comes to inducing innovation is in focus in this thesis since the previously utilized supply-side measures which were primarily focused on creating fruitful conditions for private companies (e.g. PTOs) and enabling innovation did not lead to successes, particularly when it comes to sustainability innovations. Lastly, the bar at the top of the model represents the notion that the chosen level of vertical

integration in the procurement process for innovation has an impact on the transaction costs of the whole process and thereby on the facilitation of innovation. In the current situation in Sweden, the PTAs are using the market to procure innovation, meaning that they are on the very right end of the scale. While the scope of the thesis does not allow for a comparison of transaction costs and innovation occurrence for different scenarios of vertical integration, the authors nevertheless reflect on the implications that the current level of vertical integration, i.e. market-based procurement for innovation in Sweden, has on transaction costs and the facilitation of innovation.

3. Methodology

3.1 Research design

As outlined previously, the aim of this thesis revolves around investigating how sustainability innovations can occur between PTAs and PTOs within the public procurement process in Swedish public transport. Therefore, the following research question was posed in order to guide the research:

How is the relationship between PTAs and PTOs within the Swedish market-based approach to public procurement affecting sustainability innovations in the public transport industry?

In order to address this research question, a qualitative single-case study with an abductive approach was selected, which was considered appropriate due to several reasons. Bryman, Bell & Harley (2019) highlight that a case study is suitable to describe a particular situation in detail and take contextual factors into account which is fitting to investigate the specific case of Swedish public transport. To provide the most value for the research question within a limited scope, it was deemed most beneficial to utilize a single case study that does not contain a comparative part but focuses on being descriptive and analytical.

First, a pilot study was conducted early in the process, to finalize the research question and ensure theoretical and practical relevance. Here, four explorative expert interviews were utilized since Bogner, Littig & Menz (2009) describe them as a helpful tool to collect material about a specific area that is rather unresearched and needs initial data, which is the case for the niche topic of sustainability innovations through public procurement in the Swedish public transport industry. In the pilot study, a first conceptual framework including relevant literature and pressing issues in the industry was discussed with researchers knowledgeable about the Swedish public transport industry to open up for interesting leads and perspectives that could guide the research. The background of the interviewees in the pilot study was academic with a dominance of Ph.D. researchers which helped to ensure the theoretical relevance of the research. After each of the interviews, adjustments were made to the research question and framing, hence

representing an iterative process and thus enabling the authors to refine the research along the way, which is described as beneficial by Bryman & Bell (2011).

After the research question was finalized, a conceptual framework on barriers and enablers to innovation within procurement was developed utilizing relevant literature, which also influenced the interview guide for the main empirical data gathering process, where semi-structured interviews with relevant informants were conducted. However, the goal of the research was not solely to deductively test the given framework in the Swedish context, but moreover inductively investigate how the dynamics unfold in this case and how these dynamics differ regarding sustainability innovations. Therefore, the interview guide (Appendix 1 & 2) was designed in an open way that allowed the informants to emphasize the important aspects from their perspective first after which more specific questions for certain barriers and enablers followed, which had a more deductive character. Throughout the phase of empirical data gathering and coding, the conceptual model and interview guide were continuously tested as well as extended and refined with emerging insights. By this approach, a combination of deductive and inductive elements was applied, hence using an abductive process (Bryman & Bell, 2011). Bryman, Bell & Harley (2019) describe abduction as a means to overcome the weaknesses associated with deductive or inductive reasoning. Through the back-and-forth dialogue between theory and empirical material, the paper therefore aims to answer the research question in a fulfilling way. Another reason why the abductive approach was deemed appropriate is that the academic literature hitherto mainly focused on the context of regular innovations within demand side policies, while leaving out the specific case of sustainability innovations. Hence, existing research about barriers and enablers in the context of demand-side innovations was utilized to build a conceptual model deductively and test it in the context of the Swedish public transport industry while at the same time inductively investigating the dynamics in regard to sustainability innovations.

In order to fulfill the research question, the level of analysis is chosen to be on the industry level. This is considered appropriate since public procurement is described as being very country and industry-specific and therefore a higher level of analysis would lack the important contextual factors. A more detailed level of analysis would however not open up for the appropriate conclusions to be drawn. Through a combination of interviewing both PTAs and PTOs, data was

captured from both sides of the relationship which was used to build the descriptive case of the status quo. Through five interviews focused on bigger PTAs in Sweden, meaning serving a population size of over 1,000,000 people, as well as two interviews with smaller PTAs, a more nuanced picture of the different innovation procurement processes between differently sized regions in Sweden was created. Although the dominance of bigger PTAs in the sample creates a bias towards understanding the dynamics through the lens of the larger regions, they were nevertheless targeted since they represent large portions of the Swedish market and are described to lead the way in state-of-the-art procurement practices. On the PTO side, three interviews with representatives of bigger PTOs were conducted, since interview partners from smaller PTOs were not available for an interview. This condition led to the fact that the barriers to innovation and opinions of small-sized PTOs could only be included from a theoretical point of view but could not be tested and extended, thereby limiting the research from that angle. Concerning units of analysis, the main data source was management level individuals within the public transport industry, which were targeted, since they combined both the factual knowledge of the relationships within the innovation procurement process as well as a well-developed contextual understanding of the industry.

3.2 Case selection

Bryman, Bell & Harley (2019) describe how a case can be various things from a “signal organization” to a “single event”. Due to the research question focusing on the Swedish public transport sector, it was not deemed appropriate to focus on a specific PTA or a specific PTO but rather trying to capture as much as possible about the context by treating what happens in the relationship between the PTOs and PTAs within the Swedish public transport industry as an interesting phenomenon that is a case in itself. When it comes to the type of case study, the utilized approach combines different types to fulfill the research aim. First, the given case holds aspects of an intrinsic case, which tries to understand the peculiarities of a situation (Stake, 1995) since the case study is aimed at investigating the Swedish situation and seeing it in its context. At the same time, the case also has features of an instrumental case, which perceives the case as a tool to gain insights into a broader theme (Stake, 1995), as the Swedish case is utilized to gain insights into the dynamics of sustainability innovations in public procurement which might be

applicable in more industries and context than the one investigated.

3.3 Process of data collection

3.3.1 Literature review

In regard to collecting data and material for the literature review, the authors mainly utilized the databases and search engines such as LUBsearch and Google scholar to get access to relevant papers. In this context, snowball sampling was utilized where the references and bibliographies of seminal articles were checked to gain a sound understanding of the research field and find articles that were inaccessible through a keyword search. While Biernacki & Waldorf (1981) point out that this approach can lead to the narrowing of thematic areas and be accompanied by groups of scholars who share similar opinions, the focus on a niche research area and the limited scope of the thesis convinced the author of the suitability of this approach.

3.3.2 Primary data collection

Regarding the sampling of interviewees for the primary data collection, a non-probabilistic, purposive sampling was used in the first step, followed by a snowball sampling once sound contacts were established (Bryman & Bell, 2011). Bryman & Bell (2011) describe how purposive sampling is neither convenient nor random sampling but its own category that aims to find relevant data sources. Through the usage of purposive sampling, the relevant perceptions of the issues were aimed to be captured, helping the authors to understand and explain the dynamics of sustainability innovations within the public transport sector. With this approach, it was aimed to find individuals with explicit knowledge relevant to the research question and utilize their network to access resources normally inaccessible. Furthermore, the snowball part of the sampling strategy was particularly useful to find complementary interviews within some organizations to capture a wider range of experiences.

Practically, that sampling was conducted using the business platform LinkedIn where relevant organizations on the PTA and PTO side were identified and subsequently employees searched that worked within procurement for their respective organizations, utilizing keywords such as “Procurement”, “Tender” and Swedish equivalents such as “Upphandling” or “Andbud”. The

snowball sampling was then utilized after initial contact was established, to make use of referrals and thereby increase the access to relevant individuals. Thereby, several interviews with respondents unreachable to the authors through the LinkedIn search were able to be interviewed. However, the utilized snowball sampling creates a bias where the referrals were bound to the perceptions of the initially contacted interview partners and their opinion on who could be a suitable future interviewee. Overall, this bias was however deemed to have a low impact since the expertise the initial interviewees had about their respective organizations was mainly enriching to the search for fitting interview partners.

In regard to interview guides, Bryman, Bell & Harley (2019) outline that semi-structured interviews include several overarching questions that are asked in varying order depending on what happens during the interview. Furthermore, they state that the wording of the questions tends to be more general compared to structured interviews (Bryman, Bell & Harley, 2019). This approach was deemed appropriate since the data was not only collected to deductively test the developed conceptual framework but particularly to open up for the interviewees' insights and their experience on what is important in the Swedish context, thus using an abductive approach. To allow for these interesting leads to emerge, a probing strategy was applied during the interviews, where the initial questions were posed openly and subsequently enriched by follow-up questions, allowing and encouraging the informant to deep dive and reflect on the underlying reasons to the answers (Morris, 2015). Moreover, to account for the different backgrounds of the interviewees, namely PTAs and PTOs, two different interview guides were used (see Appendix 1 & 2) which shared similar themes but nevertheless considered the different perspectives and contexts of the two interview groups. Within the interview guide, some questions emerged from the literature review and aimed at the preliminary conceptual model whereas the majority of questions were held general and aimed at understanding the dynamics, barriers and enablers of innovation and sustainability innovation in public procurement from the interviewees' point of view. Since the focus theme of the interview revolved around innovation, which is a term used widely but also in many different ways and contexts, the authors systematically outlined what innovation meant in this context at the beginning of each interview and informed the interviewees that both the dynamics for general innovations as well as the dynamics in the specific case of sustainability innovations are of interest to the thesis.

All interviews were conducted utilizing virtual video calls on different platforms. While Bryman & Bell (2011) describe virtual interviews as a lower quality alternative compared to in-person interviews, the authors deem the quality of the interviews to be personal and interactive from both ends due to the familiarity of all interviewees with video conferencing in a post-Covid-19 world. Furthermore, all interviewees were asked for their consent to be recorded and were informed that their real names and company names will be held anonymous within this thesis, in order to provide transparency and enable the interviewees to speak as freely as possible about the given topics and potential problems. Later, the audio files were transcribed using the AI-based transcription software *Trint*, and further manually corrected in case the statements were relevant for coding.

Within the primary data collection phase, two difficulties complicated the data gathering. Firstly, two informants voiced their preference to conduct the interview in Swedish due to language barriers, which was made possible by one of the authors being a native Swede. While the transcripts of the interview were translated using the AI-based translator *DeepL* and further manually adjusted by the Swedish author to ensure correct translation and meaning, this aspect nevertheless represents a limitation since not both authors could ask follow-up questions during the interview. To mitigate the issues, the authors asked for the possibility of a written follow-up where clarifying questions or deep-dives into aspects that were missed during the interview could be posed. Thereby the impact of only having one of the authors present at two of the interviews was attempted to be mitigated. Secondly, two of the respondents did not want to be recorded during the interview which further complicated the data gathering process. To overcome this challenge, one of the authors took the lead in asking questions while the other author engaged in extensive note-taking to capture the main statements.
The following table provides an overview of the informant's code names, their position, organization type as well as the duration of each interview.

