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Procurer-Supplier Interaction for Circularity

A multiple-case study of product-service systems in Swedish public procurement

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Abstract

Problem: Public procurement constitutes a large part of the global economy, accounting for 15% of GDP. But it is also responsible for 15% of global greenhouse gas emissions and consumes vast amounts of raw materials as it is strongly focused on linear products. A more circular alternative is the procurement of Product-Service Systems (PSS), which combine products and services. However, research shows that Circular Public Procurements, such as procurements of PSS, are more complex and require deeper procurer-supplier interaction. Yet, the procurer-supplier interaction in the context of public procurement of PSS has not been empirically explored.

Purpose: The purpose of this study is to explore how the interaction between the procurer and supplier throughout the public procurement process can facilitate public procurement of PSS.

Method: A qualitative multiple-case study was conducted, exploring four cases of public procurements of PSS between Swedish municipalities and Swedish private companies. Seven semi-structured interviews with interviewees from both sides were conducted. The data was triangulated with case-specific procurement documents.

Results: Procurer-supplier interaction was found to be crucial for procurers and suppliers throughout the public procurement process to make PSS happen and to improve its quality. In both, the preparation and utilisation phase of public procurement, the interaction can bring benefits for procurers as well as for suppliers, thus facilitating PSS.

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1. Introduction

This chapter aims to introduce the reader to the research topic and the context it is situated in. It discusses and problematizes the research gap and lines out the purpose of this study resulting in its research question. Further, the perspectives of the research are presented.

1.1 Background

"*What we do between 2020 and 2030 will be the decisive decade for humanity's future on Earth*" (Rockström, 2021, 68:10). This is how Johan Rockström, climate scientist and the director of the Potsdam Institute for Climate Impact Research stressed the need to change how humanity and the economy operate. Rockström et al. (2009) identified nine earth systems, that are central to human existence and defined planetary boundaries for each of them. The planetary boundaries mark quantifiable limits, inside which the safe operating space for humanity on Earth lies (Rockström et al., 2009). Humanity has already transgressed six out of nine of the planetary boundaries (e.g., climate change and biochemical flows) (Stockholm Resilience Center, 2022). Transgressing these boundaries increases the risk of irreversible and abrupt environmental changes (Stockholm Resilience Center, n.d.).

The transgression of the planetary boundaries is to a large extent driven by the linear economic model which follows *the take-make-waste* logic (Circle Economy, 2023). This means that raw materials - often from non-renewable sources - are extracted, used for the production of goods, and disposed of after use. A counterpart to the linear economic model is circular economy which promotes three circularity principles – elimination of waste and pollution, circulation of products and materials, and regeneration of nature (Ellen MacArthur Foundation, 2015). These principles can be addressed by different strategies, such as reducing material usage, using renewable materials, prolonging their lifecycle, and reusing them (Circle Economy, 2023).

For businesses, the transition towards a circular economy means not only designing circular products but also shifting to circular business models (Bocken et al., 2016). A subset of circular business models are product-service systems (PSS) (Geissdoerfer et al., 2020). Mont (2002) defines PSS in the context of environmental sustainability as "a system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer

needs and have a lower environmental impact than traditional business models" (p. 239). While PSS are not circular per se, it is the servitization of product offerings and increased responsibility of the product provider that creates incentives towards increased circularity (Tukker, 2015). Servitization describes the addition of services to the product offering or, in higher degrees, the offering of a product-as-a-service entirely (Raddats et al., 2019). Depending on the degree of servitization, PSS can take different shapes. To illustrate with an example of a car, one form of PSS could be that a company guarantees maintenance (additional service) throughout the car´s lifetime. Another form could be that a company rents out rather than sell cars. Or a company could shift its focus away from cars as such to the function of getting a person from point A to point B. This could be, for instance, achieved through a mobility-as-a-service app, integrating different options such as public transportation or bikes and is not limited to the provision of cars.

PSS can be implemented in any of the Business-to-Business (B2B), Business-to-Consumer (B2C), and Business-to-Government (B2G) markets, but until now both the practical and research focus was mainly on B2B and B2C, leaving the B2G context underexplored (Egebæk et al., 2022; Lingegård, 2020; Tukker, 2015; Witjes & Lozano, 2016). There are several reasons to explore PSS in the B2G context. One reason is, that in the B2G market, public institutions such as governments or municipalities procure from companies through public procurement which is regulated differently than purchases in B2B or B2C markets (European Commission, 2015). Another reason is, that public procurement has high leverage in terms of economic power and environmental impact because it accounts for 15% of global GDP as well as 15% of global greenhouse gas emissions (World Economic Forum, 2022). In connection to that, public procurement constitutes a large share of total demand in certain industries like infrastructure, thus being an important demand driver (Kadefors et al., 2019). Further, public institutions are interested in pursuing circularity as shown by for example the EU's Circular Economy Action Plan (European Commission, 2020), or national strategies for a circular economy such as *Circular Economy – Strategy for the transition in Sweden* (Government Offices of Sweden, 2020).

This study focuses on public procurement carried out in Sweden. The analysis focuses on one country as procurement laws differ from country to country, which would complicate cross-national comparisons (European Union, 2016). Sweden was particularly chosen for two reasons. First, Sweden has set goals to increase sustainable procurement in their procurement

strategy and many cities and regions have set sustainability and circularity goals, which increase the need for the implementation of sustainable and circular procurement practices (Swedish Government, 2016). The other reason is that Sweden is a good example of a country with significant geographical dispersion in their public procurements, as about 75% of the public procurements are done by regional authorities such as regions, municipalities, or cities (World Economic Forum, 2022). This dispersion poses a challenge to the implementation of centralized sustainability strategies as decentralization can create coordination issues (World Economic Forum, 2022).

The following sections outline the current state of research on PSS in connection to public procurement leading the research gap which is addressed in this paper.

1.2 Problem

In the special context of PSS offerings from private companies to public authorities through public procurement, both the literature and the practical application are still emerging (Egebæk et al., 2022; Lingegård, 2020). Public procurement is mentioned as a promising tool when it comes to increasing the implementation of PSS in businesses and thus potentially leading to better environmental performance, as it poses the earlier mentioned high economic power and can induce direct market demand (Ceschin & Vezzoli, 2010; Clemente et al., 2018; Hannon et al., 2015).

However, PSS in the public procurement context has so far been rarely studied on its own but rather as one option of Circular Public Procurement, among product-focused concepts. According to Alhola et al. (2019), most Circular Public Procurements are still product-focused, and therefore, rarely make use of PSS. Within the field of Circular Public Procurement, research so far mainly looked at the public institution's perspective (Alhola et al., 2019; Bratt et al., 2013; Klein et al., 2022), leaving the procurer-supplier interaction unexplored.

Many researchers highlight the increased need for procurer-supplier interaction, due to the increased complexity of procuring in a circular manner and the increased interdependency between both actors (Adjei-Bamfo et al., 2023; Alhola et al., 2019; Sönnichsen & Clement, 2020; Witjes & Lozano, 2016). Previous research on PSS from the private sector perspective further stresses the importance of the interaction between procurers and suppliers for successful

PSS provision (Moro et al., 2023). The service provision can extend the interaction beyond the point of purchase and the exchange of information and feedback can lead to improved processes that benefit both, the procuring and the supplying side (Baines et al., 2007; Bustinza et al., 2019; Raddats et al., 2019).

However, it is problematized that public procurement usually shows little interaction between the supplier and the procurer (Alhola et al., 2019; Uyarra et al., 2014). Circular Public Procurements tend to be more innovative as they can directly affect the supplier's business model as well as the ownership structure of the procured product or service itself and therefore the interaction is of high importance (Alhola et al., 2019; Kristensen et al., 2021; Witjes & Lozano, 2016). While there is a theoretical collaboration framework for Circular Public Procurement by Witjes and Lozano (2016) and cases that study Circular Public Procurement from a public authority perspective (Kristensen et al., 2021), there is a gap, when it comes to empirical research on the interaction between the public institution and suppliers throughout the public procurement process. This is even more so the case in the specific context of the procurement of PSS (Alhola & Nissinen, 2018; Lingegård, 2020; Witjes & Lozano, 2016).

1.3 Purpose

The purpose of this study is, therefore, to explore how the interaction between the procurer and supplier throughout the public procurement process can facilitate public procurement of PSS. This study aims to provide insights for companies and public authorities about the procurer-supplier interaction in the public procurement of PSS as well as contribute to the emerging literature on this topic. The study is guided by the following research question:

How can procurer-supplier interaction facilitate public procurement of product-service systems?

1.4 Perspectives

Since the study focuses on the procurer-supplier interaction, the perspectives of both the procuring organisation and the supplying company are included. This is necessary because interaction involves both actors. The study distinguishes between the findings which come from the procurer perspective, those resulting from the supplier perspective, and those which are shared by both groups because the implications can differ for each side. It is to be pointed out that when using the terms procurers and suppliers throughout this study, these refer to

employees inside the procuring organisation (municipality) and the supplying company respectively, not only the specific employees with the job title of procurer or the people physically supplying products or services.

2. Frame of Reference

The aim of this chapter is to provide an overview of the relevant literature on the key concepts of this study. The literature on PSS and public procurement is introduced, and terminology is explained. Literature on procurer-supplier interaction from both literature streams is presented, leading to a conceptual framework.

2.1 Method of Constructing the Frame of Reference

To construct the frame of reference, two approaches were used for identifying the most relevant literature related to the key concepts of this study. These were database searches and snowballing. In addition, publications from renowned organisations, such as the EU or UN, were added to explain concepts or processes related to public procurement, which were not established by academia but rather by political bodies.

The database search was performed in Scopus and Web of Science. These databases were chosen because they are commonly used in academic research (Adjei-Bamfo et al., 2023; Zhu & Liu, 2020) and include journals from both social and natural sciences (Adjei-Bamfo et al., 2023; Falagas et al., 2008) which is important for this research since it concerns a topic in the interdisciplinary field of sustainability. Furthermore, when conducting a preliminary search in Scopus, Web of Science, ProQuest, Business Source Premier, Google Scholar and PRIMO (search tool provided by the university library), Scopus and Web of Science yielded the most relevant results for this study.

During this preliminary search, it was observed that the literature on PSS in the B2G context is very limited. Therefore, searches for both the PSS and innovative/circular public procurement were performed separately to review the most relevant literature for each concept. Search terms for each of the core concepts of this research were created and combined based on keywords commonly used in the relevant literature. The search queries used for each of the concepts are summarised in Table 1.

Table 1: Search queries used to find relevant sources for the Frame of Reference

Concept	Search query
Product-Service System	("product-service system*" OR "product service system*" OR "product-as-a-service" OR "product as a service")
Public Procurement	(“public procurement“ AND (“circular*” OR “innovat*”))
Procurer-Supplier Interaction	(("public procurement") AND ("procurer-supplier interaction" OR "procurer-supplier collaboration" OR "procurer-supplier relationship" OR "buyer-supplier interaction" OR "buyer-supplier collaboration" OR "buyer-supplier relationship")

The results included in the frame of reference from the database searches were identified by reviewing the title and abstract of i) the results with the highest citations, ii) the results with the highest citations in each of the past five years (2022-2018), and iii) all the results published in 2023. Steps ii) and iii) were done to ensure that relevant results which have not been highly cited yet, potentially due to their novelty, were not omitted.

Further, a twofold snowballing approach was used. First, relevant references from the articles which were identified in the database search were reviewed. And second, in the case of older articles from the database search, the articles which cited these articles were reviewed.

Table 2 shows an overview of the final selection of records used for constructing the frame of reference. Overall, 43 records were used. 37 were journal articles, one was a book chapter, and five were other publications from well-established institutions, such as the EU. To ensure high-quality, mainly articles from ABS list journals were used (33 articles). Four articles, which were from journals not on the ABS list, underwent further quality screening by analysing citations, SJR rank, and the H-index. For example, Witjes and Lozano (2016) published in the journal Resources, Conservation and Recycling, was included as it is among the most cited articles regarding public procurement and circularity.

Table 2: Source types of records used in the Frame of Reference

Source type	Number of records
Journal article	37
Book chapter	1
Other publications*	5

**(European Union, 2016, 2017; Goedkoop et al., 1999; Konkurrensverket, 2017; United Nations Environment Programme, 2013)*

2.2 Product-Service Systems

Product-Service Systems (PSS) are originally defined as "a marketable set of products and services capable of jointly fulfilling a user's need" (Goedkoop et al., 1999, p. 18). While there were other definitions developed over the years, for example, additions for the specific research discipline, with a focus on sustainability (Mont, 2002), or recently in the digital context (Kohtamäki et al., 2019), the named definition still covers the essence that all PSS share (Tukker, 2015). The research on PSS started to become popular in the 90s and early 2000s in the disciplines of sustainability and business, and evolved multidisciplinary further - for example into the disciplines of technology, engineering, design, marketing, and operations management (Moro et al., 2023; Tukker, 2015). This research however mostly focusses on PSS research from the business model and sustainability fields.

The economic and environmental implications of PSS, compared to product-sales offerings differ depending on the degree of servitization (Kjaer et al., 2019). For a distinguished discussion, the most common classification by Tukker (2004) is used. Tukker (2004) classifies PSS into the following three main categories:

- Product-oriented PSS: This category is similar to traditional product-sales business models. Here, the providing company still sells the product but is further adding services to enhance customer value (Tukker, 2015). This can be achieved for example through consultancy, repair and maintenance, or take-back services.

- Use-oriented PSS: The user of the product does not purchase the product but its usage. In this category, the provider keeps ownership of the product (Kjaer et al., 2019). Examples are leasing, renting, or product pooling (Tukker, 2004).
- Result-oriented PSS: This category is defined by that the user pays for a function, but the product delivering that function is in control of the provider. Examples can be pay-per-service units such as pay-per-copy for copiers or pay-per-lux for lighting. Another example is a functional result, where the provider and the user agree on the wanted result and the provider has the freedom to choose how to deliver it.

2.2.1 Environmental Implications of PSS

One of the reasons that PSS is continuously studied is its potential for increased sustainability and circularity (Moro et al., 2023). While it can create the basis for a more sustainable business model compared to a product-sales model, it is also pointed out that a PSS is not automatically more sustainable and can, in some instances, be environmentally worse (Kjaer et al., 2019; Moro et al., 2023; Reim et al., 2015; Tukker, 2015). Such can be the case for the use-oriented PSS in the form of leasing a product, as it makes a certain product more accessible to a broader customer group, and leased products are also often used with less care than owned products (Tukker, 2015). It can also be the case that a PSS is less environmentally friendly if the PSS prolongs the use phase of an energy-intensive product, which has newer energy-efficient substitutions (Tukker, 2015).

