

THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

From consumption to sharing:
Generating knowledge to support urban governance
of the sharing economy

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Abstract

The Sharing Economy (SE) has emerged as a potential pathway to sustainable consumption in cities, allowing households to access products without making private purchases, and urban governance has been highlighted as crucial for ensuring the sustainability benefits of the SE. To support an evidence-based urban governance of the SE, this thesis aims to generate detailed knowledge about the consumption and sharing of durable household products. Taking Gothenburg, Sweden as a case, the study focuses on three main research objectives: quantifying behaviors and attitudes of the population regarding consumption and sharing; identifying consumption and sharing patterns from the product, demographic, and geographic perspectives; and assessing the potential contribution of sharing to sustainability from the participant perspective. The mixed-methods research design involved collaboration with local government representatives, statistical and qualitative analysis of questionnaire survey data, and the application of an urban material flow accounting method. The analysis reveals that a significant portion of respondents expressed interest in reducing their consumption, but there were varying levels of interest and participation in specific sharing activities. Demographic factors such as gender, age, and education level were found to significantly shape consumption and sharing. For specific product categories, products such as clothes presented higher consumption but lower engagement in sharing, and vice versa for tools and leisure equipment. In the geographical analysis, the maximum consumption levels were seen for clothes (in units) and furniture and household equipment (in kg). The qualitative analysis supported positive perceptions of the SE, emphasizing circularity and cost-saving benefits, but also highlighted challenges such as lack of practicality. These results provide actionable insights for governing the SE while contributing to reducing the fragmentation in the literature regarding the sustainability value of the SE. Future research directions include refining consumption estimations per neighborhood, integrating the sharing dimension into geographical patterns, and developing a library of local sharing initiatives and potential impacts such as greenhouse gas emissions and material use.

Keywords: sharing economy, sustainable consumption, urban governance, household consumption, survey methodology, statistical analysis, qualitative analysis

List of publications

This thesis is based on the following work:

- Jiménez Encarnación, D., Metheney, E. A., Thuvander, L., Kalmykova, Y., & Rosado, L. (2023). Revealing patterns in household product consumption and sharing: A systemic approach to support urban governance towards sustainability. Manuscript submitted and under review.

Author contribution:

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Other work and publications not appended:

- Jiménez Encarnación, D., Thuvander, L., & Rosado, L. (2023). Sharing and consuming in space – what is important to know for the planning of a Sharing City? (Abstract). To be presented at the 11th International Conference on Industrial Ecology. Leiden 2-5 July
- Jiménez Encarnación, D., Gkagkalidis, G., Rosado, L. (2022). Sharing Economy's contribution to social sustainability and well-being in Gothenburg (Abstract). Oral presentation at the Act Sustainable Research Conference, Gothenburg, 16-18 November
- Patricio, J., Jiménez Encarnación, D., Kalmykova, Y., & Rosado, L. (2021). Top-down method and databases for typical product demands of 103 manufacturing industries. *Resources, Conservation and Recycling*, 164, 105165. <https://doi.org/https://doi.org/10.1016/j.resconrec.2020.105165>

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1. Introduction

1.1. Background

The increasing household consumption rates during the last decade have had important environmental effects, especially at the urban level (Di Donato et al., 2015; Shittu, 2020).

At a global scale, the consumption of manufactured products is responsible for 17% of material footprints and 17% of embodied greenhouse gas (GHG) emissions, with even higher rates within the European Union (Ivanova et al., 2016). Considering the growing environmental degradation, the effects of the increasing household consumption highlight the urgency in transitioning towards more sustainable consumption patterns. However, although many sustainable consumption measures depend on the behaviors of households, it has proved challenging to shift current patterns without governance support (Dubois et al., 2019; Tukker et al., 2010).

The sharing economy (SE) has emerged as a possibility to transition towards more sustainable household consumption patterns. While the precise meaning of the SE is contested, definitions often involve the redistribution of products, services, skills, and spaces through various sharing actions; with the purpose of reducing the time that the assets remain unutilized (R. Botsman & R. Rogers, 2010; Frenken & Schor, 2017). As the SE constitutes a possibility to reduce individual purchases of newly manufactured products, it has been associated to sustainability by, e.g., private individuals, businesses, governmental institutions, and researchers. According to the European Commission (2016c), the SE has the potential of increasing circularity, economic growth, and communities' resiliency, while according to Botsman & Rogers (2010) and Heinrichs (2013), the SE is the "potential new pathway to sustainability".