Code name	Position	Organization	Time
Pilot study	Post Doc	Research Institute for Public transport	28 minutes
Pilot study	Ph.D. Researcher	Research Institute for Public transport	32 minutes
Pilot study	Ph.D. Researcher	Research Institute for Public transport	29 minutes
Pilot study	Research assistant	Research Institute for Public transport	42 minutes
Alfa	Head of procurement	PTO	35 minutes
Beta	Head of the office and sustainability responsible	PTA (Smaller)	26 minutes
Chi	Bid Coordinator	PTO	1h 3 minutes
Delta	Section manager Procurement	PTA (Larger)	54 minutes
Epsilon	Project Manager Sustainability	Industry organization for public transport authorities	54 minutes
Falk	Assistant project manager Contract responsible	PTA (Larger)	41 minutes
Gamma	Traffic manager	PTA (Smaller)	1h 7 minutes
Hiero	Section manager Management staff Procurement and tender	PTA (Larger)	39 minutes
Iota	Procurement manager Management staff Procurement and tender	PTA (Larger)	54 minutes
Juno	Contract manager	PTO	26 minutes
Kappa	Sustainability responsible	PTA (Larger)	58 minutes

Table 1 - List of informants

3.4 Data analysis

According to Bryman & Bell (2011), one negative side of qualitative research is that large amounts of data are generated quickly which require analysis to be adequately understood. To conduct the analysis within this thesis, a thematic analysis inspired by Braun & Clarke (2006) as well as aspects from the grounded theory approach were utilized, to make sure that the findings and the final conceptual model are grounded in the data. Grounded theory is described as an iterative and inductive process through which concepts and theories can emerge from the data (Guest, MacQueen & Namey, 2012). According to Bernard & Ryan (1998), the iterative procedure revolves around reading the transcripts, coding potential themes, setting these themes in relation to each other and seeking connections and lastly deriving theoretical models that are grounded in the data. While the thorough and lengthy grounded theory approach to creating new theory was out of scope within this thesis, the iterative character involving the back and forth between data and theory to generate new insights served as the intellectual basis for our analysis. A central concept within grounded theory is the usage of codes which can be described as decomposing the data into smaller parts (Bryman & Bell, 2011). Here, the transcribed interview data acted as a basis for a thorough coding of the material, which was utilized for the following thematic analysis (Brooks, McCluskey, Turley & King, 2015). To conduct a thematic analysis, Braun & Clarke (2006) outline six phases that researchers go through: familiarizing, coding, generating initial themes, developing and reviewing themes, refining and naming themes and lastly writing out the analysis. Overall, this approach was selected because it enabled the researchers to work iteratively with the transcribed material to find relevant information that could corroborate or extend the conceptual framework.

Practically the six-step process started with transcribing the interviews and consequently uploading the transcribed material to the qualitative data analysis software Atlas.ti., which was used to code and analyze the data. In the first step, both authors individually went through the material to familiarize themselves with the material and create first codes that were either stemming from the conceptual model or represented interesting factors that were relevant in multiple interviews. After this initial and individual round of coding, an iterative and collaborative process took place where the researchers jointly looked at the codes and tried to find overarching themes as well as redundant codes that could be merged (see Appendix 3 for a

final list of codes). In a second round, the authors went through the documents again to cross-code the documents and further work on the themes and connections. This iterative process was manifested in an ongoing clustering exercise on the online whiteboard tool Miro, where the authors aimed to connect the codes and different themes into clusters (*Figure 2*). Finally, the identified themes and underlying codes visualized in the Miro board were utilized to produce an empirical analysis that outlined the relations and interdependencies between the different aspects that were relevant for answering the research question.

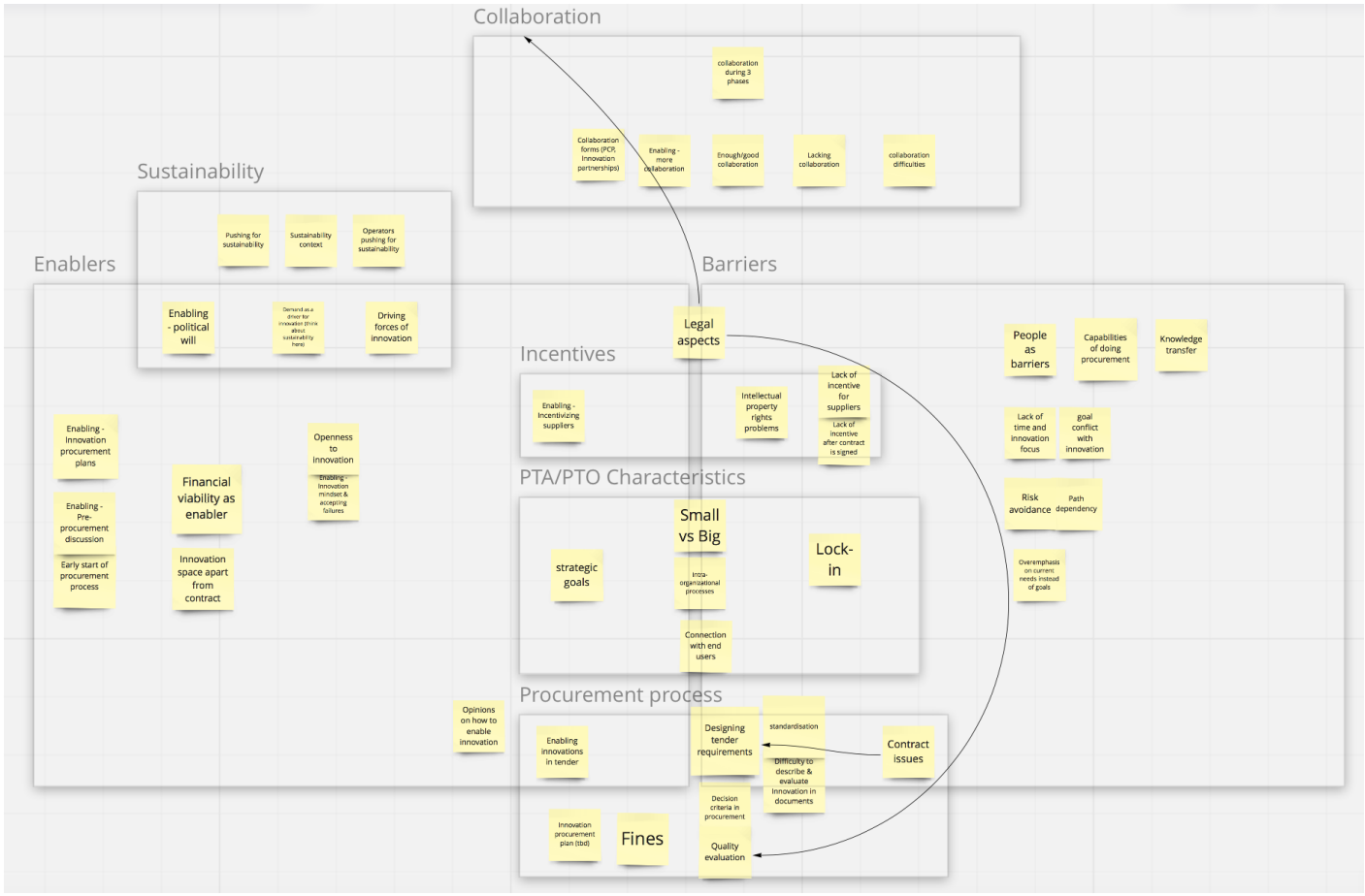

Figure 2 - Clustering of codes into themes

3.5 Reliability & Validity

According to Lincoln & Guba (1985), there is a problem with using the classic concepts of reliability and validity within qualitative research due to the impossibility of finding an absolute truth within a social context. Since this research includes different types of empirical data,

ranging from experiences to opinions about the future, it is important to note that the authors acknowledge that there does not exist one given truth and that the statements of interviewees are not considered to be completely theoretically correct and exhaustive. To mitigate misinterpretations, the authors carefully outlined what was an experience of the informants and what was an opinion about the future in the empirical material. Due to the outlined problems with the classical criteria, the authors decided to follow the alternative criteria namely credibility, transferability, dependability and confirmability to measure trustworthiness (Lincoln & Guba, 1985)

To increase the credibility of the paper the authors used triangulation which is recommended by Lincoln & Guba (1985). Triangulation was achieved through data capturing on both sides of the relationship as well as interviews with an industry organization. Furthermore, transferability is inherently hard to do within a case study (Bryman, Bell & Harley, 2019), which is why the aim was rather to do a thorough description of the status quo and leave it up to the academic audience and future research to evaluate whether the refined model holds true in more contexts, which is suggested by Lincoln & Guba (1985). Thirdly, Lincoln & Guba (1985) describe how dependability means to which extent the procedures can be traced within the research process. While it is hard to provide an external audit of the research process, the researchers documented the coding and clustering process in *Figure 2* and Appendix 3, to enable outsiders some level of insight. Lastly, to address confirmability the researchers utilized the advantage of being a two-person team to engage in deep discussions and be vigilant about preconceived notions within the research area. However, the study inevitably faced issues with personal biases, since the authors' subjective choices regarding sampling, interview guide creation, coding and creation of themes and their interpretation impacted the outcome (Creswell & Creswell, 2018), which reduces the objectivity of the research.

3.6 Ethical considerations

Numerous scholars describe how ethical consideration is highly relevant for sound research (Bryman, Bell & Harley, 2019; Creswell & Creswell 2018). Within this thesis, the following three aspects were deemed to be important to reflect upon: avoidance of harm, informed consent

and privacy (Bryman, Bell & Harley, 2019). First, causing harm to the informants can be seen as inducing stress on the subject or otherwise impacting them negatively, which was a key aspect throughout the process since the researchers continuously attempted to avoid harm to any of the respondents. For instance, informants were always given the opportunity to skip a specific question, which was respected by the authors. Furthermore, requests from the informants such as the opportunity to double check any material that was utilized from their interviews were granted to the informants. Secondly, informed consent means that partaking in the study is voluntary and that the interviewee is aware of the topic of the research. By informing the participants in an initial email as well as during the interviews about the purpose of the study and how their contribution will be used in the thesis, the risk of informants being unaware of the research area and how their data will be used was mitigated. Furthermore, verbal consent was obtained before each digital interview for the interview to be recorded. Lastly, according to Bryman, Bell & Harley (2019), privacy is intertwined with informed consent and revolves around concealing any personal information corresponding to the informants. This aspect was accounted for by anonymizing all respondents and omitting information in the empirical material that could be attributed to any specific individual, such as detailed employment history or unique characteristics.

4. Empirical material and analysis

In this section, the collected empirical data will be presented, reviewed and analyzed in order to address the following research question:

How is the relationship between PTAs and PTOs within the Swedish market-based approach to public procurement affecting sustainability innovations in the public transport industry?

First, a short description of the case context will be provided, whereafter the barriers and enablers to innovation in the case of Swedish public transport are outlined. Lastly, the role of collaboration to foster innovation as well as the peculiarities of economically and non-economically motivated sustainability innovations are discussed.

4.1 Case description

The companies participating in this study are coming from three types of organizations: Public transport authorities (PTAs), reflecting the public demand side, public transport operators (PTOs), representing the private suppliers as well as one industry organization within public transport. In regard to the PTAs, seven interviews were conducted in total with five representatives from bigger PTAs, responsible for a population of over 1,000,000 inhabitants, and two interviews with PTAs from smaller regions in Sweden. Generally, the regionally organized PTAs are responsible for issuing the tender documents in which they outline their demands for the next procurement. Subsequently, the PTAs engage in evaluations and negotiations and finally award a contract to a PTO. On the PTO side, three interviews with representatives from two organizations were conducted. The PTOs main role in the procurement process revolves around making bids to the tenders, in which they outline their proposed solutions and the respective price for that solution. Moreover, the PTOs are the actor responsible for running the public transport in practice, once a tender is won. Important to note is that PTOs are private companies, that are therefore driven by profit. Lastly, one interview was conducted with an informant from an industry organization in public transport. The chosen organization represents the interests of PTAs in Sweden in a European context and thereby offers an additional perspective. The backgrounds of the informants interviewed within this study are

listed in *Table 1* and revolve mainly around management personas with an emphasis on procurement, sustainability or both.

4.2 Barriers to innovation

In the first part, empirical findings regarding barriers to innovation are outlined and structured by the main themes emerging from the data.

4.2.1 Designing tender documents

One aspect of the procurement process that is outlined by various informants to be critical in order to allow for innovation is the way the tender documents are designed. Two informants of the PTO side, namely Alfa and Chi, point out that receiving tender documents which extensively specify the demands instead of focusing on the goals of the tender, impedes their potential to find creative solutions. Chi underlines this assertion with an example of a PTA, which specified in its tender document that the seats in their buses have to be exactly 40 centimeters apart which deviates from the Bus Nordic standard and is overall deemed "ridiculous" by the interviewee (Chi).

From the PTA perspective, the issue of specified tender requirements is likewise discussed but represents a more mixed picture. In this regard, Delta states that he experienced a wish from the PTO side to specify requirements in order for the suppliers to calculate costs more easily. Further, Gamma acknowledges the limiting effect of specific requirements and the usage of standards in regard to innovation but likewise stresses the efficiency and simplicity of working with these requirements, which are appreciated by some PTOs. These findings are in support of the assertion of Uyarra et al. (2014) who claim that narrow and rigid tender specifications hamper innovative activities on the supply side and provide insights into the underlying reasons why PTAs utilize them nevertheless on some occasions.

In regard to designing the tender documents, the main issue voiced by numerous informants from the PTA side (Delta, Gamma, Hiero, Iota, Epsilon, Kappa), revolves around describing their demand particularly in regard to innovation to the PTOs, due to uncertainties about the future.