But besides that, PSS are mostly described as more sustainable and enabling increased circularity (Rosa et al., 2019). In product-oriented PSS, the possible benefit is considered the smallest, as companies are still incentivised to sell as many products as possible, but there can be increased circularity through maintenance, repair or take-back and recycling services (Evans et al., 2017; Kjaer et al., 2019). In use-oriented PSS, the providing company keeps ownership of the product, therefore, they have the incentive to increase the usage to gain maximum value with minimal product (Tukker, 2015). In result-oriented PSS the providers' incentive to increase resource efficiency is the highest, as the provider can decide which product should deliver the agreed-upon result (Reim et al., 2015). Thus, every product and material which is used more than needed is a cost factor for the provider (Reim et al., 2015). The study by Lindahl et al. (2014) tested the environmental impact of PSS empirically and shows lower negative impacts in practice compared to product-focused offerings.

2.2.2 Economic Implications of PSS

When it comes to what servitization and offering PSS mean for businesses from an economic perspective, the literature identified both benefits and obstacles for the implementation and operations. An analysis of over 10,000 manufacturing companies by Neely (2008) shows that companies with more PSS offerings have higher revenues, while their relative profitability is lower compared to large manufacturing companies, only offering products. This is partially explained by higher labour costs for companies offering PSS. Companies with less than 3000 employees, offering PSS however showed a higher profitability (Neely, 2008). This can be partially due to a benefit of PSS that is mentioned by several authors: Competitive differentiation (Baines et al., 2007; Bustinza et al., 2019; Mont, 2002; Raddats et al., 2019). Raddats et al. (2019) argue for differentiation as a competitive motivation, since offering PSS can set a company apart compared to only selling products. The services provided can enhance customer engagement, and retainment, and ultimately increase customer satisfaction (Bustinza et al., 2019). Some service attributes, which are specialised and require a certain skill set increase competitive differentiation as they can be difficult to copy by other companies (Baines et al., 2007; Tukker & Tischner, 2006).

Raddats et al. (2019) identify revenue growth and stability as another economic motivation for PSS. With increasing servitization from product-oriented PSS to result-oriented PSS, the revenue model changes compared to a product sales model. For use-oriented PSS and result-oriented PSS revenues are not earned at the point of sale but over time throughout the lifecycle (Reim et al., 2015). While this can be more profitable over time, it was also identified as a risk and a barrier to the transition to PSS (Baines et al., 2007; Tukker, 2015). Neely (2008) argues that, especially in long-term contracts with agreed payments per use or per time interval, the profitability of offered services can vary widely due to variables such as fluctuating energy costs.

Reim et al. (2015) found that with increasingly servitized PSS, there are also higher risks on the suppliers' side due to increased responsibility, prolonged ownership, and less formalized contracts. Raddats et al. (2019) add that a higher degree of servitization increases the complexity of the offering. This needs internal and external communication as well as clearly defined contracts, dealing with topics such as data ownership and intellectual property rights (Raddats et al., 2019). It shows that PSS models bear risks but can, if implemented right, also

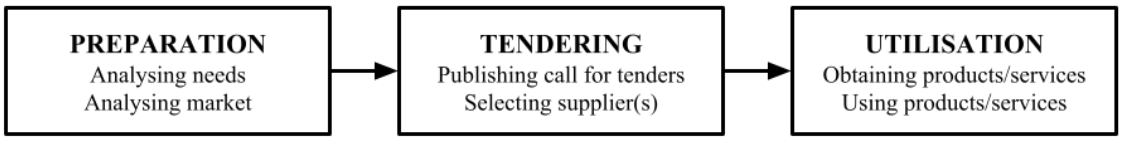
lead to increased revenues, profits, and more satisfied customers (Bustinza et al., 2019). In line with this, many of the authors mention that PSS leads to a deeper buyer-seller relationship beyond the point of sale (Baines et al., 2007; Reim et al., 2015; Tukker, 2015).

While the topic of PSS is mostly explored in the B2B context and B2C context, the literature in the B2G context is only emerging (Lingegård, 2020). Tukker (2015) pointed out that PSS needs to be analysed in all the three mentioned domains (B2B, B2C, B2G).

2.3 Public Procurement

Public procurement is the process through which public institutions such as governments or municipalities procure goods and services for their operations (Uyarra et al., 2014). The process involves several steps, which can be summarised into three main phases (see Figure 1). In the preparation phase, the needs of the procuring organisation and the market situation are analysed (European Union, 2016). In the tendering phase, a call for tenders is published, and one or more suppliers are selected based on evaluation criteria defined in the call for tenders (European Union, 2016). A tender is an offer submitted by a supplier for the provision of the demanded product and/or service(s) (European Union, 2016). In the utilisation phase, the procuring organisation obtains and uses the products or services procured (European Union, 2016).

Figure 1: Public procurement process



Source: Based on European Union (2016)

Unlike private-sector purchases, public procurement must follow stricter national and international regulations. In the Swedish context, which is the frame for this study, public procurement is governed by the Public Procurement Act (2016:1145), which is in line with the EU Directive 2014/24/EU on public procurement (Konkurrensverket, 2017). The main principles to which all public procurements must adhere are non-discrimination, equal treatment, proportionality and transparency (European Union, 2016). The principles thus guarantee fair and transparent conditions for all potential suppliers. The following sub-sections

are devoted to two specific types of public procurement which are relevant to this research – Circular Public Procurement and Public Procurement for Innovation.

2.3.1 Circular Public Procurement

A commonly used definition of Circular Public Procurement is „the process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimising, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle“ (European Union, 2017, p.5). Thus, Circular Public Procurement is a type of public procurement which contributes to a circular economy.

Two other types of public procurement closely related to Circular Public Procurement are Green Public Procurement and Sustainable Public Procurement. Green Public Procurement considers the environmental sustainability of the purchase (European Union, 2016). Sustainable Public Procurement considers not only the environmental but also the social and economic aspects (United Nations Environment Programme, 2013). Since Circular Public Procurement shares some characteristics with Green Public Procurement and Sustainable Public Procurement, and is the newest of the three, an overview of the literature concerning all these three types of public procurement is relevant (Sönnichsen & Clement, 2020).

As identified in the literature review by Cheng et al. (2018), previous research focused mainly on the uptake of Green Public Procurement, barriers to and enablers of its implementation, as well as practices used to implement Green Public Procurement. Already in 2011, Brammer and Walker (2011) found out that most of the public institutions in their study (which included 280 public procurement practitioners from 20 countries) were using some sustainability criteria in their procurement. Nevertheless, the implementation of Green, Sustainable or Circular Public Procurement is influenced by various aspects which can become barriers or enablers, depending on the approach taken. The most frequently cited of these aspects are the perceived costs of such procurements (Brammer & Walker, 2011; Cheng et al., 2018), knowledge and awareness about these procurements (Brammer & Walker, 2011; Cheng et al., 2018; Sönnichsen & Clement, 2020), leadership at the procuring institutions (Brammer & Walker, 2011; Cheng et al., 2018) and procurers´ attitudes (Cheng et al., 2018; Kristensen et al., 2021; Sönnichsen & Clement, 2020).

Even though the above-mentioned aspects are similar for both Green, Sustainable and Circular Public Procurement, the practices currently used to facilitate the implementation of Green and Sustainable Public Procurement are not sufficient for the implementation of Circular Public Procurement (Alhola et al., 2019; Kristensen et al., 2021; Milios, 2018). The current practices used for Green and Sustainable Public Procurement implementation can only partially stimulate the implementation of Circular Public Procurement in terms of, for example, procurement of more circular products (Alhola et al., 2019) such as products with recycled content. However, Circular Public Procurement should go further and promote circular business models and circular ecosystems (Alhola et al., 2019). To do so, it is necessary to adjust the procurement contracts (Kristensen et al., 2021), form new collaborations and partnerships (Kristensen et al., 2021; Rainville, 2021), and move from product- to service- and system-oriented procurements (Alhola et al., 2019; Kristensen et al., 2021).

To conceptualise this change, Witjes and Lozano (2016) developed a collaborative framework based on closer procurer-supplier interaction and procurement of PSS, which should contribute to a circular economy. And Milios (2018) suggests that to incorporate PSS into public procurement, Public Procurement for Innovation should be used.

2.3.2 Public Procurement for Innovation

It has been empirically proven that public procurement is an effective demand-side policy for driving innovation (Georghiou et al., 2014; Guerzoni & Raiteri, 2015; Krieger & Zipperer, 2022) In the literature, there are many different terms used for the type of public procurement which concerns innovation (Lenderink et al., 2022). In this research, the term Public Procurement for Innovation is used as it is a common term in the reviewed literature (e.g., Adjei-Bamfo et al., 2023; Edquist & Zabala-Iturriagagoitia, 2012; Milios, 2018) and it is suitable for solving societal problems and supporting agency mission or needs (Edquist & Zabala-Iturriagagoitia, 2012), which is the case for public procurement promoting circular economy. Similarly to Edler and Yeow (2016), this study uses the term innovation as any solution which is novel to the procuring or supplying organisation.

Alike Circular Public Procurement, the implementation of Public Procurement for Innovation is also surrounded by barriers and enablers. The key determinants of the success of Public

Procurement for Innovation commonly identified in the literature are procurer-supplier interaction, tender specifications, and risk management (Adjei-Bamfo et al., 2023; Georghiou et al., 2014; Uyarra et al., 2014).

To address the challenges of implementing Public Procurement for Innovation, Alhola and Nissinen (2018) developed a framework of facilitators, amongst which is also procurer-supplier interaction, for each phase of the Public Procurement for Innovation. Uyarra et al. (2020) propose a framework for using Public Procurement for Innovation on a sub-national level, which also includes suggestions enabling better procurer-supplier interaction. Edler and Yeow (2016) suggest establishing intermediary structures between procurers and suppliers to support Public Procurement for Innovation.

2.4 Procurer-Supplier Interaction

Both the PSS and public procurement research stream highlight the importance of procurer-supplier interaction. In the PSS literature, the enhanced procurer-supplier interaction is mentioned as one of the advantages of PSS over product-sales models, as well as an important factor for PSS implementation to be successful (Moro et al., 2023). This is the case because of the service features, which are outside the usual procurer-supplier interaction and extend beyond the point of purchase (Baines et al., 2007). Already in the early PSS research, Mont (2002) highlights that PSS aims for a better procurer-supplier relationship through increased interaction and better information flow. The interaction and information flow are seen as a potential benefit for both the public procurer and the supplier. Feedback and service analytics allow the supplier to adjust their processes to enhance customer value (Bustinza et al., 2019). The feedback and data are also valuable for a company's competitive advantage, as they have a good understanding of customer needs and can develop products and services accordingly (Raddats et al., 2019; Reim et al., 2015; Tukker, 2015).

In the reviewed public procurement literature, procurer-supplier interaction is identified as crucial for innovative and more circular approaches (Adjei-Bamfo et al., 2023). A lack of interaction is identified as one of the main barriers for the implementation of circular and innovative public procurement practices (Alhola et al., 2019; Uyarra et al., 2014). Without sufficient information exchange and interaction, the call for tenders can be too specific and transactional and thus not provide the option for development (Uyarra et al., 2014). Procurer-

supplier interaction is further important to account for the risk that the suppliers take when offering new approaches such as PSS, and to build appropriate risk management (Adjei-Bamfo et al., 2023; Alhola et al., 2019; Uyarra et al., 2014).

Karttunen et al. (2022) analysed customer satisfaction in public procurement from a supplier perspective. They found that more procurer-supplier interaction leads to more innovation and higher supplier satisfaction (Karttunen et al., 2022). Innovation enablers in the procurement process increase supplier satisfaction further (Karttunen et al., 2022). This supports the research by Schiele (2020), who stresses the importance of relational behaviour between public procurers and suppliers for supplier satisfaction. It is however to be emphasized that there are legal limits to the procurer-supplier interaction due to the public procurement principles (European Union, 2016; Uyarra et al., 2014). This is especially the case in the tendering phase of public procurement, where interaction is not allowed (Konkurrensverket, 2017). Those limits stress once more why the B2G market needs to be analysed in its specific context (Tukker, 2015).

As PSS is an innovative and circular offering, it comes as no surprise that many of the arguments on procurer-supplier interaction from the PSS and public procurement literature show similarities. It is however the case, that some of the pros for PSS mentioned in the literature, do not apply in the public procurement context. In the following paragraphs, similarities, and differences of the two streams regarding procurer-supplier interaction are discussed. Both literature streams stress that procurer-supplier interaction should begin early in the process. From the PSS literature, it is argued that this allows the development of effective PSS, that can be co-developed with the customers' needs and the suppliers' capabilities (Baines et al., 2007; Raddats et al., 2019; Tukker, 2015). From the public procurement side, early interaction is mentioned for two reasons. The first is that through early interaction it can be decided whether to procure a product or a PSS offering in the first place, depending on the market options, complexity, and circularity benefits which can be achieved (Alhola et al., 2019). The other reason is that early interaction is crucial for the procurers to gather market insights and knowledge about innovations, options, and technological advancements and to include supplier risks to design more appropriate calls for tenders (Sönnichsen & Clement, 2020; Uyarra et al., 2014).

Adjei-Bamfo et al. (2023) describe that the interaction reduces the information asymmetry between the procurer and supplier. On the procurer side, this leads to more accurate ambitions in specifications, as the procurers can design calls for tenders, which are neither over- nor under-ambitious in terms of circularity and innovation as well as providing the right amount of specificity (Adjei-Bamfo et al., 2023). From the supplier side, early involvement is of advantage as they can bring forward their innovations and ambitions and can lower their risks as they can inform their upstream suppliers based on the feedback from the interaction with procurers (Adjei-Bamfo et al., 2023; Uyarra et al., 2014).

A particular mechanism that is often mentioned is a competitive dialogue (Ntsondé & Aggeri, 2021; Rainville, 2021; Sönnichsen & Clement, 2020). A competitive dialogue is "a procedure in which any economic operator may request to participate and whereby the contracting authority conducts a dialogue with the candidate admitted to that procedure, with the aim of developing one or more suitable alternatives capable of meeting its requirements, and based on which the candidates chosen are invited to tender" (Uttam & Le Lann Roos, 2015, p.403). This form of interaction can thus provide important insights from and to the market.