However, the environmental sustainability of the SE is still uncertain (Codagnone & Martens, 2016). Money saved or generated by using the SE can be invested in more emission- and resource-intensive purchases, or households may incur in new purchases solely to share them (Frenken, 2017). In these cases, trade-offs originate from consumption not being reduced, but rather displaced or increased. Further, trade-offs might also arise if users/consumers travel long distances to access a shared product, causing higher GHG emissions (Demailly & Novel, 2014). In this way, a net reduction of consumption is an important precondition to achieve the sustainability effects of the SE, as well as local sharing transactions. Just as for shifting consumption patterns, governance mechanisms have been identified as essential for leveraging the positive sustainability effects of the SE (Bernardi & Diamantini, 2018; Ma et al., 2018; Muñoz & Cohen, 2017).

Understanding household consumption (i.e., household consumption rates, behaviors and practices, and their environmental effects) is crucial to draft appropriate policies that drive an effective transition towards sustainable consumption patterns (Shittu, 2020). Especially, understanding of local conditions could support policies that reflect the realities of communities more precisely than national policies. In the same way, the generation of information regarding sharing is identified as key for an evidence-based decision making that ensures the sustainability of the SE (European Commission, 2016c; Mi & Coffman, 2019). Thus, generation of actionable information on both consumption and sharing can give local governments the opportunity to govern the SE through various mechanisms rather than only reacting to the challenges that the SE has posed (e.g., the negative effects of Airbnb on housing markets (Voytenko Palgan et al., 2021)). Although research about the sustainability value of

the SE is increasing, these matters have not yet been sufficiently investigated (Frenken & Schor, 2017), particularly how to prevent second-order effects of the SE such as trade-offs (Geissinger et al., 2019). At the same time, it is also recognized that the SE could contribute to other sustainability dimensions (Hossain, 2020), so an effective governance for environmental sustainability could also carry social and economic benefits. As a response, this thesis focuses on generating knowledge to govern the SE towards sustainable consumption in cities.

1.2. Aim and objectives

This work aims to generate detailed knowledge about consumption and sharing to aid local authorities to potentiate the sustainability benefits of the SE through governance.

The aim is to be achieved through the following objectives:

RO1. Quantifying behaviors and attitudes of a city's population regarding consumption and sharing.

RO2. Identifying consumption and sharing patterns from the perspective of household products, demographic groups, and neighborhoods.

RO3. Identifying the potential contribution of sharing to sustainability from the participant perspective.

1.3. Delimitations and scope

The analytical frames in this thesis are based on five concepts: what is considered consumption, what is considered sharing, who consumes/shares, and how is sustainability defined (details about the terminology can be seen in Chapter 2):

While consumption can be conceptualized as purchasing products, using them, and eventually disposing of them (Magrabi et al., 1991), this thesis focuses solely on the first step. Purchases occurring during a reference year will be considered consumption, while those before the reference year are part of the household's stock. Furthermore, only the consumption of tangible and durable products is considered (see comprehensive list in the appendix of the appended manuscript - Table D.1), excluding mobility products. No distinction is made between products purchased nationally or internationally, which in the future can affect the assessment of sustainability impacts.

The definition of SE in this thesis is comprehensive, including any action that activates the idle capacity of products in the household and prevents the private purchase of newly manufactured products (inspired by Muñoz and Cohen (2017), Schor (2014) and Botsman (2013)). Thus, transactions can be permanent or temporary and monetary or non-monetary.

In terms of participants, both individuals and households are included within the roles of user/consumer and provider. The thesis makes no explicit consideration towards "prosumers". Further, the definition of a household is adopted from the Swedish Household Budget Survey (HBS) as "a group of people who live together and have such a common economy that the expenses of the different people cannot be meaningfully separated" (Statistiska Centralbyrån, 2013). This includes families, cohabitants, and single-living individuals.