Here, Iota highlights that although the PTAs engage in extensive pre-studies in an endeavor to understand their needs and the market, they lack an understanding of what they will need in the future, which is then reflected in the tender documents. Gamma further adds that the aim of designing demands that are achievable for the PTOs within the contract period conflicts with their lacking knowledge of what technologies will be available and how their own needs will develop. This problem is intensified by the fact that the contract periods within public procurement are often around ten years, therefore representing a long timeframe (Gamma). As a consequence of the PTAs' insecurity about their *future* needs, Iota claims that there is an overemphasis on articulating the *current* needs instead of focusing on goals or visions, which is a barrier to innovation as it contributes to a perpetuation of the status quo and leads to path dependencies. Lastly, Hiero outlines a further problem dealing with the description of remuneration for a given innovation. While normally a specified demand in a tender document is also connected to a certain remuneration if the service is fulfilled by the supplier, in case of innovation this is more difficult:

"You need to know or have an idea of what you're getting for the money that you're prepared to pay extra compared to the lowest bid. Because what you're doing is really you're saying that I'm prepared to pay more. But what do you get for that? That's a very hard question" (Hiero).

Overall, the outlined issues therefore corroborate the findings of Edler et al. (2005) and Georghiou et al. (2014) in the Swedish context of public procurement in the public transport sector, since these authors similarly highlighted difficulties of correctly articulating demand due to insecurities and lack of knowledge as barriers to innovation.

4.2.2 Evaluation of bids in the procurement process

Another area of barriers for the PTAs revolves around the inclusion of innovation in the process of evaluating bids in the procurement process. According to Chi, there are different practices within Sweden on how bids on tenders are evaluated, with some major PTAs evaluating on price and quality while the majority of PTAs are evaluating and assigning a winner solely based on the lowest price that satisfies the demands. Evaluations based solely on price are described as being very transparent and easy to conduct by the informants due to simple comparability and a

straightforward calculation (Epsilon). In contrast, evaluation models which include price, as well as quality indicators in their assessment, are associated with certain problems. However, several informants from both the PTO and the PTA side emphasize that innovation could be fostered if it would be included as an indicator in a quality evaluation, and if certain pitfalls are mitigated (Alfa, Delta, Epsilon, Iota).

The first problem with using quality evaluations and including innovation as a criterion deals with an objective system to compare the different bids regarding innovation. Delta states that PTAs normally use a scale from 1 to 5 to evaluate different categories and emphasizes that PTAs would have to be very precise in describing what exactly is necessary for a supplier to reach a respective grade on the scale. This very aspect is deemed complicated by Delta, Juno and Epsilon, who point out that due to the unknown characteristics of future innovations and the various solutions by different suppliers, a precise description of requirements is difficult. This aspect is further elaborated by Juno and Delta, who indicate that there are no measures available that could be utilized to compare the different bids regarding innovation and assign a value to them. While other quality indicators such as customer satisfaction can be measured with various KPIs, comparable indicators are missing for innovations. Kappa echoes this and describes similar issues in regard to sustainability, where there is a lack of calculable indicators to evaluate performance. Hence, Juno and Delta derive that inclusion of innovation variables into a quality evaluation would automatically lead to a higher subjectiveness of the evaluation.

Another barrier in this context is connected to this subjectivity in the evaluation process and deals with legal issues when using innovation in quality evaluations. Epsilon sums up the problem as follows:

"But if you make quality demands or innovation demands, how are you to decide which quality is best and does it stand up in court? Because pretty much all the procurements or tenders get taken to court by the one who loses" (Epsilon).

In this regard, Iota points out that the procurement process in general is highly regulated in order to avoid corruption and favoritism, which leads to the fact that the PTAs need to precisely

describe and explain why a certain PTO won the bid and what the underlying evaluation model was, to ensure comparability. Several informants (Delta, Epsilon, Falk) therefore claim that the subjectivity that accompanies innovation in quality evaluation can lead to legal problems if PTOs take their decisions to court which they perceive as a barrier to including innovation in their decision-making process. Falk further cites a specific incident where a PTA conducted a quality evaluation which was subsequently taken to court where finally the PTA lost against the plaintiff PTO. Besides the fact that the majority of informants describe legal problems in regard to quality evaluation, Iota claims that the law has continuously opened up in 2015, 2017 and 2022 and in the meantime allows for a more subjective approach, in case there is a clear structure applied to all participants and the rationale is clearly described, thereby mitigating some legal concerns. As a consequence, Iota states that the problem does not revolve around the law itself, but more around the people working with it, due to risk avoidance and lack of knowledge.

A third problem is mentioned by Gamma, who highlights barriers to conducting quality evaluations and including innovations in tenders especially for smaller-sized PTAs and PTOs. Gamma elaborates that quality evaluations are accompanied by more effort and a higher degree of complexity which can prevent smaller PTAs from engaging with them, if the contract size of the tender is not big enough. Similarly, he points out that smaller PTAs often collaborate with small and local PTOs who do not have the capabilities and resources to understand and prepare the extensive tender documents needed in quality evaluations (Gamma). He therefore infers that quality evaluations especially including aspects like innovation or sustainability are more suited for bigger PTAs and PTOs (Gamma). Overall, the empirical findings around barriers to innovations in regard to quality evaluations showed barriers that were not discussed within the literature review and therefore neither corroborate, extend or disprove any literature utilized previously.

4.2.3 Goal conflicts of public procurement and innovation

A further barrier to innovation is thematized around potential goal conflicts between the nature of public procurement and the nature of innovation. As Hiero outlines, PTAs are very much focused on the financial side of public procurement and are aiming to create the greatest value for Swedish citizens at the lowest price. Since public procurement in the public transport sector

deals with large budgets financed by taxpayers' money, Falk describes a high caution when it comes to procurement, which often leads to the continuation of old models and ways of procuring, therefore reflecting path dependencies. In this line of thought, Iota describes the overarching goals of public procurement as being efficiency and cost-effectiveness while securing a smooth provision of services. However, Iota simultaneously emphasizes that these goals stand in stark contrast to the antecedents of innovation, among others being openness and acceptance of failures on the way. This goal conflict between the drive for efficiency and the need for openness and trial & error is manifested in the procurement process, which is deemed too rigid to allow for innovation in Iota's opinion.

According to Juno, Iota and Falk, this conflict of aims is not only reflected in the organizational processes and decision criteria but also in the mindset of the employees at the PTAs. When it comes to the contract management phase, where PTAs and PTOs collaborate on a long-term basis, Juno states that employees on the PTA side are not very open to innovation initiatives from the PTO side and tend to stick to the initially agreed conditions. The informant describes situations where innovation initiatives arise from the PTO side as follows:

"It can be quite cumbersome to get things done when the initiative comes from the operator. That's my experience" (Juno).

While Falk acknowledges that fostering innovation might be a high-level objective of managers in PTAs, the informant claims that this does not trickle down into the actual procurement process where employees are focusing on efficiency and day-to-day operations, thereby deprioritizing innovations (Falk). Iota echoes these assertions and concludes that the overall mindset is driven by risk avoidance and a reluctance to change which consequently is counteracting innovation.
The empirical findings regarding goal conflicts are in line with findings from Amann & Essig (2015), Yeow & Edler (2012) as well as Edquist & Zabala-Iturriagagoitia (2012) who likewise point towards the conflicting nature of aims regarding efficiency and innovation.

4.2.4 Lack of incentives

A further barrier to innovation in the procurement process is described on the PTO side and deals with a lack of incentive to engage in innovative activities due to a variety of reasons. According to Chi and Juno, representing the PTO side, the main trigger for PTOs to innovate lies in their ability to make more profit. In practice, they point out that they either innovate around their own processes in order to cut costs and attain higher margins or if they receive a monetary incentive to innovate around the PTA's needs (Chi, Juno). Chi further highlights:

"It's important to remember that perhaps not all innovation is cost effective. And when it's not cost-effective, then you will lose the PTO because the PTO will not have a secondary drive to innovate anything if it's not cost-effective" (Chi).

Thus, Chi emphasizes that a monetary incentive from the PTA side is necessary to make it worthwhile to engage in innovative activities especially around additional goals such as sustainability that do not always have a direct positive cost effect. Regarding sustainability innovations, Kappa makes a distinction between sustainability innovations dealing with increasing efficiencies, where PTOs tend to be willing to innovate and non-economically motivated sustainability innovations, e.g. around securing human rights along the supply chain, where PTOs tend to lack an incentive to innovate, thereby echoing Chi's statement. However, as Juno notes, incentives for innovation are not part of the usual contracts between PTOs and PTAs which therefore impedes the engagement with innovation. Juno further states that there is a lack of incentives to innovate after a contract is signed since the PTAs are not willing to engage in and pay anything extra aside from the agreed conditions, although the close collaboration during the contract management phase would allow for innovation to occur. This very barrier is likewise picked up by informant Epsilon on the PTA side, who explains that the PTOs do not have an incentive to do anything that is not included in the contract *because they get paid anyway* (Epsilon). Hence, besides the described fruitful conditions in the contract management phase with close collaboration, innovation is impeded by a lack of incentives for the PTO to engage with it.

Delta shares the perspective that the PTOs have to gain something if they are supposed to innovate and currently lack an incentive to do so and further points to the complex issue of intellectual property rights as a barrier. To elaborate on that issue, the informant describes a scenario in which a PTA and a PTO work together on an innovation in the pre-commercial phase, i.e before a contract is signed, which is mainly financed through the budgets of the PTA. In such a scenario, Delta assumes a problem with the intellectual property rights which, according to his knowledge, would stay with the PTA side, since the innovation would be publicly funded. He points out:

"We can't go from that idea of innovation and award a business to that supplier who brought in that idea. Then we would have to make a public request for tender based on the innovation and other suppliers could use that immaterial right and the knowledge" (Delta).

Consequently, he anticipates a problem for the PTOs, since they lack an economic incentive to innovate if they cannot monetize their innovation (Delta). Overall, the empirical evidence is aligned with the assertions of Uyarra et al. (2014), who claim that the lack of incentives for suppliers is a barrier to innovation. However, the empirical findings nuance the reasons for the lack of incentives slightly differently and point out that innovation is not included in the initial contracts and moreover not incentivized after a contract is signed.

4.2.5 Capabilities and knowledge within public procurement

In regard to further barriers, several informants point towards the importance of having the right capabilities and knowledge to procure innovation, which is partially lacking in different areas. Firstly, Delta notes that there is a lack of capability among the PTAs workforce to perform quality evaluations around innovations, since there is no proven model and the employees do not have any experience with it. This argument is similarly voiced by Gamma, who outlines that they were aiming to include innovation in their quality evaluation but lacked the capabilities and resources to conduct such an evaluation, leading to the fact that they use a simpler evaluation model based solely on price.

Connected to quality evaluations is the problem of potential legal issues as outlined previously, which is likewise addressed by Iota and Epsilon in regard to a lack of capabilities. Iota elaborates that the laws around public procurement are getting altered every few years and new laws regarding innovation procurement have been released in the last decade by the European Union. Although these new laws have been in place for a few years, a majority of procurers are not yet fully savvy about the new procurement possibilities, especially regarding procuring non-standard things such as innovation, according to Iota. Epsilon echoes this lack of capabilities in regard to legal issues when it comes to procuring innovation, which leads to a lot of "headaches" and insecurities among the PTAs (Epsilon).

Apart from legal capabilities, several informants on the PTA side (Gamma, Epsilon, Kappa) further highlight a lack of knowledge in regard to new innovations and products. Kappa, representing the PTA side, describes information asymmetries towards the PTOs, when it comes to new technologies or their supply chain, which hamper their ability to create demands that are viable in the long term. Gamma and Epsilon voice similar concerns about their lack of technical understanding of new technologies and the knowledge advantage of the PTO side, which impedes their capabilities to procure innovations.

Lastly, Beta and Falk reason that for some PTAs, new procurements are occurring too seldom, which results in the fact that the respective departments and managers are lacking up-to-date capabilities and the routine to master procurements, let alone innovation procurements. Moreover, Falk emphasizes that "*usually it's not the same kind of management that takes the decisions from one procurement to another"* and there is no functioning knowledge transfer within the organizations, which leads to capability shortages in regard to procurement and discourages trials of novel practices such as innovation procurement (Falk). However, in this context Gamma points towards a difference between smaller and bigger PTAs, since bigger PTAs procure more frequently and have more resources to build and uphold knowledge in their organizations, which provides them with an advantage compared to smaller PTAs.