In the PSS literature it is also brought forward that through continuous feedback and interaction throughout the procurer-supplier relation, processes can be adjusted for increased customer value and satisfaction (Bustinza et al., 2019). In public procurement, however, this is limited as processes can only be changed to an extent, which still follows the procurement contract and tender specifications (Schiele, 2020). Another feature of PSS is enhanced customer loyalty through interaction and long contracts to lower risks (Neely, 2008; Reim et al., 2015). In public procurement, this cannot be achieved as the legal environment requires specific contract lengths that do not infringe on a competitive market and the following procurement must again abide by the procurement process (Schiele, 2020). Schiele (2020) therefore argues that a good procurer-supplier relationship needs to be established quickly to make it attractive for the supplier, as a long-term relationship cannot be guaranteed.

The aforementioned reasons are also part of the discussion in the emerging research on PSS in public procurement, where the interaction is highlighted as the tool to shift from product offerings to PSS (Alhola et al., 2019; Kristensen et al., 2021). Lingegård (2020) highlights that the interaction needs to be an iterative process for PSS. Witjes and Lozano (2016) stress the

importance of procurer-supplier interaction as well and developed a theoretical collaborative framework for PSS in public procurement.

2.5 Conceptual Framework

The thesis aims to find out how the interaction between public sector procurers and suppliers facilitates PSS procurement. Figure 2 summarises the insights about procurer-supplier interaction gained from the literature on PSS, Circular Public Procurement and Public Procurement for Innovation.

The top part of the figure shows the public procurement phases. The interaction is only discussed during the preparation and utilisation phases of the public procurement process, as it was already mentioned that it is illegal to interact with the suppliers in the tendering phase to the extent that it can affect the procedure (Konkurrensverket, 2017).

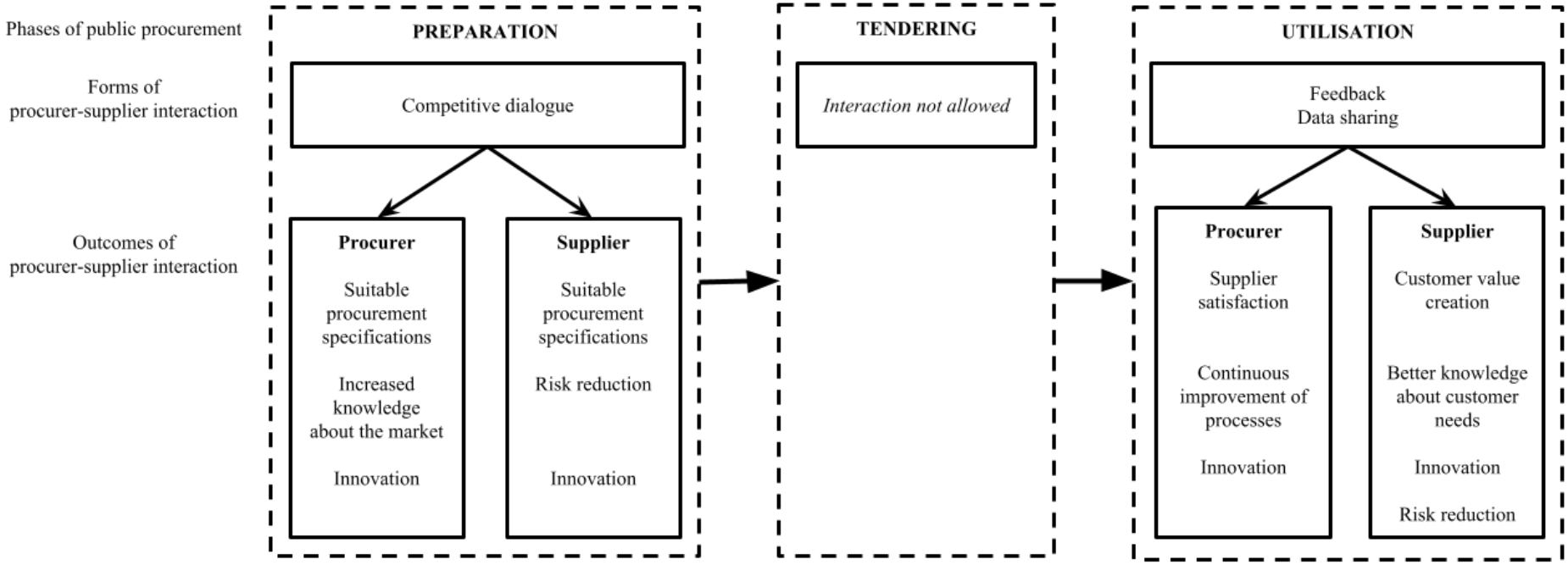
Below the phases of public procurement are the forms of interaction identified in the literature. In the preparation phase, it is the competitive dialogue and in the utilisation phase, feedback, and data sharing. At the bottom are the outcomes of the interaction, which were mentioned in the reviewed literature.

An outcome which spans both phases of public procurement and has been brought from both the procurer and supplier perspective in the literature is innovation. Besides that, in the preparation phase, the interaction can help the procurers to define suitable procurement specifications, which would be beneficial for both the procurer and the supplier. From the procurers´ perspective, the interaction can increase their knowledge about the market. And from the suppliers´ perspective, the interaction in this phase can reduce the risk taken when offering new approaches such as PSS.

In the utilisation phase, the procurer-supplier interaction can help the procurers to keep their suppliers satisfied, and the procurers could benefit from processes continuously improved based on their feedback. Thanks to the interaction, the suppliers can gain better knowledge about the procurer´s needs and create value for their customers. Similarly to the preparation phase, suppliers can also benefit from the interaction by reducing the risk of offering new solutions such as PSS.

The study further explores which implications from the framework apply in the context of public procurement of PSS and which new implications for both procurers and suppliers can be found.

Figure 2: Conceptual framework of procurer-supplier interaction

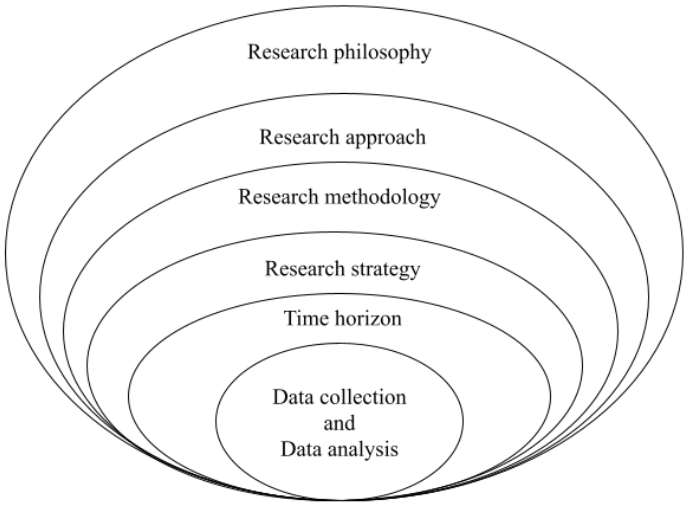


3. Methodology and Method

This chapter provides a detailed description of how the study was conducted and why the specific research choices were made. It starts with the research philosophy and continues with the research approach, methodology, strategy, time horizon, data collection, and data analysis. The chapter concludes with ethical considerations and trustworthiness.

The different choices related to the methodology and method of this research will be explained in the following sections, which correspond to the layers of the research onion from Saunders et al. (2019) shown in Figure 3.

Figure 3: The research onion



Source: Adapted from Saunders et al. (2019)

3.1 Research Philosophy

Research philosophy is influenced by researchers´ beliefs and assumptions about the development of knowledge and influences the research design (Saunders et al., 2019). In this research, the researchers´ beliefs and assumptions are not strongly oriented towards either positivism or interpretivism. Instead, the research problem and the research question guided the research process. Therefore, the most appropriate research philosophy was pragmatism (Saunders et al., 2019).

From the ontological perspective, pragmatism acknowledges that reality is complex and combines experiences and practices. Regarding epistemology, pragmatism argues that valuable knowledge enables successful action and problem-solving. And concerning axiology, researchers´ values play a role in the form of initiating, sustaining, and reflecting on the research. (Saunders et al., 2019)

The approach of pragmatism to the above-mentioned assumptions is in line with this research, which acknowledges that the procurer-supplier interaction in public procurement of PSS is a complex phenomenon, and both practices and experiences are part of it. The knowledge derived from this research should be able to facilitate the implementation of PSS in the B2G context. And the researchers´ perceptions of the importance to address the identified research problem drove the research.

3.2 Research Approach

The pragmatic research philosophy can be used with both deductive, inductive and abductive research approach (Saunders et al., 2019). This research aimed to develop a theory from empirical observations, therefore, the inductive approach was the most suitable (Saunders et al., 2019). Even though the frame of reference was developed before data collection, the aim was not to test the theories in the frame of reference but instead to use them as a point of departure for further exploration. Since there were no propositions about causal relationships derived from the frame of reference, a deductive approach was not suitable for this research (Saunders et al., 2019). Neither was the abductive approach because the theory developed from empirical data would not be subsequently tested (Saunders et al., 2019).

3.3 Research Methodology

The pragmatic research philosophy can be used in both quantitative and qualitative research, however, the inductive research approach determined that qualitative methodology was suitable for this research (Saunders et al., 2019). Qualitative methodology focuses on the perspectives and experiences of participants related to the studied phenomenon in order to develop a theoretical framework (Saunders et al., 2019). More specifically, a multi-method qualitative

methodology was adopted in this research since more than one qualitative data collection technique was used (Saunders et al., 2019), as explained in Section 3.5.

3.4 Research Strategy and Time Horizon

A case study was a suitable research strategy for this study because i) the research question concerned "how", ii) the research concerned a contemporary phenomenon as opposed to historical events, and iii) the researchers did not control the phenomenon (Yin, 2018). Furthermore, the research aimed to conduct an in-depth study of the phenomenon (procurer-supplier interaction in public procurement of PSS) within its real-life context and relied on multiple sources of evidence. These are all characteristics typical for a case study (Yin, 2018).

To strengthen the robustness of the results, a multiple-case study was adopted. The case selection followed the literal replication logic where a few cases, expected to yield similar results, were selected. (Yin, 2018)

The purpose of the multiple-case study was exploratory because the literature about the studied phenomenon was limited, and the study aimed to bring new insights (Collis & Hussey, 2021; Saunders & Lewis, 2012).

Since the study investigated the phenomenon at a particular time, the time horizon was cross-sectional as opposed to longitudinal (Saunders et al., 2019). The cross-sectional time horizon is common for research projects undertaken within academic courses (Saunders et al., 2019), which was also the case for this study undertaken as a part of a bachelor´s thesis course.

3.4.1 Case Selection

To identify suitable cases for this study, several approaches were taken. Firstly, cases featured as best-practice examples of circular, green or sustainable public procurement by relevant organisations within this field such as the European Commission or ICLEI (global sustainability-oriented network of public authorities) were reviewed. Secondly, experts within the field of circular public procurement and PSS were consulted including a researcher from the Research Institute of Sweden, a sustainability coordinator for circular procurement in the city of Malmö, and an environmental specialist for procurement in Jönköping municipality.

Lastly, Swedish public procurements published on Tenders Electronic Daily (a European portal for public procurements) were reviewed.

The main criterion for case selection was that it must be a public procurement of PSS. This criterion alone reduced the number of potential cases significantly, which reflects the findings from the reviewed literature that PSS is not yet widely implemented in the B2G context.

Procurers and suppliers from the cases identified as suitable were contacted, aiming to include 3-4 cases in the study which is a suitable number for a multiple-case study aiming at literal replication (Yin, 2018). 11 potential cases were contacted, out of which 4 accepted to participate in the study. Table 3 summarises the cases included in the study, showing the official name of the procuring organisation, a brief description of the PSS procured and the official name of the supplying organisation.

Table 3: Overview of the cases included in the study

Case	Procuring organisation	PSS procured	Supplying organisation
Case A	Malmö Stad	Procurement of the function of signage and navigation	Accus AB
Case B	Region Gotland	Rental of work clothes and textiles with washing and repair services	Textilia Tvätt & Textilservice AB
Case C	Nynäshamns kommun	Refurbished computers with repair and take-back services	Inrego AB
Case D	Jönköpings kommun	Functional rent of cleaning machines	Supplies Direct Malmö AB

3.5 Data Collection

In line with the multi-method qualitative methodology and the case study strategy, multiple sources of evidence were used in this research, allowing for data triangulation (Saunders et al., 2019; Yin, 2018). The main data source were semi-structured interviews, complemented by procurement documents related to the studied procurements and one email interview. Table 4 provides an overview of all the data included in the analysis for each case.

Semi-structured interviews are an appropriate source of evidence for research with an inductive approach and exploratory purpose (Saunders et al., 2019). Semi-structured interviews were also commonly used in the reviewed literature as a suitable data collection method in case studies aiming to explore practices in public procurement (e.g., Edler & Yeow, 2016; Kristensen et al., 2021; Uyarra et al., 2020). The semi-structured nature allows the researcher to ensure that the interview revolves around topics relevant to answering the research question, while letting new questions arise during the interview, which might provide deeper insights (Collis & Hussey, 2021). To facilitate these benefits, various types of questions were asked during the interviews. The interview guides for both the interviews with procurers (see Appendix A) and the interviews with suppliers (see Appendix B) consisted mostly of open questions such as "*Can you tell us about the interaction between (municipality) and (supplying company) or other suppliers before the procurement?*". These open questions let the interviewees speak freely about their experience resulting in rich data. In addition, the interview guide included closed questions such as "*Was there any competitive dialogue?*". These questions were used to gain information if the interviewees did not mention that information in their answers to open questions. In connection with the closed questions, probing questions were used. For example, if the interviewee answered that there was a competitive dialogue, a probing question was used such as "*Can you tell us more about how the competitive dialogue was done?*".

The interviews were conducted online because the interviewees were scattered around Sweden, and the online meetings were considered as most time-efficient by both the interviewees and the researchers. Furthermore, this research did not focus on daily operations in the case organisations. Thus, it would not significantly benefit from observations of those. Therefore, for this research, online interviews were a suitable form to gain useful insights from the interviewees. For the online interviews, the platform Microsoft Teams was used, which enables recording a meeting and provides a transcript. Furthermore, in cases where follow-up questions

arose after the interview or when answers from the interviewee´s colleagues were needed, follow-up questions were sent and answered by email. The interviews were conducted in English because that was the shared language between the researchers and the interviewees. However, English was not the native language of either of them which could hinder mutual understanding. To mitigate this, the main questions were sent to the interviewees beforehand, and the quotes used in the thesis were sent to the interviewees after data analysis.