Finally, a greater focus is placed on exploring environmental sustainability, where a reduction of item consumption will be utilized as a proxy for dematerialization potential. Also, it can be assumed that a reduction of consumption implies a reduction of raw material extraction, greenhouse gas emissions, etc. Social and economic sustainability are addressed briefly in sub-chapter 4.3.

1.4. Research context

This research is part of an ongoing project called “SEsam” and the city of Gothenburg, Sweden, is used as a case. Below, details about the SEsam project, as well as information about Gothenburg demographics, administrative divisions, and relation to the consumption and sharing topics.

1.4.1. SEsam project

The aim of the SEsam (“Sharing Economy sustainability assessment method to support the implementation of SE initiatives”) project is to develop a method that quantifies the environmental impact of consumption in different households, describes consumption in different geographic areas, and proposes appropriate sharing initiatives (SIs) according to their potential sustainability impact (described in sub-chapter 3.2.2). This information is meant to provide cost-effective guidance for local strategic decision-making (Whetstone et al., 2020). Within the SEsam project, a collaboration with the city of Gothenburg was established to connect to the Sharing Cities Gothenburg (SCG) (see below).

1.4.2. Gothenburg

Gothenburg is the second largest city in Sweden, with an approximate population of 590.000 and a household count of 270.000. As of May 2023, Gothenburg is divided into four districts (i.e., *stadsdel* in Swedish) (Northeast, Center, Southwest, and Hisingen), 36 intermediate areas (i.e. *mellanområde* in Swedish), and 96 neighborhoods (i.e. *primärområde* in Swedish).

In Gothenburg, 45% of the households are composed of one person. Only 23% of the households include children, while almost half of the population is between 30-64 years of age. The median income per person in 2022 was approximately 330.000 SEK/year, and about 38% of inhabitants over 18 years have post-secondary education levels (Göteborg Statistik och Analys, 2021). Although Gothenburg belongs to a region with a very high human development index (HDI) (Global Data Lab, 2021), it is amongst the most severely segregated cities in Europe (Östh et al., 2015; Thörn & Thörn, 2017). Therefore, there are differences in socioeconomic trends across Gothenburg’s areas.

In Sweden, the Sustainable Development Goal (SDG) 12 – Sustainable consumption and production is one of the most challenging to achieve due to high incomes and private consumption levels (Göteborg Stad, 2021). Sweden has also consistently been amongst the highest consumers in Europe (Eurostat, 2022). Because of this, Gothenburg city has high ambitions to lead in fulfilling Agenda 2030, aiming to be among the world’s most progressive cities in preventing environmental and climate issues (Göteborgs Stad, 2020). Gothenburg’s Environmental and Climate program states that their current consumption-based impacts of 8,9 tons of CO₂eq/person/year shall decrease by at least 7,6% annually until 2030. Regulating documents emphasize that changing consumption patterns is a way to achieve this goal

(Göteborgs Stad, 2017). The Gothenburg region (which includes Gothenburg city) also has clear targets to reduce and prevent the creation of waste in the household, which includes reducing consumption that will eventually become waste.

Gothenburg has also actively promoted the SE as a tool to achieve its sustainability goals. In 2017, the city received the Eurocities Award for its strategic climate work regarding the SE. Gothenburg region wants to ensure that every resident can access and provide products for reuse close to where they live, and proposes sharing as a solution for decreasing electronic waste by 50% per person (Göteborgsregionen, 2020). Further, Gothenburg city adopts several governing roles regarding the SE, including providing funds for initiatives and initiating their own (Voytenko Palgan et al., 2021). The city emphasizes that the growing sharing culture in Gothenburg must be supported and promoted, mainly through building collaborations with diverse actors (Göteborgs Stad, 2017). From 2018 to 2021, the city was involved in the Sharing Cities Sweden (SCS) national program through their Sharing Cities Gothenburg (SCG) testbed, which investigated and promoted the role of the SE in achieving sustainable cities (Sharing Cities Sweden, 2021). Parts of this thesis were developed in collaboration with the SCG testbed.

The results in this thesis apply to the context of Gothenburg while the method followed might be appropriate for similar contexts.