Overall, the outlined empirical results are in line with the findings of Georghiou et al. (2014) and Edler et al. (2005) who claimed that employees of public agencies lack the capabilities to

implement innovation procurement. Additionally, the findings provide insights into specific areas where capabilities are lacking most prominently such as quality evaluations or legal issues and further supply underlying reasons for this deficiency such as information asymmetries and lacking experience. Moreover, the findings in relation to differently-sized public agencies corroborate the statement of Uyarra et al. (2014), that smaller organizations are experiencing these shortages of capabilities in particular.

4.2.6 Risk aversion and path dependency

The last barrier revolves around a general tendency among PTAs to show risk averse and path-dependent behavior due to a variety of reasons, which impedes innovation. When it comes to underlying reasons for this behavior, Falk and Hiero cite the large amounts of taxpayer money that the PTAs manage which bring about strong responsibility as well as public scrutiny. Hiero further elaborates that public agencies are very much focused on cost efficiency and the financial side of procurement, which naturally counteracts endeavors of innovation procurement since the associated risks are higher. Further, he explains that reluctant behavior in regard to innovation procurement is grounded in a continuous risk assessment of PTAs, who want to avert risks of technological lock-ins and therefore avoid committing early onto new technologies and wait for other actors to test these. Falk echoes this tendency as follows:

"*When it comes to completely new procurements like this, I think most people want someone else to do it before they do it so they can figure out how to do it. (...) But being the first one, it's probably problematic"* (Falk).

Moreover, Chi points out that the management of large sums of taxpayer money and the connected public scrutiny leads to a fear of negative media coverage in case of failures, which discourages engagement with innovation and the related risks. This aspect is in line with the findings of Lember et al. (2011), who observed that failures are usually attributed to the respective procurement department while success is ascribed to politicians. Another rationale is elaborated by Iota, who states that the previously mentioned insecurity around the evolving legal issues in innovation procurement is affecting senior managers, who are expected to be knowledgeable about these issues but at the same time might lack a full understanding and

therefore engage in path dependent behavior building upon their experience from the past. Similarly, Gamma argues that the difficulty of articulating demands due to uncertainties about future needs encourages path dependencies to avoid risks of failure.

The outlined risk averse and path dependent behavior corroborates the findings of Tsipouri et al. (2010) and Uyarra et al. (2014) who described this behavior as a key problem when publicly procuring innovations and further provide an insight into the underlying reasons for this behavior in the case of Swedish public procurement in the public transport industry.

4.3 Enablers to innovation

In the following section the empirical material connecting to how to enable innovation within the procurement process in the Swedish public transport sector is presented.

4.3.1 Designing tender documents

In regard to designing tender documents in an enabling way, Delta explains how functional requirements are utilized by the PTAs, which enables the PTOs to explain possible innovative solutions to the given problem, instead of specifying solutions from the start. Beta, Gamma and Hiero support this statement and outline that they do not specify for instance which fuel should be used but rather allow the PTOs to find a solution. Hiero further explains that by using functional terms, they are opening up more than if they were using a more fixed description. However, Hiero likewise admits that the functional requirements they are using are quite specific but nevertheless outlines an ambition to not be unnecessary specific. This effort to focus on an outcome rather than a specific solution in a tender is in line with Georghiou et al. (2014) ideas on how to enable innovation. In this context, Gamma elaborates on shall requirements (Skallkrav), meaning demands that are non-negotiable and need to be fulfilled for the tender to be able to be chosen, which are an easy solution because they provide clarity for both parties on the deliverables, thereby reducing the risk for misunderstanding. However, Gamma further simultaneously expresses downsides of shall requirements which consist of an inflexibility that can damage the outcome of the contract especially in the case of long-term contracts. Alfa, representing the PTO point of view, echoes the claim that using functional requirements is beneficial, since the creation of an innovative solution is left with the PTO, which Alfa deems

best suited. Furthermore, Iota claims there is a need to shift from focusing extensively on describing current needs within the tender documents towards a more strategic goal setting and outlining what should be the focus in the future. According to Iota, this change in focus would allow the PTOs to find innovative solutions to reach that goal instead of being bound to the specifications of the PTAs.

4.2.2 Enabling innovation through quality evaluations

While quality evaluation can be associated with certain barriers in regard to innovation as outlined before, two PTO informants note the potential enabling effect of quality evaluations on innovation. According to Chi and Alfa, quality evaluations could be used as a tool to include innovation as an aspect when evaluating the quality of a proposed tender, thereby encouraging PTOs to innovate. Chi further describes that the current format of quality evaluations includes open style questions where PTOs outline their plan on how they will satisfy the requirements, which Chi deems appropriate for the usage of innovation requirements as well. Moreover, while one of the main concerns of PTAs around including innovation within quality evaluation revolved around legal problems, Iota and Hiero attenuate this aspect. Hiero describes how it is possible to do procurement based on innovation and utilize it as a quality component and that the trend of regulations has been to be increasingly open to innovations in procurement. Iota echoes this trend and emphasizes that the alleged issue of subjectivity is mitigated since several courts have clarified that subjectivity is allowed, in case every PTO is treated equally during the evaluation process.

4.3.3 Political will as a driver for innovation

Another enabling factor that several informants on the PTA side bring up revolves around the enabling effect of political will as a driver for innovation. Especially the field of sustainability is cited as an area where the political will has a clear driving effect on the industry. This is elaborated by Delta who cites the fact that politicians usually push for change while the PTAs take a mediating role to balance the political will with what exists on the market. This corroborates Edler & Georghiou's (2007) ideas on how public procurement can induce sustainability innovations. Kappa describes the politicians as “problem solvers" in regard to

sustainability, influencing the speed of change. To streamline the procurement process Beta exemplifies that having a clear political backing creates a smoother process and makes the procurement process easier for the PTA. From the PTO side, Chi underlines that the PTAs are driving sustainability and especially that politicians have the drive to push sustainability innovations that are not necessarily cost efficient for the PTO. This is exemplified by Hiero who cites a project, where a large sum of money was allocated towards a project which a PTO would not have necessarily backed, since it would not have been financially viable on its own. This balance of where tax money is allocated is then elaborated by Iota, who states that when there is a political backing behind something innovation takes place at a high speed. Beta, representing a smaller region PTA, highlights how the political backing was a highly important factor in pushing the sustainability agenda amongst the PTOs. Therefore, a general take away from the interviews is that Sweden has come far in the sustainability advancement of the public sector and the political will has been a crucial factor in moving the industry forward in that regard. Seeing this from a demand side innovation perspective described by Georghiou et al. (2014) the public has acted in a way that advances the industry forward which corroborates the importance of having an active political voice that is used to articulate demand.

4.3.4 Embracing failure to enable innovation

Since one of the barriers to innovation dealt with risk averse behavior and a lack of innovation focus among PTAs, Iota highlights the importance of establishing a new culture. According to Iota, a shift to a more innovation-friendly procurement process is necessary, which acknowledges the occurrence of failure when procuring innovation. In order to trigger this change, the informant suggests introducing more pilots and incentivizing a trial-and-error approach within these pilots.

4.3.5 Early discussions as enablers for innovation

Another takeaway from several PTA interviews (Beta, Gamma, Falk and Hiero) is that early discussions between PTAs and PTOs can be a driver for innovation. Falk describes that their process starts one to two years before the current contract ends with an open dialogue with PTOs, which enables them to receive their input in the early stages of the tender process. In this context,

Alfa notes that the PTO side is continuously scanning the market for new ideas, which could be utilized in early discussions with the PTAs to drive innovation in the public transport sector. Beta further outlines early discussions with other actors as being beneficial and exemplifies that they invite disability organizations within their region to bring in their point of view into the tender process to further expand the range of inputs and drive sustainable innovations. These assertions are in line with Georghiou et al. (2014) findings that early interactions between suppliers and procurers are inducing innovation.

4.3.6 Economic viability as a driver for innovation

Generally, informants from the PTA side express the viewpoint that PTOs are driven by the search for profit. Chi likewise outlines this as an enabling factor, by stating that the ability to increase sales is a crucial driver for private companies to innovate. This is further nuanced by Juno, representing a PTO, who notes that their focus lies on creating innovations that increase efficiency, meaning driving down costs. From the PTA side, Gamma and Hiero state that it is crucial to act responsibly with taxpayers' money, which is particularly given if an innovation is financially viable. Hence, while innovation is not always connected to monetary gains and in the case of demand-side innovations monetary gains are not in focus, economic viability nevertheless creates an incentive for both actors to innovate.

4.4 Collaboration to enable innovation

In order to understand the role of collaboration within the procurement process and its moderating effect on innovation, it is important to understand the three different stages in the procurement process where collaboration between PTAs and PTOs occurs. Chi points out that the first phase, which is the phase before the tender documents are published, consists of two dialogue sessions where the PTAs have the opportunity to present their upcoming project and PTOs can ask questions. First, there is an informative common consultation, which is conducted by all PTAs and attended by all interested PTOs, where the PTAs simply present their endeavor and PTOs tend to stay silent. The second dialogue session, coined individual consultation by Chi, is only conducted by some PTAs. Here, PTOs are invited to discuss the upcoming project, details and potential innovation ideas individually and in more detail (Chi). At the beginning of the

second phase, the tender documents are published, and the PTOs start to create their bids. Here, Chi points to the very strict rules that limit the dialogue until the bids are submitted and the evaluation starts. Kappa outlines that there is an opportunity to ask questions to the PTAs through a public platform where questions and answers are accessible to anyone. Once the bids are submitted, they are evaluated by the PTAs and a negotiation period starts, where closer collaboration is possible. Hiero explains that all or selected PTOs are taking part in the negotiation process where final details are configured until a contract is signed. The last phase, coined the contract management phase, starts after the contract is signed and usually includes close collaboration between the contract parties (Chi).

4.4.1 Collaboration during first phase

When it comes to the first phase of the procurement process, different viewpoints on the relevance and collaboration opportunities of the individual consultations emerge. Gamma, representing a PTA using the individual consultations, deems this collaboration beneficial to gather knowledge and engage in discussions with the PTOs about available technologies and innovations that could potentially be included in the tender documents, thereby enhancing the quality of the documents. Delta similarly points out that *in many cases, they (PTOs) are coming up with thoughts and ideas and things that we hadn't considered,* which allows the PTA to create tender documents which include innovative ideas. Chi, representing a PTO actor, emphasizes a preference for individual consultations since the PTOs can bring in their innovative ideas, explore the preferences of the PTAs and discuss the upcoming tender documents with them, thereby enabling the PTOs to influence the process and create better bids. Kappa, representing a PTA not engaging with individual consultations, however, explains that they forgo these meetings since they want to treat every PTO equally and avoid legal gray zones.

4.4.2. Collaboration during third phase

As described, the third phase revolves around contract management. Hiero, representing the PTA side, describes a generally close collaboration between PTAs and PTOs here and voices the belief that this is the phase with the highest potential for innovation to occur. From the PTO perspective, informant Chi echoes this strong collaboration and likewise states that the biggest

chance for innovation exists during the contract management phase. However, Chi and Hiero only express their assumption and do not possess first-hand knowledge about it, since they are working within the first two phases of procurement. Informant Juno however works within contract management and agrees on the high level of general collaboration but highlights that nevertheless innovation is not happening in the current collaboration during the contract management phase. As a reason for this seeming contradiction between close collaboration and an absence of innovation, Juno names a lack of openness and innovation focus from the PTA side as well as a lack of incentives for the PTOs, which are explained previously.

4.4.3 Novel collaboration forms

Insights on novel collaboration forms in procurement such as innovation partnerships or pre-commercial procurement are available to a limited extent in the empirical material. Delta for instance shows an openness to new models, stating that it could be interesting to explore and open up innovation in an innovation arena where multiple suppliers can collaborate in an ecosystem. Falk indicates to be aware of these collaboration forms being used in major infrastructure contracts but is however not knowledgeable of any traffic contracts surrounding public transport using these approaches. Gamma, who indicates to have carried out a complex procurement of an IT system related to public transport that would have benefited from such collaboration models in regard to innovation, also states to not yet made use of them. Thus, the overall empirical material on these novel collaboration forms for innovation procurement remains insufficient to derive meaningful conclusions.