Even though email interviews do not allow direct interaction with the interviewees and can result in short, shallow responses (Fritz & Vandermause, 2018), they can facilitate the inclusion of participants who would otherwise be excluded (Dahlin, 2021). The inclusion of a participant who would otherwise, due to time constraints, be excluded from the study was the main reason to incorporate an email interview in this research. To obtain in-depth insights from the email interview, the interview was asynchronous, meaning that the participant was provided with the questions and could take time to answer them instead of answering them instantly (Saunders et al., 2019). Another strategy which could be used to overcome the issue of shallow responses is sending follow-up questions (Dahlin, 2021). However, in this case, follow-up questions were not sent because the initial answers were received shortly before the deadline for data collection. Therefore, the researchers acknowledge that the email interview did not yield rich data, which is a limitation of this particular interview. However, given that it was only one interview out of eight, there were also additional secondary data used for this case, and rich data were collected during the interview with a supplier in this case, the limitation did not significantly influence the study. Moreover, the data collected from this interview triangulated the interview with the supplier in this case and the procurement documents and confirmed the insights gained from those data sources. So, even the limited amount of data was useful for the study.

Table 4: Overview of data collected for each case

Case	Organisation	Interviewee	Interview length	Pages of transcript	Sources of secondary data	Pages of secondary data
Case A	Mälmo Stad	Sustainability coordinator for circular procurement	60 min	19 pages	Procurement document	33 pages
	Accus AB	Project leader	47 min	21 pages		
Case B	Region Gotland	Agreement controller Manager of janitorial and transport unit	47 min	16 pages	Procurement documents	26 pages
	Textilia Tvätt & Textilservice AB	Sustainability manager	63 min	22 pages		
Case C	Nynäshamns kommun	IT technician	email interview	1 page	Procurement documents	23 pages
	Inrego AB	Key account manager - purchasing	62 min	26 pages		
Case D	Jönköpings kommun	Environmental specialist for procurement	42 min	16 pages	Procurement document	18 pages
	Supplies Direct AB	Managing director	43 min	15 pages		

3.6 Data Analysis

Thematic analysis was chosen to analyse the collected data. It is a commonly used data analysis technique in qualitative research, suitable for all research philosophies and research approaches (Saunders et al., 2019). In line with the inductive approach of this study, the themes were developed from collected data rather than from existing theory. Thematic analysis enabled the researchers to focus on the content of the collected data and develop themes which provide answers to the posed research question.

The process of thematic analysis consists of four steps: i) familiarizing with the data, ii) coding the data, iii) searching for themes and recognising relationships, and iv) refining themes and propositions (Saunders et al., 2019). Firstly, the researchers familiarized themselves with the collected data by revising the transcripts of online interviews and reviewing the procurement documents.

Secondly, the coding process was done, which consisted of several steps. Initially, the researchers selected one interview transcript, which both independently coded. The NVivo software was used to organise and store the coding performed by the researchers. After refining the independent coding, the researchers discussed it together and aligned on how to code the remaining data. The remaining data were divided among the researchers, and each of the researchers coded their share of the data independently. The benefit of this decision was time efficiency, whereas the limitation was that one of the researchers could miss something that the other one would have noticed, or one researcher could code a unit of data differently than the other one would have done. To mitigate these limitations, the researchers did the previously mentioned alignment on coding.

Once all the units of data relevant to answer the research question were coded, the researchers discussed the codes and started developing themes by grouping related codes (Saunders et al., 2019). The identified themes were revised several times to organise the data most suitably for answering the research question.

Figure 4 and Figure 5 illustrate how empirical data were coded and how the codes were grouped into themes. Figure 4 illustrates the process for the themes related to the preparation phase of

public procurement, and Figure 5 illustrates the process for the themes related to the utilisation phase of public procurement.

Figure 4: Illustration of the coding process and development of themes related to the preparation phase of public procurement

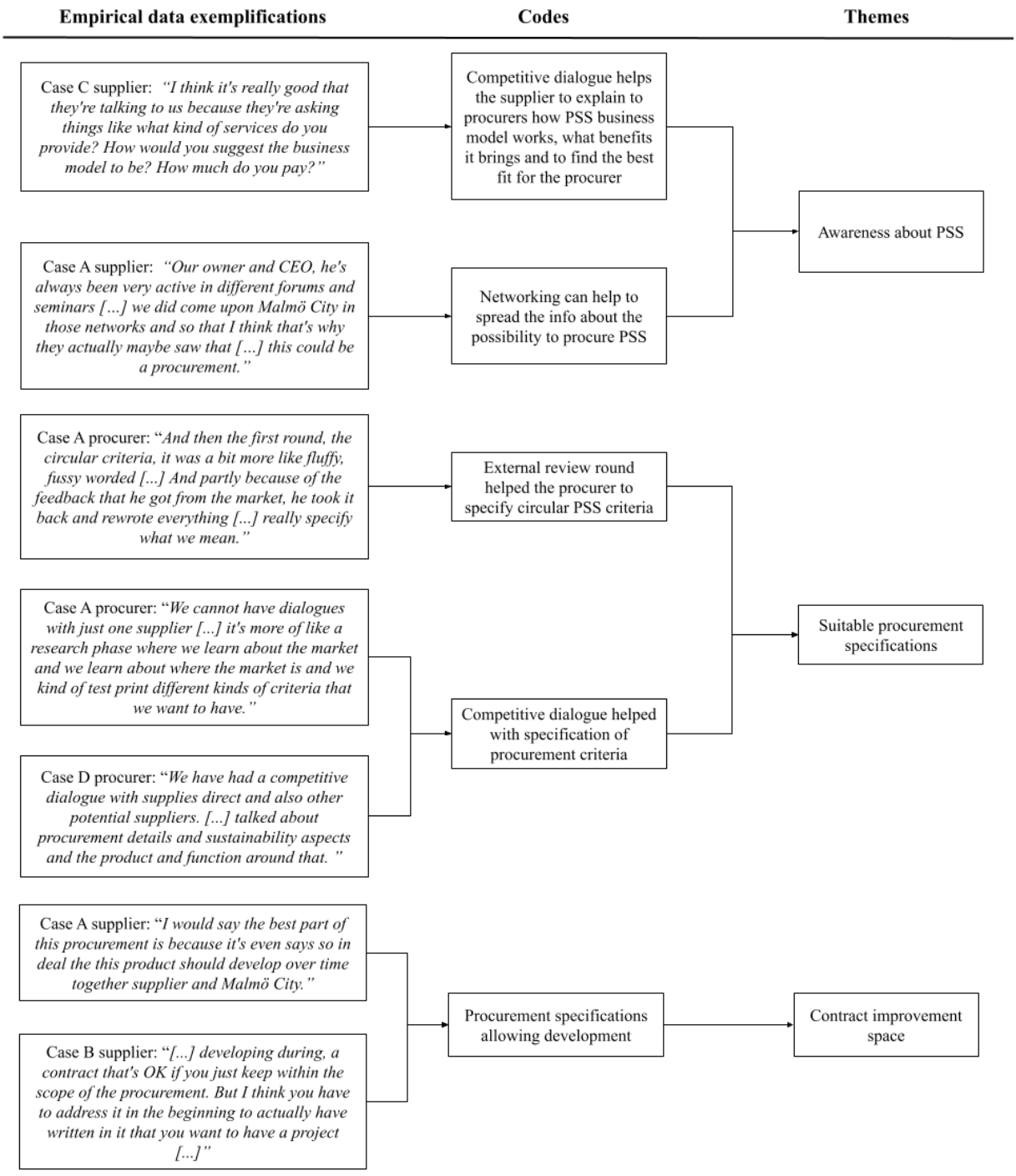
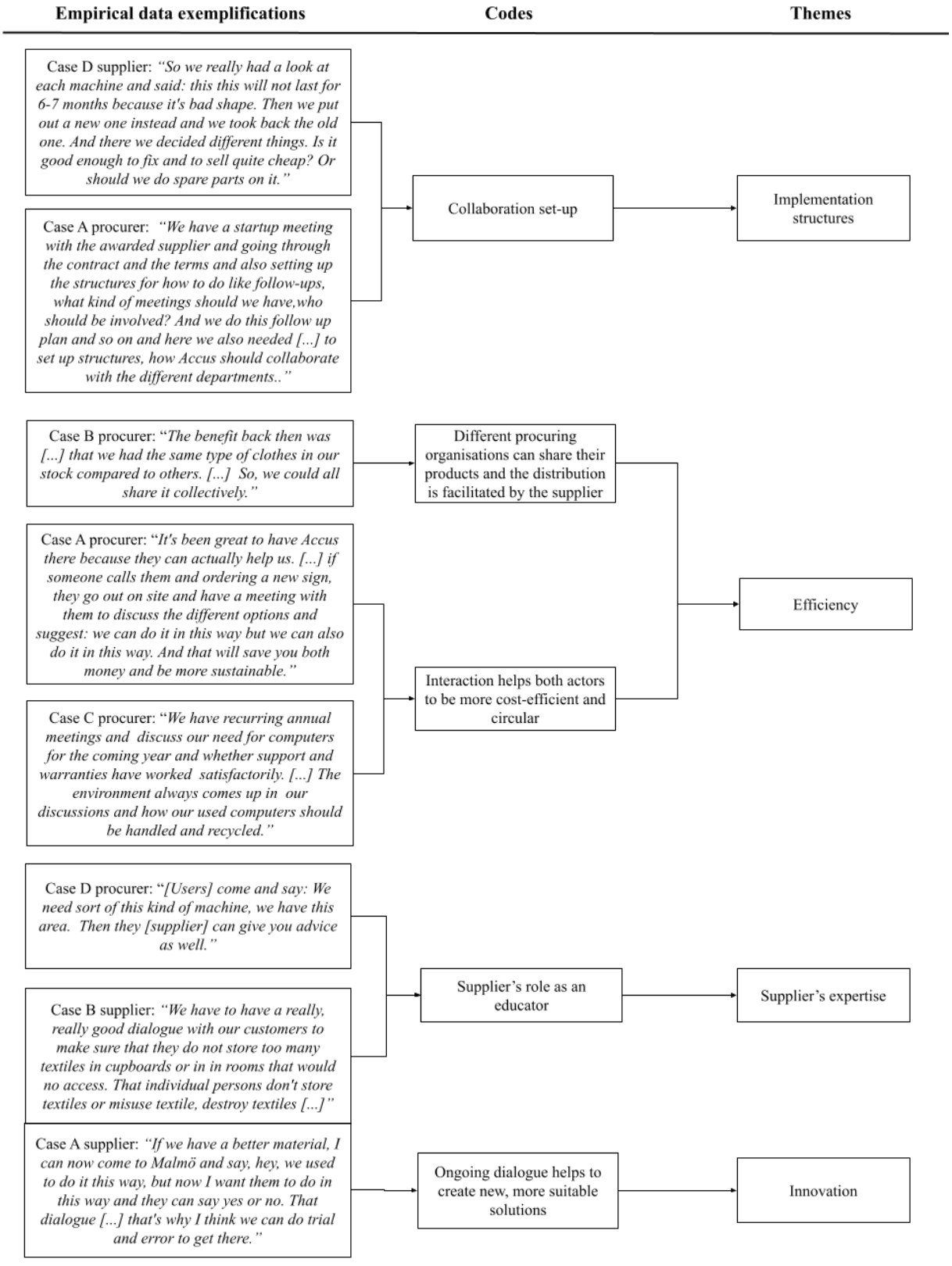


Figure 5: Illustration of the coding process and development of themes related to the utilisation phase of public procurement.



3.7 Ethical Considerations and Trustworthiness

3.7.1 Ethical Considerations

The ethical considerations of this study were mainly addressed by issuing a Consent Form for Participating in a Bachelor Thesis Study which followed the GDPR guidelines. The consent form included information about the purpose of the study, data collection and the corresponding data processing, as well as what participation in the study entails. Furthermore, the consent forms listed the participant´s rights including the right to withdraw the consent to participate at any time before the thesis submission, the right to opt for anonymity, and the right to rectification of information which was used in the published thesis (such as quotes). The researchers sent the used quotes to the participants before submitting the thesis. Moreover, before all the recorded interviews, the participants were asked if they agree with the recording.

3.7.2 Trustworthiness

In qualitative research, the trustworthiness or quality of the research is investigated from four dimensions including credibility, transferability, dependability, and confirmability (Collis & Hussey, 2021).

3.7.2.1 Credibility

Credibility in qualitative research concerns if the subject of inquiry was correctly identified and described (Collis & Hussey, 2021). The credibility of this study was based on several aspects. First, the researchers have an educational background in sustainable enterprise development, which enabled them to perform a study concerning circular business models. Second, the researchers consulted experts from the fields of PSS and circular public procurement to verify the relevance of the research focus and identify suitable cases. Third, the names of the studied organisations and job titles of the interviewees are published in the study to facilitate verification of the suitability of the cases and participants. Fourth, triangulation in data collection was used to avoid single-source bias. And last, the data excerpts published in the study and their context were sent to the interviewees for verification.

3.7.2.2 Transferability

Transferability in qualitative research regards applying the findings to another, sufficiently similar, situation (Collis & Hussey, 2021). To facilitate the transferability of this study, the research context was described in the Background. The cases were presented in the Case Selection, Findings, and in Appendix C. The research choices influencing the research design were explained in the various sections of the Methodology and Method chapter. In the same chapter, the details of Data Collection and Data Analysis were presented.

3.7.2.3 Dependability

Dependability in a qualitative study can be addressed by ensuring a systematic, rigorous and well-documented research process (Collis & Hussey, 2021). Throughout this study, the researchers kept a thesis journal documenting all the steps and decisions taken. The journal then facilitated reporting on the research process in the published thesis. Descriptions and explanations of the methods of conducting the literature review and the study can be found in chapters 2. and 3. respectively.

3.7.2.4 Confirmability

Confirmability in qualitative research focuses on whether it is possible to derive the findings from data (Collis & Hussey, 2021). To address the confirmability of this research, the interview guides for both the interviews with procurers and suppliers are included in Appendices. Furthermore, in the section Data Analysis, an illustration of data coding is provided. The data excerpts used in the published thesis and their context were sent to the interviewees to provide the option for rectification.