1.5. Structure of the thesis

The thesis is structured as follows: Chapter 2 introduces background concepts for the thesis and related research while underlining gaps. Chapter 3 presents the research design, methods utilized, and relevant perspectives of the researcher. In Chapter 4, findings are shown for each of the research objectives. Chapter 5 introduces ongoing research and related future work, while Chapter 6 discusses the findings considering extant literature. Finally, Chapter 7 concludes the work.

2. Extended background

In this chapter, the basic concepts will be presented regarding household consumption, sharing economy (SE), sustainability impacts of the SE, and SE urban governance. The introduced terminologies will be used throughout the rest of the thesis. Furthermore, each sub-chapter briefly shows the status of the research field and underlines relevant gaps.

2.1. Household consumption of manufactured products

Households consume products to support their activities, satisfy their needs and wants, and enhance their wellbeing (Magrabi et al., 1991). Due to the necessary function of consumption, its rate and intensity has experienced an increase over the last decade resulting in considerable environmental effects (Di Donato et al., 2015; Shittu, 2020). In the European Union, the material footprint of manufactured products ascends to 20% (being the second highest category), and clothing and manufactured products are the second and third categories with the highest water footprint (0.05 m³/EUR and 0.02 m³/EUR respectively). Notably, the share of emissions and resource use due to consumption of manufactured products is much more significant in industrialized countries than in emerging economies (Ivanova et al., 2016), while the growing rates of urbanization make cities a focal point for increased consumption and impacts (Ottelin et al., 2019). These effects highlight the importance of quantifying household consumption rates, the behaviors and practices supporting it, and its environmental effects (Shittu, 2020), but also the urgency in transitioning towards more sustainable consumption patterns.

2.1.1. Measuring household consumption, behaviors, and impacts

Measures of household consumption are almost exclusively obtained through survey methods, either interview- or questionnaire-based (Beegle et al., 2012), which are the base for national statistics (e.g., national expenditure surveys). Some household consumption studies enhance data analysis through additional questions addressing behaviors and attitudes underlying the consumption (Shittu, 2020). Top-down approaches to investigate household consumption include national survey results and models such as Input-Output (I-O) and Material Flow Accounting (MFA). Several studies have combined these base models with environmental impact accounts to calculate carbon footprints and materials required by economic activities at different levels of disaggregation, such as Environmentally Extended Multiregional Input-Output (Hertwich & Peters, 2009), and Economy-Wide Material Flow Accounting (EW-MFA) with lifecycle assessment (LCA) values (Di Donato et al., 2015). From this, direct material supply, material intensity factors to and emissions from households can be calculated. At an urban scale, multi-regional input-output (MRIO) based on supply-use regional transaction tables have been used (Lenzen & Peters, 2010; Mieke et al., 2016) as well as IO-LCA combined with a household budget survey (HBS) and census data (Jones & Kammen, 2014). However, these methods have limitations in terms of scalability, applicability, and capturing differences between households within the same region. For this, Whetstone et al. (2020) developed the “SEsam” method, which is suitable for application at the neighborhood level to quantify household consumption on a mass basis, based on expenditure statistics and the elaboration of archetypes that characterize different households (more details in sub-chapter 3.2.2).

2.1.2. Transitioning towards sustainable consumption patterns

Sustainable consumption entails the use of products and services to satisfy needs and contribute to quality of life, while minimizing its impacts so that they not affect the capacity of future generations to meet their needs (UNEP, n.d.). The concept involves measures across the life cycle of products; from reducing the impacts of raw material extraction and production and decreasing material and energy per unit of product, to using more products and services more efficiently, shifting consumption towards products with lower impacts, and reducing overall consumption levels. The three latter are closely related to household behaviors, and can be prompted through increasing knowledge, shifting attitudes and values, and providing other ways to fulfill needs. However, these tend to be ineffective without support by policy approaches (Dubois et al., 2019; Tukker et al., 2010).