4.5 Sustainability innovations

While the enablers, barriers and collaboration aspects in regard to demand-side innovation outlined previously are valid for all types of innovation equally, including sustainability innovations, the informants nevertheless point out several dynamics that are different in the context of sustainability innovations. As outlined previously, various informants (Chi, Gamma, Epsilon, Kappa) emphasize that while the driving force behind innovation in general tends to be the PTOs, in the field of sustainability it is the PTAs that are driving the change. Chi, representing a PTO notes: "*I would say that it's us that initiates these initiatives usually. But*

maybe when it comes to sustainability, it's actually a little bit different" (Chi). Chi and Kappa further distinguish that the driving force differs among different types of sustainability innovation initiatives. These informants unanimously state that for sustainability innovations that are connected to cost reductions or efficiency gains, the PTOs are leading the way. However, Kappa highlights that this interest in sustainability innovation is less pronounced from the PTO side around sustainability issues such as human rights along the supply chain or recycling, which are less associated with immediate economic gains. Lastly, Gamma and Epsilon elaborate on the mechanism through which PTAs induce sustainability innovations and point out that they set clear sustainability demands in their documents and contract. Thereby, they signalize to the PTOs the importance of sustainability for them, which leads to a respective adaptation of the PTOs (Gamma). Epsilon further outlines that the PTAs utilize large sums of money within these demands, which enables and incentivizes the PTOs to engage in sustainability innovation since they have customers who actually purchase the innovation in large quantities. Hence, Epsilon summarizes the dynamic as follows: "*So I would not say that all members (PTAs) are doing all the innovation, but they're making the demands to enable innovation (Epsilon)*. This very notion is in line with Edler & Georghiou's (2007) ideas that demand-side innovation policies such as public procurement can create demands that steer the market and its private actors into a direction that is beneficial for society, such as increasing innovation in regard to sustainability. Moreover, the empirical material corroborates the findings of Uyarra et al. (2014), who outline that public agencies can create a large enough aggregate demand around a certain field to incentivize private companies to innovate by reducing uncertainties about the return on investment.

5. Discussion

In the following chapter, the key empirical takeaways are presented and discussed in conjunction with the concepts outlined in the literature review. The main empirical findings support the assumption of a market failure in regard to the emergence of sustainability innovations within the Swedish market-based procurement in the public transport industry and suggest that demand-side innovations are needed to induce *non-economically motivated sustainability innovations*. As outlined in the empirical material, there is a contextual distinction to be made between the innovation dynamics of sustainability innovations where direct efficiency gains and cost reductions are associated with the innovation and the PTOs are driving the innovation and non-economically motivated sustainability innovations, where these direct economic benefits are less given, and the PTAs obtain the driving role.

In regard to general barriers and enablers to demand-side innovation, the empirical material corroborates *designing tender specifications* as a key barrier to innovation and further adds *quality evaluations* as an enabler to innovation, although challenges remain. Concerning barriers and enablers specifically relevant for non-economically motivated sustainability innovations, the empirical findings suggest *political will* as a key enabler while indicating *lack of incentives* and *goal conflicts* as the main barriers. The chapter is concluded with a discussion of the conceptual model which is subsequently refined and elaborated.

5.1 Demand side innovation within Swedish public transport

When it comes to the main drivers for innovation from a PTO point of view, the empirical findings clearly indicate that financial viability and potential increases in profit are the main triggers. While this realization is not novel in itself, it has wide implications for the occurrence of innovation and particularly the type of innovation that is occurring. One insight that the empirical findings elicited is that in the current situation of market-based procurement in Sweden, the PTOs only engage in innovative activities around sustainability in case they are connected to direct efficiency gains or cost savings, which increase their profit. While these economically motivated sustainability innovations are desirable, the informants likewise highlight that in the case of non-economically motivated sustainability innovations the PTOs

lack an incentive to innovate which leads to an underprovision of these innovations although they are demanded by the PTAs. This fact generated the insight that there is a market failure to provide non-economically motivated sustainability innovations due to a lack of incentives and despite the societal need and a will from the PTA side to foster these types of innovations. Historically, other market failures to serve societal needs, for instance the case of orphan drugs which are not economically profitable due to the low numbers of potential buyers, have been addressed by supply side innovation policies to incentivize innovation (Moors & Faber, 2007). However, when it comes to solutions to this underprovision in this case, the empirical findings point towards the important role of the PTAs to demand non-economically motivated sustainability innovations, which they already do and simultaneously incentivize the PTOs to innovate around it, which resembles around the idea of demand-side innovation policies. These aspects corroborate Edler & Georghiou (2007), who state that demand-side innovation policies such as public procurement have the potential to act as a driver for sustainability innovations and are moreover in line with Georghiou et al. (2014) who point out that the crux of demand-side innovation lies in ensuring that there is both an incentive to innovate and a willing buyer once the innovation is there. Overall, the findings confirm that there is a market failure regarding the provision of non-economically motivated sustainability innovations which could be addressed through demand-side innovation policies. After the initial motivation for studying demand-side innovations as a driver for change in regard to sustainability is corroborated, the following chapters discuss the empirical findings in regard to barriers and enablers of demand-side innovations through public procurement in the Swedish context.

5.2 Barriers and enablers for innovations

Since the aim of this thesis revolves around contributing to an understanding of the innovation process and its barriers and enablers within public procurement between PTAs and PTOs to enable sustainability innovations, the main findings are discussed in relation to the literature below. First, the main barriers and enablers for innovations in general are presented, which are valid for sustainability innovations as well, and subsequently the main barriers and enablers specific for non-economically motivated sustainability innovations are discussed.

5.2.1 Barriers and enablers for all innovations

When it comes to barriers and enablers to innovations, one aspect that emerged from the empirical material as essential is the way in which tender documents are designed. In case the tender documents are designed in a narrow way, which specifies extensively how the suppliers are supposed to provide the service, the findings indicate that the creation of innovative solutions is impeded, which is in line with Uyarra et al. (2014) who claim that rigid tender specifications hamper innovation. These findings elicited the insight that the relationship between PTAs and PTOs regarding innovation is of contractual nature. While the informants on the PTA side emphasized their ambition to induce innovation in their contracts and tender documents, they voiced uncertainties about their future needs and a lack of knowledge as limiting factors in designing the tender documents. These uncertainties about the future combined with information asymmetries vis-à-vis the PTOs, who are described as being closer to the market and technological developments, lead to contracting difficulties. This is in line with arguments of Hart (1995), who argued that it is not possible to anticipate every outcome of the future which as a consequence leads to the presence of incomplete contracts. The issue of dealing with incomplete contracts due to difficulties in designing tender documents which include future innovations whose characteristics are unknown at the moment of creation is further amplified by the fact that the contracts are procured for time spans of eight to twelve years. This is problematic since Hart & More (1999) outline that the problem of incomplete contracts is particularly present in situations where re-negotiation is not feasible. Although informants claim that procurement contracts are extended in certain circumstances, major alterations to the contracts are rather uncommon. In order to address these contracting difficulties, the empirical findings point towards the usage of functional requirements in tender documents, which aim at describing the outcome of the contract instead of specifying the way to get there. Thereby, the PTOs are given the leeway to innovate within the contract and find creative solutions that lead to a viable solution for both parties. These findings corroborate the views of Georghiou et al. (2014), who categorize functional requirements as inducive for innovation.

The second crucial aspect that emerged from the empirical material revolves around the role of quality evaluations in the procurement process to enable innovation. Here, the findings led to the insight that including innovation as a factor when evaluating the bids of PTOs can have a

positive effect since clearly articulating the demand for innovation encourages the PTOs to innovate. Despite general agreement on the innovation enhancing effect of including innovation in quality evaluations, the empirical evidence points towards another contractual difficulty: Due to the fact that PTAs are legally required to publish the evaluation criteria within the procurement process, there is a need to outline a framework for evaluating innovation which allows for comparison and equal treatment. As the innovative ideas proposed by the PTOs and their outcomes are unknown ex-ante and there is further a described lack of KPIs, the findings indicate a perceived difficulty to create an evaluation framework that allows for objective evaluation and moreover a concern that the evaluation will be inherently subjective. Therefore, the need to find measurements and KPIs for innovation that can provide comparability is evident. In the current situation, the comparability issue is further amplified by the fact that the informants voiced strong legal concerns regarding subjectivity in case the evaluation model is challenged in court by a losing PTO which is perceived as a strong barrier to including innovation within quality evaluations. However, the empirical evidence reveals deviating opinions on the legal situation in regard to subjective evaluations and the possibility to include innovations in them, with some informants citing new regulations which enable subjective evaluations in case they are conducted equally for everyone. These findings led to the new insight that the regulations themselves might not be the main barrier to innovation in itself but more the people applying them in the procurement process. The findings further suggest that the reason for this behavior lies in a lack of knowledge around new regulations combined with risk averse behavior due to high public scrutiny which finally leads to path dependencies. While the notion of quality evaluations as enablers for innovation was new to the conceptual model, the accompanying barriers to implementing these quality evaluations due to risk averse and path dependent behavior corroborate the findings of Tsipouri et al. (2010) and Uyarra et al. (2014), who outlined such behavior as critical barriers to innovation procurement.

5.2.2 Barriers and enablers for sustainability innovations

When it comes to barriers and enablers that are specifically relevant for non-economically motivated sustainability innovations, three aspects stand out in particular. First, the empirical material revealed the notion that since not all sustainability innovations are cost-efficient and PTOs do not have any secondary goals besides making profit, there is a clear lack of incentive

for PTOs to innovate when it comes to non-economically motivated sustainability innovations. This lack of incentive is further reinforced by the general issue of intellectual property rights, where the empirical findings indicate that the intellectual property rights of innovations that are emerging from a public-private relationship usually have to be public since the innovation is financed publicly, therefore further reducing the chance for PTOs to monetize it. These aspects trigger the new insight that the innovation dynamics work differently in the case of non-economically motivated sustainability innovations which leads to the derivation that PTAs have an even more significant role to play in incentivizing and economizing this type of innovation. The empirical findings further showed that currently such incentives from the PTA side are not in place within the contracts and that moreover there is no incentive to innovate after a contract is signed, although the collaboration is described as close during the contract management phase. This aspect led to the insight that while altering the incentives in the contracts might be beneficial, there might be additional potential to induce sustainability innovations on a relational level and utilize the close collaboration during the contract management phase to foster innovation. This is in line with the innovations systems theory which outlines close cooperation and recurring feedback loops among actors on the supply and demand side as antecedents for innovation (Breschi, Malerba & Orsenigo, 2000). Besides the positive effect of close collaboration on innovation, there are further implications in regard to transaction costs, since the procurement of sustainability innovations is associated with high degrees of uncertainty, complexity and the aforementioned issue of incomplete contracts where collaborating closely has the potential to reduce transaction costs. Overall, the empirical findings further corroborate Uyarra et al. (2014) assertions that a lack of incentives is one of the main barriers to innovation and outline the dynamics in the specific context of non-economically motivated sustainability innovations.

Second, the empirical evidence pointed towards another barrier to innovation on the PTA side which is particularly relevant for non-economically motivated sustainability innovations. Several informants pointed out that there is a goal conflict between the public goals of efficiency and the induction of innovation: While the PTAs pursue the strategic goal of providing well functioning public transport in a cost-efficient manner to fulfill their responsibility as reliable managers of taxpayers' money, they likewise aim to induce innovation and reach secondary goals such as

sustainability. According to the empirical material, this endeavour is problematic for two reasons, particularly in the context of non-economically motivated sustainability innovations. Firstly, the PTOs are needed as partners in order to generate innovations but in the case of non-economically motivated sustainability innovations, they lack the incentive to innovate as outlined previously and incentivizing the PTOs might be connected to additional spending, thereby reducing cost-efficiency. Secondly, the findings underlined the fact that openness to innovation and an acceptance of failures on the way to innovation are crucial, which is a mindset that collides with the focus on efficiency and caution with taxpayers' money but is currently manifested at the PTAs. Particularly in the case of non-economically motivated sustainability innovations, which are not accompanied by direct efficiency gains, this inherent goal conflict becomes apparent. The findings therefore elicited the insight that besides potential changes in the contractual and relational interconnections between PTOs and PTAs, a further change on the organizational level for the PTAs is motivated to foster a mindset that is more open to innovation. Overall, the findings in regard to inherent goal conflicts between efficiency and innovation corroborate the literature by Yeow & Edler (2012), Amann & Essig (2015) and Edquist & Zabala-Iturriagagoitia (2012), who outlined the counteracting nature of goals regarding innovation and efficiency, by applying it to the specific case of non-economically motivated sustainability innovations.