4. Findings

This chapter first introduces the four cases of this study. This is followed by bringing forward the findings for each of the three themes developed for the procurer-supplier interaction in the procurement preparation phase as well as the four themes developed for the procurement utilisation phase.

In the public procurement cases of PSS, the interviewees stressed the importance of procurer-supplier interaction to have a well-functioning PSS offering and to procure PSS in the first place. The procurer from Case A highlighted this followingly: *"When we procure something circular, and especially when we are not just buying something [...and...] have a lot of services around this [...], we need a supplier that is committed and that we work with more of in like a partnership than we do with the ones that we are just buying products from."*

To provide a better context for the findings, the following sections briefly introduce the four cases, describe their offering and classify the type of PSS based on the procurement documents. The case organisations are elaborated on in Appendix C.

Case A

This case is a procurement of indoor- and outdoor- signage with a focus on circularity done by Malmö Stad. The procurement contains the provision of signs, which are supplied by Accus AB, as the product aspect of the PSS. In addition to the product aspect, there are several services that are part of the same offering. Those include project management and consultancy services, cleaning services and repairs, as well as installation and disassembly. In addition to various sustainability criteria, Malmö Stad included circular award criteria in the call for tenders. The suppliers which could provide one or more of three additional services got a discount on their offer. The services were the storage of signs which are not in use, reuse of existing signs, and recycling of signs at the end of their lifecycle. Accus AB could provide all three additional services, thus receiving a 40% discount on their offer. As the procurement focuses on providing the function of signage and navigation in Malmö Stad, the number of signs was not

predetermined but rather evaluated through supplier consultation, this procurement can be classified as a result-oriented PSS.

Case B

This case is the procurement done by Region Gotland from Textilia Tvätt & Textilservice AB. The procurement contains the provision of textiles for the healthcare sector as the product part of the procurement. However, here the ownership of the textiles remains with the supplier. The service aspects of the PSS are delivery, control, sorting, repairs, purchasing, post-treatment, and a washing service. It is further stipulated in the contract that Textilia Tvätt & Textilservice AB has the general responsibility for the textile management of Gotland's textile stock and its quantity and quality. As the type of product is defined in the contract but the ownership and responsibility remain at the supplier, this case can be classified as a use-oriented PSS.

Case C

This case is the procurement done by Nynäshamns kommun from Inrego AB. It covers the sale of refurbished computers as the product aspect of the PSS. The service aspect is an agreed takeback and reconditioning or recycling of the computers plus a de-identification and security clearance of the products. This approach was chosen with the goal to achieve lower costs and environmental impacts. Furthermore, data reporting on saved materials and carbon emissions were agreed upon. As this procurement involves a sale with added services, this case can be classified as a product-oriented PSS.

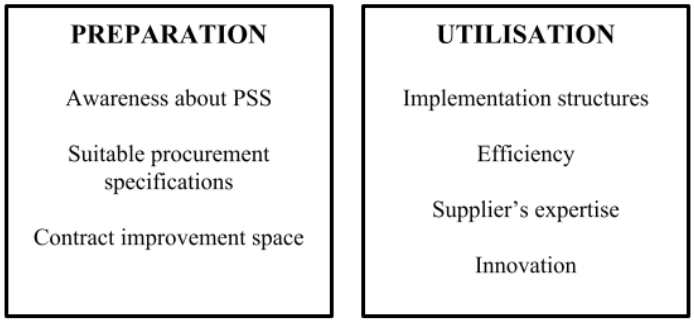
Case D

This case is the procurement of cleaning machines by Jönköpings kommun from Supplies Direct Malmö AB. The procurement consists of two different types of product provision by the supplier. For smaller machines, a traditional sales model covers the product part, whereas for larger cleaning machines a functional rental model was agreed upon. This means that the specific product was not defined in the contract and the supplier can decide which product to supply as long as it applies to the contractually defined specifications. This research focused mainly on the functional rent. In addition, the procurement contains maintenance and repair services of provided machines and machines in Jönköping's inventory, purchasing of spare parts, and training for cleaning personnel using the machines. Special in this contract is further that the provision of the machines includes the option for used machines. The procurement did

not specify the number of machines to purchase but it was identified through an inventory by the supplier after the contract was awarded. Because of this and the functional rent, this procurement can be classified as result-oriented PSS.

The thematic coding of the interviews and supporting secondary data resulted in eight themes showing how the procurer-supplier interaction can facilitate the public procurement of PSS. The themes are divided into the preparation phase and the utilisation phase of the procurement as both phases differ vastly in the type of interaction and what it implies. The preparation phase, which is about open, competitive interaction between the procurer and several suppliers features the following three themes: *Awareness about PSS, Suitable procurement specifications,* and *Contract improvement space*. The section on the utilisation phase, which is about the interaction between the particular supplier of the case and the procuring organisation, and its users features the following four themes: *Implementation structures, Efficiency, Supplier´s expertise,* and *Innovation*. Figure 6 summarises the themes identified for the preparation and utilisation phase of public procurement.

Figure 6: Themes



4.1 Preparation phase of public procurement

4.1.1 Awareness about PSS

Procurer-supplier interaction in the preparation phase of public procurement can raise awareness about the possibility to procure or supply PSS. From the supplier perspective, when interacting with the procurers in the preparation phase through a competitive dialogue, they can make the procurers aware that the possibility of procuring PSS exists and what it entails. The supplier in Case C acknowledged that *"it's really good that they're talking to us because they're*

asking things like what kind of services do you provide? How would you suggest the business model to be? How much do you pay?".

Another form of interaction through which the suppliers can raise awareness about PSS is networking. It happens independently from a specific procurement, for example, when participating in knowledge-sharing networks as explained by the supplier in Case A: *"Our owner and CEO, he's always been very active in different forums and seminars […] we did come upon Malmö City in those networks and so that I think that's why they actually maybe saw that […] this could be a procurement."*

From the procurers´ perspective, the interaction in the preparation phase through competitive dialogue can make the suppliers aware of the demand for PSS. A procurer in Case D explained how they used competitive dialogue to communicate their idea about procurement of PSS to the suppliers: *"There was an idea to rent and to open up for used machines […] We often have a thought with us how we want to make it, but then we have to check if it's possible".*

4.1.2 Suitable Procurement Specifications

The procurer-supplier interaction in the preparation phase of the public procurement process was found to be crucial to enhance the quality of the procurement specifications included in the final call for tenders. The interviewees from the procuring organisations highlighted the value of industry feedback to get a better understanding of the possibilities and limitations in terms of sustainability requirements or services for PSS procurement. The procurer from Case A explained this by saying that they *"do a scan of the market and also ask questions about [how the suppliers] see the development here in one year, in two years and four years, and so on".* The procurer from Case D underlined the importance of the interaction in PSS procurement by stating that it is *"important [...] to have a dialogue because that is the base of our understanding of the market and what's possible [...] and what the challenges are for the suppliers".* The most used method of interaction was a competitive dialogue, where the procurers post an invitation to possible suppliers of the specific industry to ask questions, present ideas and gather input from the market. Another method that was mentioned was a request for information which are *"written questions that the suppliers can answer to".*

The supplier side perceived the interaction in the preparation phase as beneficial as they could bring in their perspective, feedback, and concerns. It furthermore allowed them to know what was expected and thus supported their preparatory processes in the business. The supplier in Case B argued that the interaction helped to advocate for sustainability criteria and pointed out that in a PSS procurement, communication is key to sharing the responsibility for the environmental goals of the procurer as well as the supplier: *"The thing is when you purchase something, you have to take responsibility for the environmental impact and that's why the communication is important so we can say our part and they can say their part and we hopefully meet somewhere in the middle".* The importance of interaction regarding the services and circular offerings was also brought forward by the supplier in Case A, when talking about prices and tender evaluation. For previous procurements, the interviewee stated that if *"[they] got procurements and so on, [they] wouldn't actually answer them because it was all about prices, and there the sign market has been developing all over Europe with crazy prices"*. For the procurement with Malmö, it was different because of *"how they evaluated it"*. In the procurement documents, it was stated that the supplier could get up to a 40% price discount on their tender offer if they could fulfil the circular service requirement of storage for signs in circulation, take-back services, and recycling of electronic material, thus making more circular offerings more competitive. The supplier in Case A said that for taking the quality, service, and circularity aspects into account in the contract and in the preparation phase, interaction is important because *"otherwise, I think many sustainable and circular companies would just say: No, the public sector is not for us. But if we have [the] ability to get extra credit […] for actually doing the work […] that would open up more circular companies to actually do more procurements".*

In Case A, Malmö Stad engaged in one more type of interaction in the preparation phase. They drafted a call for tenders and published it for an external review round. The procurer described it as a good tool when the procurer is doing something *"that is a bit new or [is] unsure if the market will respond well".* The interviewee further described that the feedback then helped to refine the criteria for the final call for tenders.

4.1.3 Contract Improvement Space

The previous section discussed the importance of interaction that brings information that can lead to suitable specifications in the call for tenders. This section touches upon the interaction

that can determine how much not to specify and where rooms could be left open for improvements throughout the utilisation phase of the contract. In Case A, the procurer mentioned the importance of this open approach to give greater room for interaction in the utilisation phase: *"And that's also why […] we made this contract in the way it is not very set in the procurement exactly how we should work together and exactly what types of products and how many we will buy of different kinds of signs and so on because […] we didn't know what we really needed. So, we needed to have that openly. And then the interaction is crucial to make it work".* Leaving this kind of room allows for result-oriented PSS, which can change and be adapted throughout the contract. For this, the procurement documents did leave some aspects open but further specified that new products and solutions can be added to the defined basket of goods as long as they perform better in terms of sustainability and as long as the price is on comparable market levels. In Case D, it was also specified that other products and qualities could be added throughout the contract, allowing for result-oriented PSS.

From the supplier side, this was further brought forward as an argument in Case B to allow for a better offering that the contracts *"actually open up for development during the contract time".* Also, in Case A the supplier mentioned the option for result-oriented PSS as something positive: *"I would say the best part of this procurement is because it even says so in the deal that this product should develop over time together […]. That means that we can tweak, come back with a different solution, and so on, as long as it's within the price range".*

The supplier in Case B further mentioned that contracts should be less specific in terms of less individualistic to enhance the efficiency and circularity of the PSS offering: *"One way of actually making a big difference is being less specific when it comes to colour and exact look. […] So that's one way you're actually opening up for reuse of textiles. Then you also have to add that you accept used textiles".* Being less specific allows the supplier to use their products more efficiently. For the supplier in Case B, it means that they can circulate their product beyond one customer and are thus also more flexible. In Case A, it was similarly stated that the products can vary but should not deviate from standard sizes to facilitate the possibility of product reuse and recycling.

4.2 Utilisation Phase of Public Procurement

The importance of procurer-supplier interaction in the utilisation phase of public procurement of PSS varied among the cases. Cases A, B, and D shared extensive insights into the interaction

in this phase. The procurer in Case A even emphasized that "*the interaction […] is most important now when the contract is in place because during the contract management phase, we see the effects of the circular or sustainability criteria*". However, the supplier of the product-oriented PSS in Case C expressed that *"a lot of take backs, they don't really require interaction"* and the procurer from Case C confirmed it by expressing "*we do not have a great need for consulting the company. We have our own department that solves our need for IT-related problems."* Therefore, the next sections mainly elicit the findings from the Cases A, B, and D regarding the facilitation of public procurement of PSS through procurer-supplier interaction in the utilisation phase of public procurement.

4.2.1 Implementation Structures

Both the procurers and the suppliers mentioned that early in the utilisation phase, they interacted in the form of start-up meetings to create structures for the implementation of PSS. In these start-up meetings, they agreed on how to interact further throughout the utilisation phase. The procurer from Case A described that they had *"a startup meeting with the awarded supplier"* where they were *"going through the contract and the terms and also setting up the structures for how to do follow-ups, what kind of meetings should we have, who should be involved".* In some cases, during these start-up meetings, they also discussed how to approach circularity in the utilisation phase, as illustrated by the supplier in Case A: *"We started up and then we had the first few meetings to see how we go about circularity".*

From the supplier perspective, the start-up interaction facilitates the provision of PSS by helping them to decide how to perform their business throughout the contract period. This applied in three of the cases in which the supplier was also supposed to take care of products already used by the procuring organisation. For example, the supplier in Case D explained that during an inventory process which was part of the start-up interaction, they assessed how to use the existing products and how many new products should be supplied: *"we really had a look at each machine and said: this will not last for 6-7 months because it's bad shape. Then we put out a new one instead and then we took back the old one. And there we decide different things. Is it good enough to fix and to sell quite cheap? Or should we do spare parts on it?"*

The same supplier also mentioned the financial implications of the decision about how to conduct the business throughout the contract period: *"I would say, we will not earn money the first years on this contract. Because we have put out a lot of new [machines]. So, I think the last year will be a good year for us, but that's a good investment, I would say."*

While the procurer-supplier interaction was found to be crucial to set up structures for the particular PSS procurement, from the procurer perspective, it is important to ensure that these structures can also be used in the next procurements, regardless of which suppliers win those procurements. The procurer in Case A summarised this by saying that it is important to *"build systems that are resilient, that can live on and are not dependent on one supplier."* Since the structures are complex and costly to implement, the limited timespan of public procurement contracts was mentioned as a barrier by some of the interviewees. In connection to that, the supplier in Case A pointed out the dilemma that for circular public procurement, it would be good to have "*longer cycles*" but that they should not be too long to keep the market "*competitive*".

4.2.2 Efficiency

The interviewees highlighted how the interaction between the suppliers and various actors in the procuring organisation can improve the efficiency of their operations throughout the utilisation phase. The efficiency manifested itself through lower costs, lower material usage, and more circularity.

This for example applies in the use- and result-oriented PSS in Cases A, B, and D, where the supplier informed the procurers about the state of their products and how they are used. In Case D, the supplier *"put in the system where every machine is"* and through this system supported the procurer *"to secure, where they have their machines and that they have control over it"*. The supplier in Case B underlined the benefit of data sharing for the procuring organisation and the users because they *"can now follow up on their personnel to see if they're actually following the principles"*. In this case, the data was further improving the customer experience by providing *"automatic ordering systems"* which analyse the *"usage phase"* of the products.