Shittu (2020) emphasizes that understanding consumption at the household level is crucial to develop policies towards sustainable consumption. Local policies are encouraged, as they reflect the realities of communities more precisely than national policies. An example of adapting policy strategies to how households consume is seen in Shwom and Lorenzen (2012), who mention implied policy solutions according to how consumers are typified. “Homo economicus” consume rationally according to their interests, and “Predictably irrational” consumers are influenced by cognitive, social, and emotional factors. For these two types, regulation involves information and price regulation. “Locked-in” consumers are constrained by diverse cycles and government decisions, and “Socially organized” consumers organize themselves around institutions and lifestyle patterns. Here, urban planning and the support of alternative forms of social consumption (e.g., sharing communities) are recommended.

2.2. Sharing economy

The sharing economy (SE) is an emerging phenomenon that was popularized with the success of AirBnB and Uber (Martin, 2016) and that entered the academic field through R. Botsman and R. Rogers (2010)’s book on collaborative consumption. Several definitions are recognized in the literature, going from restrictive models (“Sharing is an alternative to the private ownership that is emphasized in both marketplace exchange and gift-giving”(R. Belk, 2014)) to broader definitions (“An economic model based on sharing underutilized assets from spaces to skills to stuff for monetary or non-monetary benefits” (Botsman, 2013). According to some, the difference between the conventional sharing that has occurred since the origins of humanity and the SE lies in its efficiency and sustainability (Hossain, 2020).

2.2.1. Characterizing basic elements of the SE

The scope of shared assets, roles and platform models, and actions in the SE vary across academic definitions. Here is presented a collection of elements included in different definitions, which will serve as a base to understand the scope of the thesis:

- **Shared assets:** These are classified into tangible and intangible, where the first refers to space, durable products and non-durables, and the latter services, time, knowledge, money and online content (Curtis & Lehner, 2019). Durable products do not deteriorate quickly (e.g., cars, bikes, sports equipment, electronics, kitchen equipment, furniture, and household equipment), and potentially have a high idling capacity (i.e., they stand unutilized or “idle” for long periods of time, even if they are still functional). Shared assets

can also be classified by their level of rivalry (i.e., whether use by a person prevents simultaneous use by another).

- **Roles and platform models in the SE:** Households, businesses, organizations, and governmental institutions can adopt various roles depending on the platform model of the sharing initiative (SI). In business-to-consumer models (B2C), a business or organization might provide the assets (e.g., Styr och Ställ (2023)), while in peer-to-peer models (P2P), individuals and households adopt both the roles of provider and users/consumers (e.g., Hygglo (2023)) (Curtis & Lehner, 2019). Extant literature introduces additional roles, such as “prosumers” (i.e., individuals who can switch between being consumers and service providers in P2P models, often in accommodation and energy sharing (Magnusson & Palm, 2019; Xiang et al., 2022)), and “mediators” or “intermediaries” (i.e., businesses/organizations which regulate the transaction between two private parts in P2P models (Sutherland & Jarrahi, 2018)). Beyond individuals and businesses, governmental institutions can also act as service providers through self-initiated SIs or as consumers in B2C models.

Other authors elaborate on types of SIs according to current academic perspectives in the SE rather than classifying them according to actor roles. Acquier et al. (2017), for example, introduce three cores of the SE: access economy (i.e., which focuses on optimizing the use of underutilized assets), platform economy (i.e., where digital platforms mediate P2P exchanges), and community-based economy (i.e., interactions without economic remunerations, hierarchy, or contracts).

- **Sharing actions:** While some authors only include actions that result in temporary access to assets (e.g., sharing, lending, borrowing, and renting diverse assets) (Russell Belk, 2014; Frenken & Schor, 2017), others extend the definition to include permanent transactions (e.g., through swapping, gifting, and selling and buying used products) (Benkler, 2004; Muñoz & Cohen, 2017; Schor, 2016). These transactions could be monetized (e.g., renting, co-buying) or not (e.g., lending, swapping).