Third, the empirical findings point towards political will as one of the key enablers for non-economically motivated sustainability innovations. According to the informants, sustainability is a topic that is strongly driven by politics, which also has the ability to accelerate processes and allocate funds to projects that are deemed beneficial for society. In light of the previously outlined barriers to innovations, the role of politics in fostering non-economically motivated sustainability innovations becomes even clearer. Since the PTOs usually lack an incentive to innovate due to the missing opportunity to monetize on non-economically motivated sustainability innovations, politics can allocate funds to such projects and create incentives for PTOs to innovate, even though the innovation might not occur under normal conditions as it might not be cost-efficient in the first place. In these cases, the findings indicate that the PTAs can act as a mediator between politicians and the PTOs in order to ensure that political wishes are translated into actionable demands. Moreover, it can be assumed that in the case of political

demands for certain sustainability projects, the aforementioned goal conflicts between efficiency and innovation are partly mitigated since additional funds are provided which shifts the focus to the successful realization of the project instead of a sole focus on efficiency. These findings thus generated the new insight that political demand for sustainability projects has the potential to overcome the pure focus on cost efficiency and incentivize innovations that would not have been possible within the current market-based approach to public procurement in Sweden. Therefore, the empirical findings corroborate the literature on demand-side innovations of Edler & Georghiou (2007) and Georghiou et al. (2014), who claim that public agencies have the potential to induce sustainability innovations through the use of public demand in procurement processes. Lastly, the presented findings open up for a reflection on whether the current Swedish market-based approach to procurement is optimal for inducing sustainability innovations and particularly non-economically motivated sustainability innovations or whether alterations to the status quo, such as vertical integration could represent viable alternatives.

5.3 Further implications

The empirical material in this research elicited that the collaboration between PTAs and PTOs in the Swedish market-based public procurement approach mainly occurs within a contractual setting. When looking at this collaboration and the chosen setup for public procurement from a strategic point of view, it becomes clear that the chosen level of vertical integration, i.e. using the market to procure innovations, has implications on transaction costs. For instance, the high uncertainties regarding future demands on the PTA side increase the bargaining costs as well as policing and enforcement costs, due to the presence of incomplete contracts as outlined previously. This is reflected by the informants, who point out that they utilize monitoring and audits to enforce contracts, which is time-consuming and troublesome particularly in connection with incomplete contracts regarding innovation. In regard to quality evaluations including innovation, the outlined problems of objectively evaluating different innovation proposals from PTOs and negotiating contracts further increase the transaction costs and lead to high time consumption due to the complexity of the process. While there are indications that the Swedish legal system is opening up to allowing more subjectivity and innovation-powered collaboration forms, which have the potential to reduce transaction costs, the current system is nevertheless

built upon the idea of utilizing markets to procure innovation. Given a hypothetical scenario where the level of vertical integration and the relationship between public and private actors when it comes to procuring innovation and particularly procuring non-economically motivated sustainability innovations could be freely chosen, it is debatable whether the current structures would be seen as optimal. The underlying reason for this notion is primarily that high complexity is described as increasing transaction costs and market solutions are furthermore characterized as suitable for non-complex off-the-shelf products (Williamson, 1985) which is incongruent with the situation of innovation procurement in the Swedish public transport industry.

At the same time, the inherent difficulties of predicting societies' needs in the future which lead to contractual difficulties due to the presence of incomplete contracts will not be simply solved by having a more vertically integrated relationship. However, besides contractual problems, several issues in the current situation could be mitigated by a higher level of vertical integration that is accompanied by closer and smoother collaboration. One key factor in making valid strategic decisions and understanding the future is information, which could be exchanged and shared more effectively in a setting with closer collaboration. Such a setting would enable PTOs to get closer to and understand the needs of the customers better, while PTAs could tap into the knowledge pool of PTOs around upcoming technologies and thereby mitigate information asymmetries. This paper is however humble to the fact that a higher level of vertical integration and closer collaboration will be accompanied by other issues and that the gathered empirical material is insufficient to make conclusive judgements about different levels of vertical integration and its implications, which is why this aspect is proposed to be deepened by further research.

5.4 Refined Conceptual model

In this section, the conceptual model outlined in chapter 2.3 will be compared and enriched with the empirical findings, leading to a refined conceptual model which will be further explained and presented. Within the refined conceptual model, additions and changes derived from this research are marked in bold.

5.4.1 Barriers to sustainability innovations - Demand side

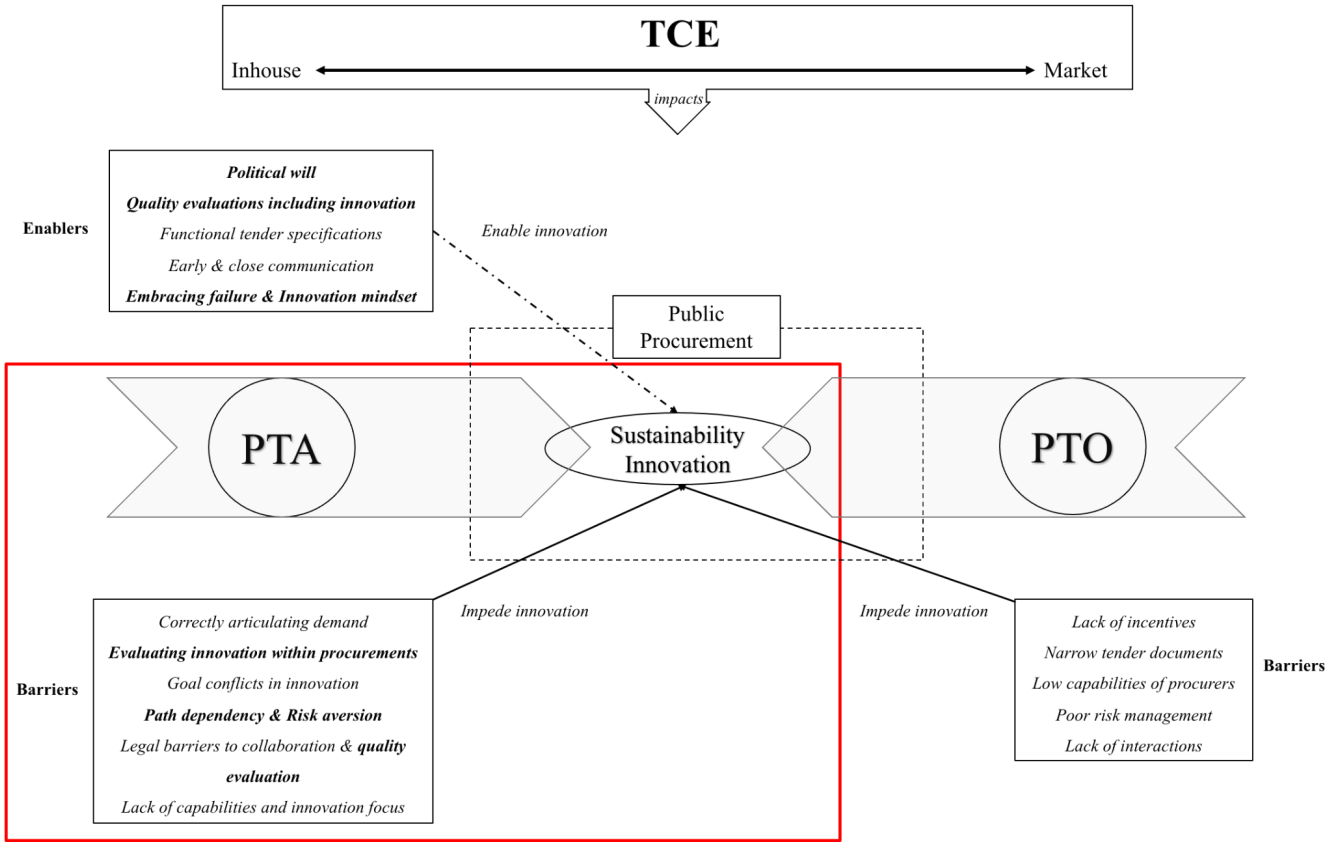

Figure 3 - Refined conceptual model - Barriers demand-side

As this thesis focuses on demand-side innovation and thereby mainly on the public side, the barriers to sustainability innovations for the PTA side are elaborated first. To begin with, the first three barriers of *correctly articulating demand, evaluating innovation within procurements,* and *goal conflicts in innovation* have been discussed extensively within section chapter 5.2 and will therefore be described more briefly. The barrier of *correctly articulating demand,* which revolves around difficulties to define innovation demands and include them in tender documents, was supported by this study. The empirical findings corroborate that PTAs are struggling with defining their innovation needs and designing their tender documents in a way that innovation is incorporated, due to uncertainties about their future needs and then available technologies or innovations, which is in line with Edler et al. (2005) and Georghiou et al. (2014) who likewise describe this lack of knowledge about the future and respective needs as a barrier to innovation.

The barrier of *evaluating innovation within procurements* represents an addition to the conceptual model and deals with difficulties to find a model to compare different innovation proposals by the PTOs in an objective way, due to missing sustainability innovation KPIs and potential legal problems associated with subjective evaluations. While this aspect was not described in the initial literature review due to a lacking emphasis in existing literature, Edler et al. (2005) mentioned lacking capabilities in evaluating innovations within the procurement process as a barrier before. Accordingly, although the barrier is not entirely new, the importance of this aspect in the case of Swedish public procurement in public transport is an addition to the existing literature.

Thirdly, *goal conflicts in innovation* describe the inherently conflicting aims of cost-efficiency and fostering sustainability innovations within the public sector. Here, the findings underline that the PTAs are mainly focusing on low costs when evaluating bids and avoid risks whenever possible, which is described as impeding innovation and is corroborating Edquist & Zabala-Iturriagagoitia (2012), Amann & Essig (2015) and Yeow & Edler (2012) who outlined that efficiency and innovation are conflicting priorities.

In this context, the barrier of *path dependency & risk aversion* comes into play, which reflects another addition to the conceptual model. According to the empirical findings, the PTAs tend to show risk averse and path-dependent behavior when it comes to innovation procurement which is explained by high degrees of public scrutiny, uncertainties about the future and great responsibility for the handling of taxpayers' money. However, this behavior stands in contrast with a mindset of openness and acceptance of failure that is needed to allow for sustainability innovations, according to the empirical material. As a consequence, the presence of the barrier of risk aversion and path dependency leads to the conclusion that there is potential for improvement not only on a contractual and relational level, but also on an organizational level to address risk averse behavior and establish a culture that allows for innovation within public procurement. Altogether, the barrier of path dependency and risk aversion, although not particularly mentioned in the initial model, corroborates the literature of Uyarra et al. (2014) and Tsipouri et al. (2010), who identified these aspects as impediments to innovation.

A further barrier to innovation revolves around *legal barriers to collaboration and quality evaluations*. Here, the findings indicate that there is a widespread notion among PTAs, that there are tight legal rules that hamper collaboration between PTAs and PTOs in the procurement process, which consequently impedes innovation. Moreover, there is mainly consensus that including innovation in quality evaluations is legally restricted due to a missing framework that allows for objectivity as explained before. Despite these widespread assumptions, there are some deviating opinions on legal possibilities around collaboration and particularly including innovation in quality evaluations, which outline that there have been changes in Swedish procurement law which allow for such activities but that these alterations are not well known or utilized so far. This latter aspect elicited the insight that the law itself might not be the problem but that there is path dependent behavior and moreover a *lack of capability and innovation focus* among the workforce which counteracts innovation. This point is underlined by the fact that the findings indicate that the *lack of capability* is particularly strong in regard to quality evaluations and knowledge on legal aspects, which supports the derivation that the full potential of legally possible innovation within procurement might not be realized in the current situation due to a lack of knowledge and capability. Overall, these findings corroborate Edler et al. (2005) and Georghiou et al. (2014), who stated that a lack of capability among public organizations is an important factor hampering the procurement of innovation and widen these statements by suggesting legal and collaborative issues as areas of improvement in the case of the Swedish public transport industry.