The information exchange was not only taking place through automatic systems but also in follow-up meetings and regular interactions with procurers and product users on the procuring side. The supplier in Case B stressed the importance and benefit of efficient product usage for the supplier and said that they need *"to have a really, really good dialogue with their customers to make sure that they do not store too many textiles"*. He concluded that *"buying a lot of textiles and not using them [is] bad for business and for the environment".* When providing a use-oriented PSS, retaining ownership, and gaining revenues from the service provision and rental, it is the suppliers *"incentive"* to lower the product use, because in Case B *"the production is the main cost"* and responsible for *"60% - 80% of the negative environmental impact"*.

The supplier in Case A highlighted the cost benefits that they could get from consulting users on reusing or not using signs and said: *"We've saved so much money because we don't need to do new signs. We can just use what they have and […] take the extra hour to see what is needed and be able to charge it".* She emphasized that in the more circular PSS offering, the costs shifted significantly to *"more man hours, but then again less materials".* The cost efficiency of providing a function was highlighted by the procuring side of Case A as well: *"The supplier can then suggest the option that is most sustainable. And that will often save you money as well".* In Case B, the procurers emphasized that the cost savings from shifting the ownership and responsibility to the supplier instead of setting up their own system can be of benefit to the procurer because setting up a system costs *"many millions in the start and you have to have a process to buy new clothes and we have a lot of [other] investment needs"*. Authorities with smaller budgets and fewer resources can therefore benefit from PSS.

The procurer in Case D pointed out that another benefit of PSS was *"to be more flexible. If our needs change that we close the school or we open up a new one […] we are more flexible in our machine park in that way. So that we don't have machines doing nothing".* In the use-oriented PSS environment, the procuring side from Case B argued that through the standardized products which were touched upon in the findings in the Contract Improvement Space, it is *"easier to have everything in stock that the personnel needs"* as the standardized sizes fit more people. It further can increase the circularity of the products and flexibility for the procurer of the stock. The interviewees referred to a previous procurement with the same supplier and stated that the products were very easily available since the supplier could *"send more because someone else in the shared stock maybe used a little less".* The new contract in Case B used a

new standard for textile sizes, which was not yet widely adopted in other municipalities. This made it impossible to share the same textile stock with other municipalities, showing how the application of different standards can limit PSS efficiency.

Beyond the economic efficiency and material efficiency mentioned, both sides interact to assess and further develop circularity. The procuring side in Case A was in the process of a *"life cycle assessment comparing different circular strategies"* in order to *"evaluate what gives most effects when it comes to reducing CO2 emissions, but also reducing material use".* This evaluation can provide both the procurer and the supplier with insights into which services in the PSS offering make the most sense from an environmental perspective. And that is important for the procurers as was described by the procurer from Case D: *"The most important thing and why we want to rent things is to make the lifespan of the product as long as possible […] The end goal is to minimize waste".*

The findings in this theme thereby show that the procurer-supplier interaction facilitates an improved service provision in the PSS, which can lead to higher cost efficiency and lower material usage on both sides. The procurers can lower their cost and waste, can improve operations and circularity based on information and data exchange, and in the result-oriented PSS cases show a higher flexibility. The suppliers can also improve their operations, lower their costs, and shift from material costs to labour costs. They can scale solutions with a lower material footprint and reduce waste, as the revenues come from service provision, monthly rental fees, or consultation and less from product sales.

4.2.3 Supplier´s Expertise

Both procurers and suppliers strongly emphasized that when interacting in the utilisation phase, the suppliers could use their expertise to improve the public procurement of PSS.

Firstly, both sides acknowledged that the supplier could advise which solution is needed in specific situations better than the procurer. One reason is that the procuring side might not have the necessary competencies, as brought up by the procurer in Case B: "*I think, we don't have the competence to buy our clothes. So, I think it's better that the company who works with it every day takes that decision."* Another reason is that throughout the contract period, some solutions might become more important than the procurer originally assumed. The procurer in

Case A illustrated this by saying: "*We thought that storage was a big thing, but it turned out that doing repairs and refoliation on site is something that we use more in this contract."* In Case D, the procurer explained that the users of the procurement might know the function which they need but not exactly which solution is the best fit to perform it. So, the users can tell the supplier that they *"need sort of this kind of machine, we have this area [to be cleaned]"* and then the supplier *"can give you advice*". Similarly, the supplier in Case A emphasized that the users *"don't know what products they need or not need. So, for us actually the main thing has been turning down signs to see you don't need this one, you need this one."*

Secondly, the procurers in Cases A, B and D agreed that the users of the procurement do not focus on circularity but on the usability of the solutions. For example, the procurer in Case B mentioned that "*one aspect is the sustainability […] and one other part is for the employees of the hospital to put forth their opinions like the fit of the garments on the body, like if it's good or not".* Therefore, it is crucial that the supplier promotes circularity when interacting with the users in the daily utilisation of the procurement. This view was also reinforced by the supplier in Case A: "*our contact persons are mostly the graphical persons, so it's always the graphical interface that's important […] the circularity is from us as a supplier to remind them all the time."*

Thirdly, by providing education and training to the users, the suppliers use their expertise to facilitate the public procurement of PSS. In Cases B and D, it was incorporated in the procurement document that the supplier should provide education and training to the users. The interaction between the supplier and the users of the procurement in the form of education and training avoids misuses of the PSS such as careless handling. The supplier in Case D elaborated that they do not experience careless handling with their machines because they *"educate the ones that are operating the machines […] to handle the machines in a good way in order to make them last longer."* Similarly, the supplier in Case B explained how they avoid actions which would undermine the procurement of PSS by having a *"good dialogue with our customers to make sure that they do not store too many textiles in cupboards […] that individual persons don't store textiles or misuse textiles, destroy textiles".* And the procurer in case A added that when their supplier promotes circularity in the interaction with users, it brings *"education and the behavioural change […] that can kind of like sprinkle to other buying behaviours as well."*

From the procurers´ perspective, it is beneficial when the suppliers bring their knowledge to the interaction because the procurers can get advice for the best solutions to meet their needs. They can also get the users of the procurement on board with the circular aspects of the procurement.

From the suppliers´ perspective, it is beneficial to bring their knowledge to the interaction because they can advise the best solution to use in specific situations. They can also promote circularity and educate on correct usage, which allows the suppliers to improve their processes, a topic discussed in the section devoted to Efficiency.

4.2.4 Innovation

As explained in the theme Contract improvement space, it is important to leave an innovation space within the contract, especially when procuring result-oriented PSS. While in the preparation phase the procurer-supplier interaction can ensure that there will be room for innovation in the contract, in the utilisation phase, the procurer-supplier interaction can use this innovation space to develop new solutions. The experience with development work was brought up by procurers and suppliers in Case A and Case D, which were procurements of result-oriented PSS.

From the procurers´ perspective, it can be beneficial to set up a development group consisting of relevant actors from both the procuring and the supplying side to develop solutions which were not available when starting the procurement process. In Case A, the procurer explained that their development group focused on developing "*a standardized product range"* which was "*very important for [them] to have*". In addition, it also needed to be a "*circular product range*" which highlights that the contract improvement space can be used to deliver more circular solutions. Similarly, the procurer in Case D mentioned that during follow-up meetings, they discuss the possibilities to implement new solutions which would improve the sustainability of the procurement: *"Does the supplier see things we can change to make it more sustainable? […] If they have something that's a good idea and that works for the users, that's maybe something we can adjust in terms of what product we have or the service or a small adjustment in the contract."*

From the supplier perspective, the interaction in the utilisation phase allowed them to propose new, better, solutions as emphasized by the supplier in Case A: "*it's an ongoing dialogue […]*

that makes us doing a better job because we can change it. I don't have to sell a bad sign just because someone said it one time ago. If we have a better material, I can now come to Malmö and say, hey, we used to do it this way, but now I want them to do it this way and they can say yes or no." Furthermore, the supplier in Case A mentioned that the interaction also let them to "*do trial and error*" with the procuring organisation to test new solutions. This was confirmed by the procurer in Case A when saying that the supplier can "*develop circular solutions in […] a safe environment and to test out things that is a huge risk to do otherwise*".

The supplier in Case A also mentioned the benefit of applying the learning gained throughout the development work with the procuring organisation to their private sector offering. Similarly, the procurer in Case A aimed to apply the learning gained throughout the interaction in this procurement into the next procurements: "*the goal here is to learn how does this collaboration or supplier-buyer interaction differ from a regular contract and what can we learn from that and what can we take with us into other procurements*."

5. Analysis

This chapter analyses the findings of the study with the help of the reviewed literature for both the preparation and utilisation phase of PSS public procurement. The chapter ends with a proposed framework, highlighting forms and outcomes of procurer-supplier interaction facilitating the public procurement of PSS.

The findings from this research contribute to the emerging literature on public procurement of PSS. The literature reviewed in the frame of reference was used to analyse the findings of this study. Some of the findings relate to the reviewed literature, whereas others bring new perspectives not addressed by the reviewed literature. Overall, the findings related to the preparation phase of public procurement are reinforced by the reviewed literature more than the findings related to the utilisation phase.

5.1 Preparation Phase of Public Procurement

The findings show that the procurer-supplier interaction in the preparation phase of public procurement can have various forms. Competitive dialogue is a form of interaction, which has been identified in the findings of this research and previous literature (Ntsondé & Aggeri, 2021; Rainville, 2021; Sönnichsen & Clement, 2020). In addition, this research shows that procurers and suppliers can also interact through a request for information and an external review round. Another form of interaction, which can influence public procurement but is not connected to a specific procurement, is networking. The findings further show how the procurer-supplier interaction in the preparation phase can facilitate public procurement of PSS.

Firstly, this research found that procurer-supplier interaction in the preparation phase of public procurement can facilitate public procurement of PSS by raising awareness about the possibility to procure or supply PSS. In the reviewed public procurement literature, knowledge and awareness about Green, Sustainable, or Circular Public Procurement were found to influence whether procurers pursue these kinds of procurements (Brammer & Walker, 2011; Cheng et al., 2018; Sönnichsen & Clement, 2020). Therefore, given that the public procurement of PSS belongs to Circular Public Procurement (Alhola et al., 2019), it is important that the procurer-

supplier interaction can raise awareness of the procurers about the possibility to use PSS. On the other hand, the reviewed literature did not discuss the reversed situation in which the procurer makes the supplier aware of the possibility to supply PSS. Yet, the findings in this research show that the awareness of both the procurers and the suppliers can be raised through the procurer-supplier interaction in the preparation phase and thus facilitate public procurement of PSS.

Secondly, it was found that procurer-supplier interaction in the preparation phase can facilitate public procurement of PSS by defining suitable procurement specifications. The need for this was emphasized by several authors in the reviewed literature as one of the key determinants of successful Circular Public Procurement and Public Procurement for Innovation (Georghiou et al., 2014; Kristensen et al., 2021; Uyarra et al., 2014). In the literature, it was also argued that an early procurer-supplier interaction enables the procurers to get insights from the market, which then help them to define suitable procurement specifications (Adjei-Bamfo et al., 2023; Sönnichsen & Clement, 2020; Uyarra et al., 2014). This is in line with this research, which found the same phenomenon in the public procurement of PSS. From the supplier perspective, the findings show that the interaction with procurers in the preparation phase helps them better understand procurers´ needs and tailor the offer according to the procurement specifications. This benefit was mentioned by the PSS literature in relation to the utilisation phase of PSS in the private sector context, where continuous feedback from customers helped the suppliers to adapt the products and services accordingly (Raddats et al., 2019; Reim et al., 2015; Tukker, 2015). The findings of this research thus show that a similar benefit can be obtained through interaction with the public sector, and already in the preparation phase.

Thirdly, the research found that the procurer-supplier interaction can facilitate public procurement of PSS by not only defining clear specifications but also by leaving some aspects of the procurement unspecified. As pointed out by Schiele (2020), in public procurement, the extent to which products and services supplied can be changed is limited by the procurement contract and tender specifications. Therefore, Uyarra et al. (2014) advocate that procurer-supplier interaction is needed in the preparation of Public Procurement for Innovation in order to avoid the call for tenders being too specific, without room for development. This research shows that such a need is also present in the public procurement of PSS, especially result-oriented PSS. Both the procurers and suppliers can benefit from a contract enabling innovation, the development of which is analysed in the utilisation phase.

The only outcome of procurer-supplier interaction in the preparation phase which was identified in the reviewed literature (Adjei-Bamfo et al., 2023; Alhola et al., 2019; Reim et al., 2015; Uyarra et al., 2014) but did not emerge from the findings is risk reduction on the supplier side. The reason for this might be that unlike in a private sector procurement of PSS, in the public sector, the procurers cannot interact only with one supplier and cannot guarantee that this supplier's offer will win in the tendering phase. Therefore, the supplier´s risk associated with offering new approaches such as PSS cannot be reduced. And unlike in the reviewed articles on Public Procurement for Innovation, which mentioned risk reduction (Adjei-Bamfo et al., 2023; Alhola et al., 2019; Reim et al., 2015; Uyarra et al., 2014), the suppliers in the cases studied in this research were primarily supplying their established PSS offerings. This mean that they were not developing new solutions before the procurement, for which they would need assurance from the procurers in the preparation phase to reduce the risk of development.

5.2 Utilisation Phase of Public Procurement

The utilisation phase begins after the contract is awarded to the supplier. Here, the interaction in the form of start-up meetings was found to be crucial for the setup of structures and systems. Especially in the use-, and result-oriented PSS cases the initial interaction gives the suppliers a better foundation for their planning. They get a better understanding of the procuring organisation’s inventory, discuss, and define the products that are needed and set up deliveries, services, and data management systems. This higher complexity was mentioned as an initial risk in this study, which means an initial investment that takes time to amortize and turn profitable. This follows the argument from the PSS literature highlighting that the transition and implementation of PSS poses a financial risk but can turn profitable in the long run (Baines et al., 2007; Tukker, 2015).

Data-sharing systems for inventory, product, and service provision were emphasized as another form of interaction. The findings bring forward a dilemma, which relates to the limited length of the procurer-supplier partnership mentioned by Schiele (2020). On one hand, data-sharing systems were found to be crucial and valuable for the provision of PSS and achieving higher circularity. On the other hand, those systems can be costly and need to be set up so that they also work independently as long partnerships cannot be guaranteed. This means that the supplier should not become dependent on a procurer’s system and vice versa. Some interviewees mentioned that longer contracts could make it more viable to implement complex systems, but pointed out that they also should not be too long to not disturb market competitiveness.