2.2.2. SE state-of-the-art

As a developing research field, the SE has been approached from various perspectives. Overall, there is some fragmentation in the SE research field (Gurău & Ranchhod, 2020). It is common to find in-depth studies that focus on one or few shareable products (Strulak-Wójcikiewicz & Wagner, 2021), specific business models (Noh et al., 2020), single sharing initiatives (Shmidt, 2019), and limited households or user profiles (Morone et al., 2018; Yates, 2018). Hossain's review (2020) summarizes the perspectives of SE research into “consumption practices, lifestyle, mobility, social movement, social and disruptive innovation, sharing paradigms, travel patterns, trust, and motivation”. Cheng (2016) identifies three main topics addressed, “1) the different types of business models and their impacts, 2) the nature of the SE, and 3) the sustainability development of the SE”. Cheng points out a gradually changing focus towards sustainability topics and a trend towards multi-disciplinarity beyond economics, but still considers the research field immature. The research about the governance of the SE is growing, often as a response to the lack of regulation and the lack of certainty about the sustainability impacts of the SE. Research about the SE's sustainability will be addressed in sub-chapter 2.3. - Sustainability of the SE, while literature concerning governance is addressed in sub-chapter 2.4. – SE governance.

2.3. Sustainability of the SE

The sharing economy (SE) has been associated with sustainability by private individuals, businesses, governmental institutions, and researchers (Böcker & Meelen, 2017; R. Botsman & R. Rogers, 2010; European Commission, 2016a; Geissinger et al., 2019). The following sustainability connotations are cited, corresponding to environmental, social, and economic effects:

Environmental effects

Due to the possibility of more efficient use of materials and products, SE activities are included within the framework of circular economy (Kalmykova et al., 2018). Potential environmental benefits could result from the reduction of purchase amounts due to increased access and utilization of products, leading to an eventual decrease in production and raw material extraction (Ala-Mantila et al., 2017); of water and energy use, and of GHG emissions (Cheng, 2016), and of waste amounts (Puschmann & Alt, 2016). However, these effects are uncertain, as savings made from participating in the SE may be invested in new or more resource-intensive purchases. Also, long travel distances to access shared products may increase greenhouse gas emissions, leading to trade-offs (Codagnone & Martens, 2016; Frenken, 2017; Demailly & Novel, 2014).

Despite the possibility of trade-offs, the reputation of the SE as inherently sustainable persists, while a gap is seen in investigating first- and second-order effects (Geissinger et al., 2019). Theoretical preconditions to avoid negative effects have been addressed; for example Curtis and Lehner (2019) suggest a definition of sustainable sharing (i.e., that it is ICT mediated, that the motivation of the ownership is not solely to rent out, that transactions are temporary, and that shared assets are tangible). Other examples rely on stakeholder perceptions of the sustainability of the SE, for instance Leismann et al. (2013), who discuss reductions in resource use facilitated by textile swapping and tool hiring while highlighting the risk of rebound effects. A gap is seen for studying the impacts of shared durable products, as many investigations refer to mobility and accommodation (Enochsson et al., 2021; Plewnia & Guenther, 2018). A few examples are seen for studying the environmental effects of sharing products through life cycle assessment (LCA) (e.g., (Martin, 2018; Zamani et al., 2017)), hybrid methods supported in input-output assessment (e.g., Ala-Mantila et al. (2017)), and material flow accounting (MFA) studies (e.g., (Vélez, 2019)).

Social effects

The SE, particularly in P2P models, could allow participants to have fun and experience social situations, and can promote bonding and cohesion at the individual and community level (Plewnia & Guenther, 2018). Further, the SE could promote equal access to resources for underprivileged groups (Martin et al., 2015). On the other hand, some research poses that racial discrimination and income inequalities are perpetuated in accommodation and mobility sharing (Brough et al., 2016; Jin et al., 2018; Plewnia & Guenther, 2018; Schor, 2017).

The social aspect of the SE has been less explored than the environmental (Padilla-Rivera et al., 2020), which mirrors general sustainability literature (Boström, 2012). One example of assessing the social impacts of the SE is seen in Luthin et al. (2023), where a social LCA study was seen for CE strategies including sharing. Also, many studies address the social motivations for individuals to participating in the SE. Some authors say that social aspects do not have much importance for private individuals nor businesses compared to other motivations (Hossain, 2020; Plewnia & Guenther, 2018).