5.4.2 Barriers to sustainability innovations - Supply side

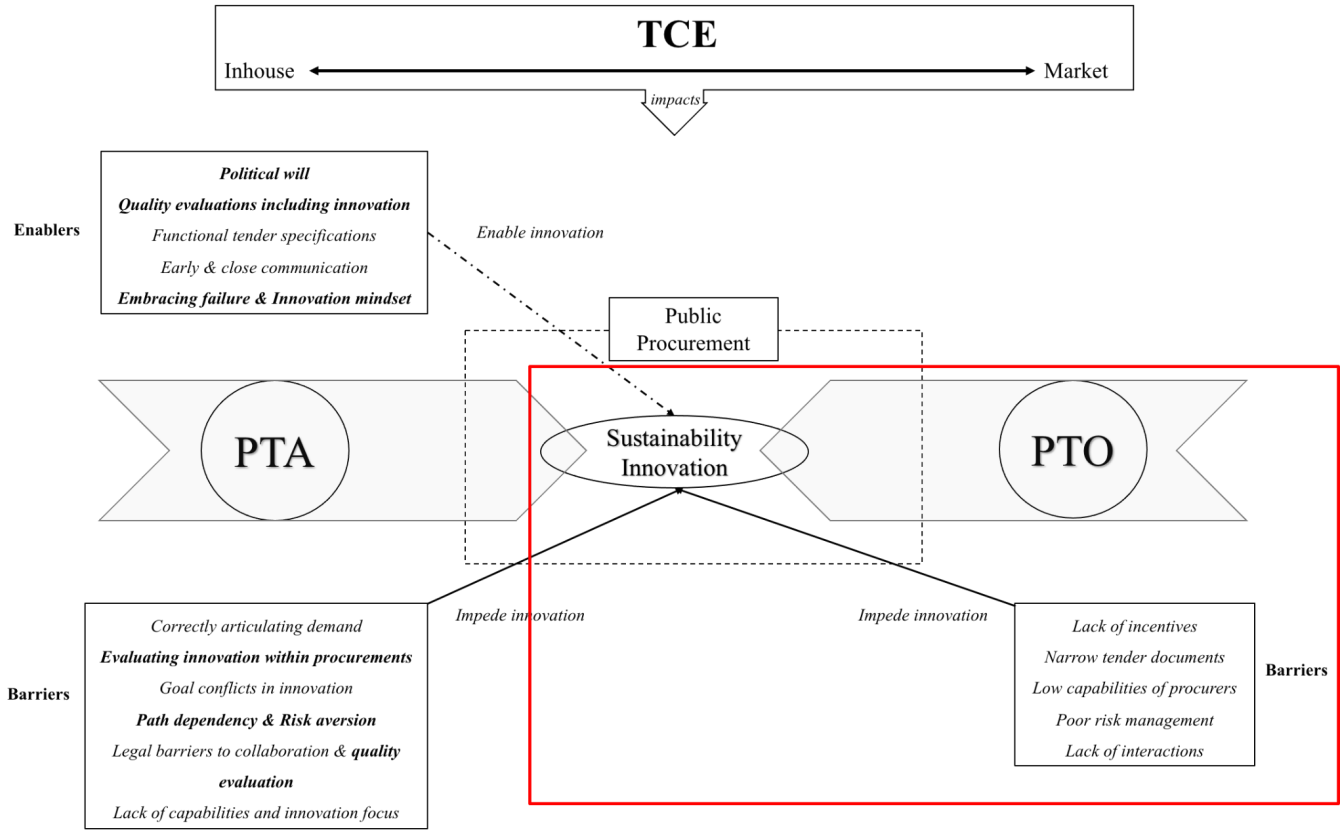

Figure 4 - Refined conceptual model – Barriers supply-side

In regard to barriers to sustainability innovations from the PTO side, the main barrier revolves around a *lack of incentive* to innovate as outlined in chapter 5.2.2 in more detail. The empirical findings elicited that particularly when it comes to non-economically motivated sustainability innovations, the profit driven PTOs lack the incentive to innovate since these types of innovations are not connected to direct efficiency gains or cost reductions. Therefore, the inherent incentive to innovate to reduce costs and increase margins is not given anymore, which led to the insight that particularly for non-economically motivated sustainability innovations, the PTAs need to find ways to provide incentives in other ways. Regarding this barrier, the assertions of Uyarra et al. (2014) were corroborated, who likewise described a lack of incentives for suppliers as impeding innovation.

Further, the barrier of *narrow tender documents* was examined. Here, the empirical findings indicate that PTOs experience tender documents which extensively specify demands and the way that these demands are to be fulfilled as hampering innovation, as they are deprived of the opportunity to find more cost-efficient and innovative solutions to achieve the goal set by the PTAs. While the PTAs outlined the efficiency and clarity that specific demands provide to both parties, they likewise acknowledged the limiting effect these requirements have on the innovation potential. Hence, this research finds support for the claims of Uyarra et al. (2014) who stated that narrow tender documents are counterproductive to innovation.

The barriers, low *capabilities of procurers* and *poor risk management* mirror the barriers *lack of capability* and *path dependency & risk aversion* on the PTA side and the findings resemble each other, which is why these barriers will not be discussed in detail. In addition to the aforementioned lack of capabilities on the PTA side regarding legal and collaborative aspects, the informants on the PTO side pointed out that their counterparts tend to lack a deeper understanding of new technologies and their respective costs, which once again underlines the information asymmetry within this relationship. Therefore, the findings once again back the insight that close collaboration on innovation issues is necessary for innovation to occur within the procurement process and make up for information asymmetries.

Lastly, the initial barrier *lack of interaction* was reframed to *lack of interaction regarding innovation*. Overall, the empirical material showed differing opinions regarding the level of interactions and collaborations between PTAs and PTOs during the procurement process. The informants on the PTO side particularly emphasized their appreciation for interaction in the format of individual consultations in the phase before the tender documents are published in order to induce innovation, which however not all PTAs engage with. Moreover, while there was consensus that there is generally close collaboration during the contract management phase, meaning after a contract is signed, the empirical findings indicate that there is little cooperation in regard to innovation. This led to the insight that close collaborations between PTAs and PTOs within the Swedish public transport industry do exist in certain phases, however the collaboration specifically regarding innovation is lacking. Therefore, the claim of Uyarra et al. (2014) that collaboration within procurement processes is crucial for innovation to occur is corroborated,

however the barrier within the conceptual model is renamed to account for the specific interaction regarding innovation.

5.4.3 Enablers to sustainability innovations - Demand side

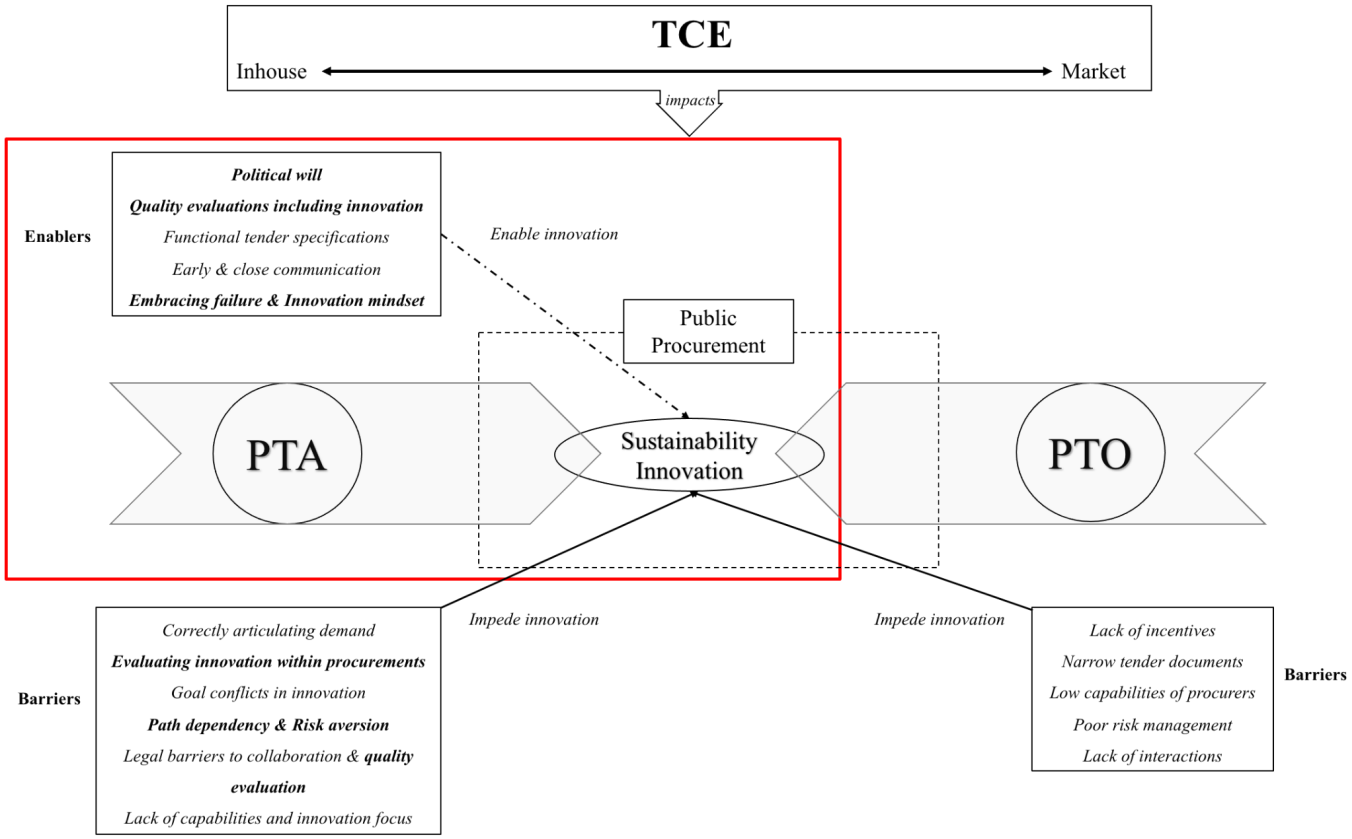

Figure 5 - Refined conceptual model - Enablers demand-side

When it comes to enablers to sustainability innovations on the demand side, the two factors *quality evaluations including innovation* and *political will* stand out in particular but were discussed in 5.2.1 and 5.2.2 respectively and will therefore not be discussed in depth again. The main takeaways from the empirical findings are that especially in the case of non-economically motivated sustainability innovations, *political will* plays a crucial role to provide incentives and resources to support these projects because the PTOs lack an incentive to innovate and PTAs tend to be hampered by goal conflicts and an overemphasis on efficiency. In regard to the second aspect, the findings elicited the insight that *including innovation in quality evaluations* can signal

public demand for innovation to the PTOs, which are therefore more prone to engage with innovative activities to fulfill these demands. These insights corroborate the take of Georghiou et al. (2014) and Edler & Georghiou (2007) who argued that public demand signaled through public procurement has the potential to induce sustainability innovations.

In order to address the previously outlined barrier of narrow tender documents, the empirical findings underline the use of *functional tender specifications* as an enabling factor for innovation. According to the informants, using functional requirements, meaning that the outcome of procurement is described but not the means of achieving it, provides the PTOs with the opportunity to find innovative solutions without being restrained by specifications. In this context, the empirical material further highlights the importance of functional tender requirements, since the PTOs are described as being best suited to create innovations due to their expertise which can be best leveraged when using functional specifications. This very aspect led to the insight that PTAs are described as best suited to trigger sustainability innovations with their demand and tender documents, while PTOs are characterized as best suited to finally create the innovation. Overall, the expressed emphasis on using functional requirements and focusing on outcomes and strategic goals, thereby leaving room for the PTOs to innovate corroborates Georghiou et al. (2014), who likewise pointed out the enabling nature of functional requirements.

A further enabler to sustainability innovation described by the informants revolves around *early & close communication.* Here, both actors on the PTA and PTO side emphasized that communicating and collaborating closely in the early stages of the procurement process and beyond allows the parties to share knowledge and demands and involve manifold stakeholders, which leads to better procurement documents that can enable innovation. An example of such a close and early communication are the aforementioned individual consultations before the tender documents are published, which are highly valued by the PTOs to bring in their state-of-the-art knowledge and engage in discussions about the upcoming procurement, thereby laying the foundation for innovation to happen later in the process. This aspect elicited the insight that early and close collaboration is particularly important in light of the previously outlined information asymmetries between PTAs and PTOs regarding new technologies and the further described lack of capabilities in procuring innovation, which can be partly mitigated by early and close collaboration. Moreover, the empirical findings led to the derivation that the previously

elaborated uncertainties about future needs and associated problems due to the presence of incomplete contracts can be attenuated by collaborating closely early on in the process. In sum, the outlined importance of early and close communication and collaboration corroborates the notions of Georghiou et al. (2014), who emphasized the need for early interactions between procurers and suppliers to enable innovation.