Another finding from the utilisation phase is that the procurer-supplier interaction can lead to higher efficiency, both in terms of money and material usage. This is desired by both sides in the PSS procurement to lower costs and enhance circularity, supporting sustainability goals and targets. The interactive efficiency is facilitated through data sharing, follow-up meetings, and direct interaction between the supplier and users. Usage data can help the supplier to optimize service cycles and product stock, reducing idle products as seen in Cases B and D. As mentioned by Reim et al. (2015), it is the suppliers' incentive to prolong the lifecycle and to lower material usage as it turns into a cost factor, when ownership remains at the supplier. Reim et al. (2015) further argued that in result-oriented PSS, the supplier´s incentive to lower material usage is the highest. The findings of this study support that explicitly in Case A, where the supplier in many situations consults with the users to reuse products already in place or advises them to purchase fewer products overall. This can provide a new perspective on the mentioned barrier to Circular Public Procurement, which is that the costs are perceived to be higher for circular and sustainable products (Brammer & Walker, 2011; Cheng et al., 2018). While this might be the case for a single product, in this case of result-oriented PSS, it can be cheaper overall and throughout the lifecycle.

Bustinza et al. (2019) highlight the benefit of adjustments of processes for increased customer value through interaction with the procuring organisation. Accordingly, the findings show that the procuring organisations appreciate the flexibility and adjustability of the product amount through rental such as in Case B and D, or through product storage such as in Case A. This leads to more efficiency as the PSS can adjust to changes in demand and does not lead to the procurer having idle machines if they would not need them anymore. However, to make such adjustments possible, it must be specified in the contract.

In the reviewed literature, Tukker (2015) mentioned a possible disadvantage of PSS and argued that if the users do not have ownership, this can lead to them treating the products with less care. While this was also pointed out by one supplier who argued to set strict criteria in the contract to prevent misuse, other interviewees highlighted the importance for the supplier to interact with the users directly and make use of supplier´s expertise. Through the iterative interaction mentioned by Lingegård (2020), the supplier can gather information on how products are used through their data collection and during inspections when maintaining the products. Those insights can be used in follow-up meetings. It was further found to be helpful

to provide education and training to increase the probability of better usage that prolongs the product life cycle.

One finding from the utilisation phase which was not identified in the reviewed literature is the importance of supplier´s interaction with the users from the procuring side. While the procurements stipulated circularity requirements and it is in the interest of both the procurer and the supplier to enact them, this study found that to make this work, behavioural change is needed also for the product users in the municipalities. They were often found to be mainly concerned with the useability of the products or were not aware of the circular options. Therefore, the interaction with the suppliers can facilitate the uptake of the services and a more circular PSS. The supplier acts as an advisor, promoting reused products, where applicable, and promoting that take-back services are used. This goes even further in Case A, where the supplier in some cases was found to consult the users not to get a product at all but to rethink the product usage. Beyond the advisory role of the suppliers in terms of circularity, the findings further showed that the suppliers of PSS can consult both the procurers and the product users on the most suitable solution regarding, for example, product choice, product usage, and servicing.

In a PSS, where the ownership and responsibility remain with the supplier, it was further found that the suppliers with their expertise can improve the processes if they are contractually given leeway to do so. Here again, it is less likely to be misused as the incentive is not to sell as many products as possible but rather to fulfil the rental or the function demanded, making efficiency more attractive.

PSS procurements offer the possibility for innovation if allowed for in the contract. The literature on Public Procurement for Innovation states that for innovation to happen, procurer-supplier interaction and risk management are of high importance (Adjei-Bamfo et al., 2023; Georghiou et al., 2014; Uyarra et al., 2014). The findings of this study go in line with that as they point out that new solutions can be created through development groups, such as in Case A. Improvements can further be discussed in follow-up meetings such as in Case D, where suggestions can be made. This benefits the procuring organisations as they can get potentially better and more circular solutions, leading to potentially higher customer satisfaction and value (Bustinza et al., 2019). The suppliers benefit as they can through constant interaction improve and innovate throughout the contract, which can help them financially and in terms of their sustainability ambitions in the contract. But furthermore, it was found that the improvements through continuous feedback and interaction, and the learned processes can improve the

supplier's business overall, as they can apply the learnings to other contracts and their private sector offerings. The procurers can improve their internal processes and apply learnings to future procurements. While the risk of the limited contract lengths remains for implementing complex systems (Schiele, 2020), the findings show that if a public procurement creates space for it, it can also act as a safe testing ground for new and circular solutions. It, therefore, can account for the innovation risk mentioned in the PSS literature (Adjei-Bamfo et al., 2023; Alhola et al., 2019; Reim et al., 2015; Uyarra et al., 2014).

Several findings of this study confirmed various aspects of procurer-supplier interaction from the reviewed PSS and public procurement literature. However, some aspects cannot be transferred to the combined setting of public procurement of PSS. In the utilization phase, this is the case for customer retainment, which is pointed out as a benefit of PSS by Bustinza et al. (2019). As expected, in the public procurement setting, the suppliers cannot retain customers because a new, competitive public procurement process has to be done after contract expiration.

5.3 Framework for Procurer-Supplier Interaction Facilitating Public Procurement of PSS

The findings of this research can be summarised in a framework showing how procurer-supplier interaction can facilitate public procurement of PSS (see Figure 7). The framework has a similar structure to the conceptual framework introduced in the section about Conceptual Framework. However, the conceptual framework was developed based on reviewed literature on PSS, Circular Public Procurement and Public Procurement for Innovation. Whereas the framework resulting from this research is based on empirical findings in the specific context of public procurement of PSS.

The top part of Figure 7 shows the three public procurement phases, namely preparation, tendering, and utilisation. As clarified in the Frame of Reference, procurer-supplier interaction is forbidden in the tendering phase of public procurement.

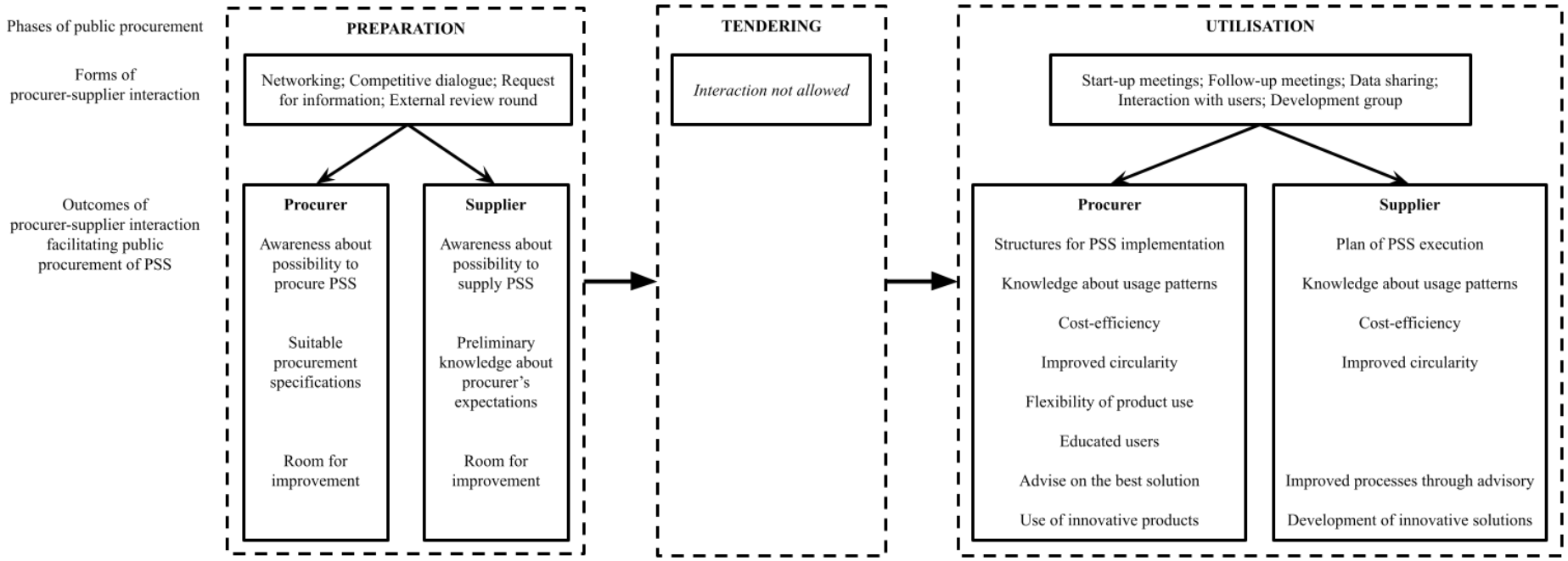
The middle part of Figure 7 shows the forms of procurer-supplier interaction which were identified by this research. In the preparation phase, the procurers and suppliers can interact in the form of networking, competitive dialogue, request for information, or external review

round. In the utilisation phase, the procurers and suppliers can interact in the form of start-up meetings, follow-up meetings, data sharing, interaction with users, or development groups.

Most important is the bottom part showing the outcomes of procurer-supplier interaction facilitating the public procurement of PSS. In the preparation phase, the procurer-supplier interaction can raise the awareness of procurers about the possibility to procure PSS and of the suppliers about the possibility to supply PSS. Being aware of the possibility to procure or supply PSS is a prerequisite for making public procurement of PSS happen. Therefore, it facilitates this type of procurement. Next, the interaction can help the procurers to define suitable procurement specifications. Defining specifications which allow and even encourage public procurement of PSS facilitates such a procurement. The interaction can also equip the suppliers with preliminary knowledge about the procurer´s expectations. When the suppliers know about the PSS expectations of procurers, they can tailor their offers accordingly, which again facilitates public procurement of PSS. Lastly, thanks to the procurer-supplier interaction in the preparation phase, the suppliers can propose where to leave room for innovation in the procurement specifications, and the procurers can incorporate this feedback. In this way, it can facilitate public procurement of PSS solutions, which would be developed or adjusted in the utilisation phase.

In the utilisation phase, the procurer-supplier interaction can help the procurers to set up structures for PSS implementation. It can also help the suppliers to plan the PSS execution throughout the utilisation phase, thus facilitating this type of procurement. Next, thanks to interaction, both the procurers and the suppliers can gain knowledge about the usage patterns of the PSS solutions, make the public procurement of PSS cost-effective and improve the circularity of the procurement. In addition, on the procurer side, the interaction can help them to use the products more flexibly, which is again making the public procurement of PSS easier for them. The interaction can also help to train and educate the users of the PSS procurement, which is yet another facilitator. Furthermore, thanks to the interaction, the procurers can get advice on the best solution for specific use cases, which makes the execution of the PSS procurement easier. Similarly, by providing the advisory through interaction, the suppliers can improve their processes for providing PSS to the procuring organisation. Lastly, the procurer-supplier interaction in the utilisation phase can allow the suppliers to develop innovative products and can help the procurers to get access to them, both of which facilitate public procurement of PSS

Figure 7: Framework of procurer-supplier interaction facilitating public procurement of PSS



6. Discussion

This chapter brings forward theoretical contributions and practical implications of the study. It further shows limitations and suggests departing points for future research.

6.1 Theoretical Contributions

This thesis contributes to the emergent research on public procurement of PSS. The study highlights the role of procurer-supplier interaction by proposing a theoretical framework that outlines different forms of interactions found in the procurement process as well as how the interaction facilitates the PSS procurement for both sides. It therefore empirically explores a topic, which was highlighted as important in the public procurement and PSS literature, by providing insights from four PSS cases in the context of procurements done by Swedish municipalities.

The theoretical contributions of this study are threefold. Firstly, it contributes by confirming facilitating factors from the PSS and the public procurement research streams which apply in the combined setting. Secondly, the study brings forward new aspects regarding procurer-supplier interaction that have not been identified in the reviewed literature. Lastly, the study also highlights aspects, which cannot be transferred to the public procurement of PSS from the reviewed literature.

6.2 Practical Implications

The research provides insights into how the interaction between the procuring organisation and suppliers can help the procurement and provision of PSS and can thus be valuable for procurers and suppliers alike. Procuring organisations who have not procured PSS before but are looking at the option in order to support regional circularity ambitions, can be informed by the findings of this study on how interacting with suppliers can help in PSS procurement. Furthermore, they can learn about some forms of interaction and how they could support them in the process. This study can support suppliers with a PSS offering by pointing out several possible ways of creating awareness about and improving the PSS offering through interaction with a procuring organisation.

Procuring organisations and suppliers, who are already involved in PSS procurements, can take this study as an inspiration to learn from other cases and to see if there are ways of interaction that are not used yet, which could provide possible improvements in the future.

6.3 Limitations

This research does not come without its limitations. The specific aim of the thesis was to find forms and factors of procurer-supplier interaction which facilitate PSS procurement. It is thereby to point out, that the research did not compare PSS procurement to product procurements and that some of the findings from this research might therefore not be solely applicable to PSS. While the study in some cases points out how public procurement distinguishes itself from private sector procurement, the research is only focused on public procurement and does not explore any comparisons between the two sectors. Furthermore, the study is only exploring forms and outcomes and is neither quantifying the outcomes in terms of importance nor claiming to provide a full set of them.

The study is further limited by only investigating the procurer-supplier interaction. Other forms of interaction such as internal interaction inside the organisations as well as intraregional interaction between regional authorities came up during the interviews as another facilitator but were not discussed in the scope of this study. The same applies to other variables which might facilitate the procurement of PSS.

While the methodology of a case study was purposefully chosen to explore the phenomenon with rich data in four cases, the choice of methodology limits the study in a few ways. Firstly, case studies are limited in their generalizability, as they only cover a few cases (Yin, 2018). Secondly, the cases selected range across different organisation sizes, different industries, and types of PSS. It is therefore possible that some findings from this research might not apply to all cases of public procurement of PSS. Thirdly, the case selection is only covering procurements from Swedish municipalities and therefore the findings could differ for national procurement agencies or in different countries, where there might be either more options or limitations through different legislation.

6.4 Future Research

Future research can build on the framework and findings of this study and develop the research of PSS public procurement further. Studies could explore the procurer-supplier interaction in different regional contexts and on a national level. They could further test the findings for specific industries, specific procurer and supplier sizes, or only focus on one type of PSS. When there is a higher uptake in PSS procurements, quantitative studies could help to weigh the importance of certain forms of interaction in regard to facilitation of PSS procurements, and test for correlations between certain forms of interaction and other factors such as cost efficiency and circularity or compare the interaction to product procurements. Lastly, future research can develop the framework further, adding different forms of interaction and their implications for PSS facilitation.