Lastly, the empirical findings generated *embracing failure & innovation mindset* as a new enabling factor for innovation. In light of the outlined tendencies of PTAs to show risk averse and path dependent behavior which impedes innovation, some informants emphasized the importance of failures on the way to innovation, which is an aspect that collides with the present mindset shown by many PTAs currently. Therefore, a change in mindset is proposed in order to provide an environment that is fruitful and open to innovation. These assertions elicited the insight that not only the relational and contractual bonds between PTA and PTO are important to foster innovation but that organizational factors particularly on the PTA side play a crucial role and therefore need to be taken into consideration to see the facilitation of sustainability innovations within public procurement holistically.

6. Conclusions

The starting point of this thesis was the realization that there is a large common effort necessary to reach sustainability goals, in which the public transport industry as a major contributor to greenhouse gas emissions as well as a public agent representing society and holding a significant purchasing power has a major role to play. Further, it was argued that innovations in regard to sustainability will be necessary to reach sustainability goals, which however are only occurring to a limited extent. In this context, it was reasoned that public demand could be a driving force to enable (non-economically motivated) sustainability innovations if organized correctly. Thus, this research was aimed at understanding the public procurement process in regard to innovation between PTAs and PTOs in the Swedish public transport industry as well as to identify enablers and barriers to innovation, in order to finally derive insights into how PTAs can drive sustainability innovations. This purpose was articulated in the following research question:

How is the relationship between PTAs and PTOs within the Swedish market-based approach to public procurement affecting sustainability innovations in the public transport industry?

To address the posed research question, a qualitative case study of the Swedish public transport industry was conducted, which explored relevant factors in the relationship between PTAs and PTOs that affect innovations and particularly (non-economically motivated) sustainability innovations. The empirical findings discussed previously suggest that there is indeed a market failure to provide non-economically motivated sustainability innovations in the current situation, which calls for a higher involvement of the public actor, i.e PTAs, to engage with demand-side innovations. Further, in regard to factors affecting innovations, the findings indicate that the extent to which demands are specified in tender documents and whether innovation is included in quality evaluations, has an impact on innovations in public procurement. Here, low specifications and demands formulated in a functional way have been described to be inducive to innovation as well as including innovation as a criterion in quality evaluations, although challenges persist. These findings elicited the insight that the contractual relationship between PTAs and PTOs and the way these contracts are designed play a crucial role in fostering innovation.

Additionally, when it comes to aspects that are particularly relevant for non-economically motivated sustainability innovations, the findings suggest that political backing on the PTA side, the public provision of economic incentives for PTOs and the management of goal conflicts on the PTA side are essential to induce non-economically motivated sustainability innovations. These findings led to the insight that on top of contractual aspects affecting the relationship and innovation, there are organizational aspects especially on the PTA side, such as the public character of PTAs aiming for efficiency and leading to goal conflicts with innovation, that similarly influence the relationship between PTAs and PTOs and affect innovation. Thirdly, the remaining findings elaborated in the discussion further elicited the insight that besides contractual and organizational aspects affecting the relationship and innovation, the level of collaboration regarding innovation e.g. in the early phases of procurement impacts the emergence of innovation. Therefore, the thesis proposes that there are contractual, organizational and relational elements affecting the relationship between PTAs and PTOs, whose respective sub-aspects, meaning barriers and enablers, influence the emergence of innovation.

6.1 Theoretical implications

Within this thesis, there are three main theoretical implications. First, the thesis contributes to theory by enhancing the understanding of relevant barriers and enablers for sustainability innovations between public and private actors in the context of public procurement in Sweden through a refined conceptual model. Since public procurement dynamics are very context dependent and can differ between countries, regions and industries, studying the public transport industry in Sweden can act as a starting point for further research that aims at finding generalizations among cases. Secondly, the strongly emphasized role of including innovation as a criterion in quality evaluations to induce innovations enhances the literature since this aspect was only rarely mentioned in previous research and opens up for investigation in other countries and contexts. Thirdly, the authors propose the separate consideration of dynamics for economically motivated sustainability innovations and non-economically motivated sustainability innovations. Here, the thesis contributes to the scarce academic literature on the specific case of non-economically motivated sustainability innovations and related barriers and enablers to induce this type of innovation within public procurement.

6.2 Practical implications

When it comes to implications for practitioners, the research provides various valuable insights. By investigating innovation procurement practices within the Swedish public transport sector, managers on both the PTA and PTO side are supported in gaining a deeper understanding of the barriers and enablers that the respective other side encounters. Since the focus of this thesis lies on studying demand-side innovations and how they are facilitated, particularly managers from PTA organizations can gain insights into the three levers they can tweak in order to promote sustainability innovations. Firstly, PTAs can work on the contractual lever, meaning that they can adjust the way they design their tender contracts and quality evaluation documents. In this context, utilizing functional requirements within the tender documents as well as including innovation as a criterion in quality evaluations was found to be inducive for innovation. Secondly, managers can utilize the relational lever and adjust the level of collaboration with the PTOs in the procurement process. Here, establishing early and close communication with the PTOs, such as through individual consultations before the tender documents are published as well as more collaboration regarding innovation in the contract management phase was found to be beneficial for innovation. Thirdly, the PTA managers can work towards improving their organizational capabilities and corporate culture to create an innovation-friendly environment. The findings indicate that acquiring legal knowledge in regard to possible collaboration models and new forms of innovation procurement is equally important as creating a culture that embraces and accepts failure to allow for innovation to happen. Lastly, the empirical findings elicited two takeaways that are relevant for policymakers both in public transport as well as similar public industries. First, policymakers and politicians should provide more clarity on how the legal framework can be utilized in practice to enable close collaboration between the public and private actors as well as include innovation in quality evaluations. Second, politicians should be aware that political will has the power to ignite change and therefore push for non-economical sustainability innovations within the public sector.

6.3 Research Limitations

In order to provide transparency about the implications of the chosen methodological approach, the research limitations of this thesis are outlined in the following section. Firstly, there is a limitation in regard to generalizations that is caused by only researching a small subset of organizations within the Swedish public transport industry. Since the Swedish public procurement process differs from other national contexts and is furthermore organized regionally in Sweden with differing procurement approaches, the generalizability of the conclusions is limited. Another limitation lies within the number of conducted interviews during the empirical data collection and the distribution of informants between PTAs and PTOs. Since the majority of respondents came from the PTA side and the PTO side was represented by three informants, the statements voiced by the latter respondents are not deemed representative of every PTO but rather reflect an indication of their individual experiences and opinions. Moreover, while a certain level of theoretical saturation especially on the PTA side was achieved with similar answers coming up in the last interviews, the study would have benefitted from more interviews from different regions and particularly including more PTO informants. Furthermore, there is a need for distinction between experiences and opinions expressed within the empirical material, which is particularly relevant in the case of informants voicing their opinions about the future or improvement potentials. Therefore, the conclusions derived from these opinions are less substantiated and should be seen as tentative conclusions that need further research to back them. Lastly, the chosen abductive method reflected an explorative intention to identify the main barriers and enablers to innovation in the specific context of Swedish public transport, which led to the fact that several barriers and enablers to innovation that emerged from the academic literature and were used in the initial model were not discussed by the informants. As a consequence, they were excluded from the refined model due to a lack of empirical evidence, which however does not necessarily imply that these factors are irrelevant in the Swedish case. In order to address this issue, a deductive approach testing the different aspects is recommended for further research.

6.4 Future research

As a result of the limited scope and the selected method of this thesis, several topics for future research emerged. Firstly, the Swedish public transport sector currently utilizes the market in order to procure innovations with implications for collaboration, contracts and transaction costs outlined before. Consequently, future research could be conducted to understand how a higher level of vertical integration, such as a more in-house solution, would affect the occurrence of non-economically motivated sustainability innovations and the respective transaction costs, collaboration levels and further implications. Moreover, while Sweden is seen as a frontrunner in regard to using procurement within the public transport sector (Molander, 2018), further research could focus on understanding innovation procurement activities in different countries and legislative contexts. Here, it would be particularly insightful to compare Sweden's practices to those of other EU countries to explore if there are any commonalities among EU countries that could elicit general derivations. Building upon the previously noted limitation of not being able to test all factors voiced in the academic literature in this thesis, further research could utilize a deductive and quantitative design to test all the enablers and barriers outlined in the initial conceptual model in the Swedish context and potentially attribute respective importance to them. Lastly, future research could empirically test the refined conceptual framework in other industries or countries to extend the model and further deepen the outlined insights.

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Appendix

Appendix 1 - Interview guide - PTO

1. Would it be fine with you if we record the interview?

2. Could you shortly state, how long you have worked in the company and what is your role within the company?

3. How would you describe the procurement process, particularly regarding innovation? Is it easily possible for you to innovate?

4. Which factors in the procurement process do you feel are contributing to innovation and which are limiting innovation and why?

5. How would you describe the relationship between you and the PTAs regarding innovation? How does this form of interaction/collaboration impact innovation in the procurement process and why?

6. Which form of collaboration would induce innovation in your opinion and why?

7. How could this be realized and implemented? What would it need? What are barriers to reaching this state?

8. Who is the driving force behind innovation (PTA/PTO)? How would you describe this relationship regarding sustainability?

9. Is your innovating process in any form incentivized by the PTAs and how? What kind of incentives would you need to innovate/be incentivized to innovate? Why?

10. How is the PTAs' focus on price when selecting tenders impacting your incentive to innovate?

11. Would you describe the collaboration with the PTAs as an enabler for innovation? Is it always clear to you what they demand from you?

12. Do the tender documents allow for innovative solutions or are there any problems associated with the tender documents regarding innovation?

13. What are your thoughts on the willingness to take risks from public procurers when it comes to innovative solutions?

14. How do you perceive the level of expertise from the procurer side on new & innovative technologies or solutions?

15. Is there anything you would like to add regarding this topic?

Appendix 2 - Interview guide - PTA

1. Would it be fine with you if we record the interview?

2. Could you shortly state, how long you have worked in the company and what is your role within the company?

3. How would you describe the procurement process, particularly regarding innovation?

4. Which factors in the procurement process do you feel are contributing to innovation and which are limiting innovation and why?

5. How would you describe the relationship between you and the PTOs regarding innovation? How does this form of collaboration impact innovation in the procurement process and why?

6. Which form of collaboration would induce innovation in your opinion and why?

7. How could this be realized and implemented? What would it need? What are barriers to reaching this state?

8. Who is the driving force behind innovation (PTA/PTO)? How would you describe this relationship regarding sustainability?

9. Do you feel like you, as a PTA, are incentivizing PTOs to innovate in the procurement process? In which way?

10. What could help support innovation in the procurement process from your perspective? Why?

11. Which criteria drive your decision making within procurement? Which role do innovation & sustainability play in your decision making process within procurement?

12. Do you have any experience with pre-commercial procurement, innovation partnerships or competitive dialogue? If yes, what are your thoughts? What are pros and cons? Why?

13. Is there a distinct innovation procurement plan outlining how you will go about procuring innovation within your organization?

14. How is your procurement team organized? How close is the collaboration with suppliers and end-users (the people actually using PT)

15. Is there anything you would like to add regarding this topic?

Appendix 3 - Codes within Atlas.ti

50 thematic codes

Capabilities of doing procurement

Collaboration difficulties

Collaboration during 3 phases

Collaboration forms (PCP, Innovation partnerships)

Connection with end users

Contract issues

Decision criteria in procurement

Demand as a driver for innovation

Designing tender requirements

Difficulty to describe & evaluate Innovation in documents

Driving forces of innovation

Early start of procurement process

Enabling - Incentivizing suppliers

Enabling - Innovation mindset & accepting failures

Enabling - Innovation procurement plans

Enabling - more collaboration

Enabling - political will

Enabling - Pre-procurement discussion

Enabling innovations in tender

Enough/good collaboration

Financial viability as enabler

Fines

Goal conflict with innovation

Good quotes

Information transparency

Innovation procurement plan

Innovation space apart from contract

Intellectual property rights problems

Intra-organizational processes

Knowledge transfer

Lack of incentive after contract is signed

Lack of incentive for suppliers

Lack of time and innovation focus

Lacking collaboration

Legal aspects

Lock-in

Openness to innovation

Operators pushing for sustainability

Opinions on how to enable innovation

Overemphasis on current needs instead of goals

Path dependency

People as barriers

Pushing for sustainability

Quality evaluation

Risk avoidance

Small vs Big

Standardisation

Strategic goals

Sustainability context