7. Conclusion

This chapter concludes the findings of this study, highlighting how procurer-supplier interaction can facilitate public procurement of PSS.

The purpose of this study was to explore how the interaction between the procurer and supplier throughout the public procurement process can facilitate public procurement of PSS. The study fulfils its purpose by proposing a theoretical framework which shows the facilitation in two phases of the procurement process – the preparation phase and the utilisation phase.

In the preparation phase, the procurer-supplier interaction can increase awareness of the procurers and suppliers about the possibility to procure or supply PSS in the public procurement context. The interaction can further help the procurers to define suitable procurement specifications which however leave room for sustainable innovations.

In the utilisation phase, the procurer-supplier interaction can help the procurers to set up structures for PSS implementation and the suppliers to plan the PSS execution. The procurers and suppliers can gain knowledge about the usage patterns of the PSS solutions, make the public procurement of PSS cost-effective and improve the circularity of the procurement. In addition, on the procurer side, the interaction can help them to use the products more flexibly. Through the interactive process, the suppliers can advise procurers on adequate solutions for various use cases and train and educate end-users of the PSS. This benefits the procurers but also the suppliers as they can improve their processes through continuous feedback. Finally, the procurer-supplier interaction in the utilisation phase can allow the suppliers to develop innovative solutions and can help the procurers to get access to them.

Overall, this study shows that the interaction between public sector procurers and suppliers can bring many benefits for both sides in PSS procurements and was found to be crucial to make PSS procurements happen and to increase their quality.

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Appendices

Appendix A – Interview Questions for Procurers

Introduction:

1. Can you tell us a bit about yourself and your work at (*municipality*)?

Decision to procure PSS:

2. Why did (*municipality*) decide to procure (*PSS*) rather than just the (*product*)?

Circularity of the procurement:

3. Can you tell us about the circularity (*or sustainability or environmental*) requirements of this procurement?
4. Can you tell us a bit more about the award criteria in this procurement?
    a. Was the contract awarded based on purchase price?
    b. Was the contract awarded based on life-cycle costing?
    c. Was there any weighting of circularity (*or sustainability or environmental*) criteria?
5. Can you tell us more about the goals for gradual development of (*circularity or sustainability or environmental requirement*)?

Procurer-supplier interaction:

6. Can you tell us about the interaction between (*municipality*) and (*supplying company*) or other suppliers before the procurement?
    a. Was there any competitive dialogue?
    b. Did you send out RFIs?
    c. What role did circularity (*or sustainability or environmental aspects*) play in the pre-procurement interaction?
7. Can you tell us about the interaction between (*municipality*) and (*supplying company*) right after the contract was awarded to (*supplying company*)?
8. Can you tell us about the interaction between (*municipality*) and (*supplying company*) now in the use-phase?
    a. Are there any feedback meetings?

b. What role does circularity (*or sustainability or environmental aspects*) play in these interactions?

9. Is (*municipality*) trying to improve circularity (*or sustainability or environmental aspects*) of the procured products and services together with (*supplying company*)?
    a. If yes, how?
10. How did the interaction with (*supplying company*) help (*municipality*) to do a procurement of a set of products and services with circular aspects?

Alternative questions:

11. What role did interaction with (*municipality*) play in general in the procurement?
12. How has the interaction between (*municipality*) and (*supplying company*) influenced the circularity (*or sustainability or environmental aspects*) of the procurement?
13. How has (*municipality*) benefitted from the interaction with (*supplying company*)?
14. How has the interaction with (*supplying company*) helped (*municipality*) to move towards its circularity (*or sustainability or environmental*) ambitions?

Appendix B – Interview Questions for Suppliers

Introduction:

1. Can you tell us a bit about yourself and your work at (*supplying company*)?

Offering of (*supplying company*):

2. Can you tell us about (*supplying company´s*) offering?
    a. What share of (*supplying company´s*) business is in the public sector market?
3. Can you elaborate on the (*specific PSS offering of the supplying company, e.g., rental of cleaning machines)?*
    a. Can you tell us what this offering implies for (*supplying company*) in terms of business?
    b. Can you tell us what this offering implies for (*supplying company*) in terms of circularity (*or sustainability*)?

Supplying to (*municipality*):

4. Can you tell us about supplying to (*municipality*)?
5. We saw that in the procurement document from (*municipality*), one of the requirements was (*specific PSS requirement*), can you elaborate on that?
6. Can you tell us about the role of circularity (*or sustainability*) in this procurement?

Procurer-supplier interaction:

7. Was (*supplying company*) part of any interaction with (*municipality*) before the procurement?
    a. Was there any competitive dialogue?
    b. Was there any RFI?
    c. What role did circularity (*or sustainability or environmental aspects*) play in the pre-procurement interaction?
8. Can you tell us about the interaction between (*supplying company*) and (*municipality*) after the contract was awarded to (*supplying company*)?
9. Can you tell us about the interaction between (*supplying company*) and (*municipality*) now in use phase?
    a. Are there any feedback meetings?

b. What role does circularity (*or sustainability or environmental aspects*) play in those interactions?

10. How has (*supplying company*) benefitted from the interaction with (*municipality*)?

Alternative questions:

11. How has the interaction with (*municipality*) helped (*supplying company*) to perform your offering of a set of products and services?

Appendix C – Case organisations

Case A – procurer: Mälmo Stad

Malmö Stad is a municipality located in the southern part of Sweden, in Region Skåne (Sveriges Kommuner och Regioner, 2021). As of December 2022, there have been 357 377 inhabitants living in Malmö Stad (Malmö Stad, n.d.-a). In regards to population, Malmö is the third largest city in Sweden and also the fastest growing city (Malmö Stad, n.d.-a). Malmö Stad is the largest employer in the municipality (Regionfakta.se, 2023). Malmö Stad spent more than 5 billion Swedish crowns on public procurement in 2021 (Upphandlingsmyndigheten, n.d.).

The work of Malmö Stad towards sustainability is organised into several different initiatives and goals. The municipality has signed *A declaration of Cities Commitment to the 2030 Sustainable Development Agenda* (Sveriges Kommuner och Regioner, 2019). The municipality has signed *A declaration of Cities Commitment to the 2030 Sustainable Development Agenda*. In connection with this, Malmö Stad developed a *Strategy for localising the SDGs in the City of Malmö* (Malmö Stad, 2022*),* which includes five processes for implementation of Agenda 2030 into local development work in Malmö Stad (Malmö Stad, 2022). To report on the progress of implementing Agenda 2030, Malmö Stad issues sustainability reports (Malmö Stad, 2023a). Furthermore, Malmö Stad participates in various climate- and environment-related networks such as Eurocities, ICLEI or Sustainable Business Hub (Malmö Stad, 2023b). The municipality has also defined twelve goals related to climate and environment (Malmö Stad, n.d.-b).

Malmö Stad translates its sustainability ambitions also to public procurement. It has joined a project called ProCirc which helps the municipality to explore opportunities for circular public procurement (Malmö Stad, 2023c). And their pilot circular procurements within furniture, IT, and signage have been recognised as examples of good practices and awarded various prizes for circular, sustainable or innovative procurement (European Commission, 2019; Procura+, n.d.; Rivera, 2021).

Case A – supplier: Accus AB

Accus AB is a Swedish company established in 1965, located in Malmö (Bureau Van Dijk, n.d.). It is a small company with 18 employees and an annual turnover below 30 million Swedish crowns (Bureau Van Dijk, n.d.). The company is privately held and the CEO of the

company is Andre Zandelin (Bureau Van Dijk, n.d.). In the interview conducted for this study, the interviewee from Accus AB stated that the company´s customers are primarily from the private sector.

Accus AB focuses on designing and delivering signage and navigation solutions for indoor and outdoor environments. They created a concept called re:sign, which guides them when offering their solutions. The concept is in line with circularity principles as it consists of reusing, remaking, and recycling products and materials. Accus AB has been recognised for its circularity and sustainability efforts by various awards. Most recently, the company has won the prize titled Preventor of the Year 2021 awarded by Avfall Sverige – Swedish Waste Management. Accus AB won the prize for showcasing how products can be developed to fit into the circular economy and prevent waste. (Accus AB, n.d.)

Case B – procurer: Region Gotland

Region Gotland is both a municipality and a region at the same time, and it is located on the Swedish island of Gotland (Sveriges Kommuner och Regioner, 2022).(Sveriges Kommuner och Regioner, 2022). As stated in the procurement documents used in this study, the population in Region Gotland is around 60 000 inhabitants, and the municipality is the largest employer on the island, with approximately 6 900 employees. Region Gotland spent more than 1 billion Swedish crowns on public procurement in 2021 (Upphandlingsmyndigheten, n.d.).

Regarding sustainability, Region Gotland has the ambition to become an ecologically sustainable society by 2025. In connection with this, the municipality focuses on improving sustainability in four areas – Energy and Climate, Water, Sustainable choices, and Nature´s diversity (Region Gotland, 2020)

Region Gotland considers public procurement as one of the tools to reach its sustainability goals (Region Gotland, 2020). Since 2010, Region Gotland is part of Hållbar Upphandling, an organisation uniting Swedish Regions which want to promote sustainable procurement by using a common code of conduct for suppliers (Hållbar Upphandling, 2023).

Case B – supplier: Textilia Tvätt & Textilservice AB

Textilia Tvätt & Textilservice AB is a Swedish company established in 1997, located in Örebro (Bureau Van Dijk, n.d.). It is a large company with more than 600 employees and a turnover of almost 800 million Swedish crowns (Bureau Van Dijk, n.d.). The company is privately held, and the CEO of the company is Kenth Patrick Mattias Olsson (Bureau Van Dijk, n.d.). In the interview conducted for this study, the interviewee from Textilia mentioned that the company´s customers are primarily from the public sector.

Textilia Tvätt & Textilservice AB offers textile services in five areas – healthcare, restaurant, hotel & conference, cleanroom, and food industry. In addition, the company also provides solutions for the distribution of textiles. The company has four sustainability focus areas in its strategy – the environment, reusing and recycling, diversity, and production. They also follow Agenda 2030 and actively work towards 5 of the Sustainable Development Goals. The company is also certified by various certifications, such as the Nordic Swan Ecolabel. An initiative concerning circularity is Textilia Upcy, a clothing line that upcycles used textiles into new products. Textilia has set the goal of becoming climate neutral in 2027. (Textilia, n.d.)

Case C – procurer: Nynäshamns kommun

Nynäshamns kommun is a municipality in the region of Stockholm (Sveriges Kommuner och Regioner, 2021). As of 2022, there have been 30 043 inhabitants living in Nynäshamns kommun, and the municipality is the largest employer in the municipality with approximately 2,000 employees (Nynäshamns Kommun, n.d.). Nynäshamns kommun spent more than 130 million Swedish crowns on public procurement in 2021 (Upphandlingsmyndigheten, n.d.).

Nynäshamns kommun´s sustainability strategy focuses on six areas – Climate and Energy, Ecosystem services and Biodiversity, Community planning and Resource use, Education and Labour market, Public health and Safety, and Human rights and Equality. In all the areas, Nynäshamns kommun sets targets which should be achieved within a specified timeframe.

In two of the areas - Climate and Energy, and Community planning and Resource use – there are also specific targets and strategies for procurement. A circularity-related target is that by 2030 circularity must be considered in the majority of municipal procurements. This means that

it must be documented how circularity was taken into account in the preparation phase of the procurement (Nynäshamns Kommun, 2022).

Case C – supplier: Inrego AB

Inrego AB is a Swedish company established in 1996, located in Täby. It is a medium-sized company with more than 100 employees and an annual turnover below 400 million Swedish crowns. The company is privately held, and the CEO of the company is Johan Henrik Nilsson. (Bureau Van Dijk, n.d.)

Since its establishment, Inrego AB has specialised in buying used IT equipment, refurbishing it, and selling refurbished products. By prolonging the lifecycles of IT equipment and reducing the use of raw materials, the business of Inrego AB promotes a circular economy. The company is also ISO-certified in four areas – quality, environment, data security, and safety. (Inrego AB, n.d.)

In the interview conducted for this study, the interviewee from Inrego AB mentioned that the company also helps their customers to become more sustainable by issuing certificates showing CO_2 savings resulting from selling the used IT equipment to Inrego or buying refurbished equipment from them. And the company´s customers are from both the private and public sector.

Case D – procurer: Jönköpings kommun

Jönköpings kommun is the largest municipality in Region Jönköping (Sveriges Kommuner och Regioner, 2021), with 145 114 inhabitants registered as of December 2022 (Jönköpings kommun, 2023). Jönköping kommun is the largest employer in the municipality, with approximately 15 325 employees (Jönköpings kommun, 2023). Jönköpings kommun spent almost 2 billion Swedish crowns on public procurement in 2021 (Upphandlingsmyndigheten, n.d.).

Jönköpings kommun´s sustainability strategy is based on the 17 Sustainable Development Goals (SDGs) and Agenda 2030. It includes the municipality´s strategies and goals for each of the 17 SDGs. (Jönköpings kommun, 2022)

The sustainability of public procurement done by Jönköpings kommun is addressed mainly under goals number 9 and 12, which concern sustainable production and consumption. In this section, Jönköpings kommun emphasizes the need to apply circularity principles in procurement. It is stated that before each procurement, it must be considered whether i) the new product or service is really needed; ii) it is possible to share or borrow; iii) it is possible to buy or rent used products; iv) it is possible to buy or rent products with bio-based or recycled content. In line with this, it is also stated that in procurement, the focus must be on limiting total material consumption, reducing the amount of raw materials, extending the product lifecycle, and maximising the reuse of components and recycling of materials. (Jönköpings kommun, 2022)

Case D – supplier: Supplies Direct Malmö AB

Supplies Direct Malmö AB is a Swedish company established in 1973, located in Malmö (Bureau Van Dijk, n.d.). It is a privately held small company with around 10 employees and an annual turnover below 40 million Swedish crowns (Bureau Van Dijk, n.d.). In the interview conducted for this study, the interviewee from Supplies Direct stated that the company´s customers are primarily from the private sector.

The company is a wholesaler within the cleaning business, offering cleaning products, cleaning machines, cleaning robots, and work clothes and shoes. In addition, Supplies Direct also offers services related to their products, such as service of cleaning machines, digital solutions, delivery of products, and training courses. Besides product sales, the company also offers rental options. The company offers the rental of machines, repair and maintenance of machines used by their customers and by reuses parts of old machines as spare parts, which can contribute to increased sustainability and circularity of their offering. (Supplies Direct, n.d.)