Economic effects

From the perspective of providers (whether private individuals or businesses), the SE is an opportunity to generate additional income, to partake in entrepreneurship, to create jobs and to foster economic growth (European Commission, 2016b). At the same time, costs are reduced for the users/consumers in comparison to purchasing products for exclusive ownership (Rachel Botsman & Roo Rogers, 2010). However, the money saved or generated is often used for “unproductive economic purposes” (Hossain, 2020). Rauch and Schleicher (2015) object that economic gains might not only depend on reduced costs, but also on avoidance of tax, varying consumer standards, and lack of regulation for workers’ rights”. As a response, Demailly and Novel (2014) stress the importance of appropriate economic and regulatory frameworks to achieve the economic benefits of the SE.

2.3.1. Research gaps regarding sustainability of the SE

Many of the above effects are theoretically attributed by actors involved in the SE rather than measured Geissinger et al. (2019). Much of the research on the sustainability of the SE has been focused on sustainability aspects as a motivation for users to engage, and some have addressed the sharing initiatives (SIs) acknowledgement of a link to sustainability, specially focusing on motivations for mobility and accommodation (SIs) (Hossain, 2020). The gap in investigating the actual impacts of the SE might be explained by the novelty of the SE. Pouri and Hilty (2018) state that “Owing to the relative novelty of the concept of the SE, it is not straightforward to adopt rigorous approaches in studying it. [...] The SE’s impacts on sustainability should be studied prospectively”. On this, Frenken and Schor (2017) suggested that future research should focus on conceptualizing and empirically assessing the impacts of the SE from different sustainability perspectives and on analyzing the possibility of making such assessments facing lack of data. Furthermore, while the possibility of trade-offs is recognized, few studies have combined consumption and sharing analyses (amongst these (Beretta et al., 2021) (Esposti et al., 2021) and Cohen and Muñoz (2016)). Often, sharing is mentioned as a suggestion to reduce consumption (for example, in Chen, Hadjidakou et al. (2018)), but there is a lack of studies that explore which circumstances are likely to reduce consumption and increase sharing. The lack of understanding about the economic, social, and environmental impacts of SE, as well as first- and second-order effects, could hinder the development of appropriate policy guidelines (Hossain, 2020).

2.4. Sharing economy governance

Governance mechanisms are “processes through which collective goals are defined and pursued by multiple public and private actors” (Voytenko Palgan et al., 2021). Various authors propose that governance of the SE is essential for leveraging its positive sustainability effects (Bernardi & Diamantini, 2018; Ma et al., 2018; Muñoz & Cohen, 2017) and consider that the SE currently lacks the necessary policy and regulation to function appropriately (Cheng, 2016; Hossain, 2020).

In the literature, several overarching governance approaches have been identified. A primary distinction is seen between proactive and reactive governance (Mont et al., 2020), where the latter refers to governing emerging challenges and limiting the negative effects of the SE. Voytenko Palgan et al. (2021) also identify top-down (i.e. a controlling approach to ensure quality of the sharing system) and bottom up (i.e. seeking to empower grassroots democratic platform governance) approaches. Other approaches include strategic city actorhood and collaborative governance, both of which involve engagement by several stakeholders to

achieve common goals (Vith et al., 2019); (Ma et al., 2018). Collaborative governance can be seen as a midway between the top-down and bottom-up approaches and is appropriate when handling complex issues.

While these approaches may be applied at different scales, there is often a distinction between how central and local governments address the SE (Ferrerri & Sanyal, 2018; Hong & Lee, 2018). Local governance is highlighted, as cities are considered essential hubs for sharing practices (Henry et al., 2021) and local governance could be more responsive to local processes than national regulations Hong and Lee (2018). The relevance of local processes is reflected in the literature, as great variation has been seen in how cities interpret the potential opportunities and challenges in the SE and in their specific sustainability goals (Vith et al., 2019; Voytenko Palgan et al., 2021), and on how this leads to different approaches in governing the SE (such as higher degrees of restriction when the SE is seen as a menace to the city's goals) (Mont et al., 2020). Liu and Chen (2020) also mention that governance strategies may change throughout time, posing that relatively loose regulation is suitable when the SE is developing, and more regulations can develop as the SE expands.

The different strategies that local governments use to interact with the SE and SIs can be summarized into incentivizing “appropriate behavior”, punishing “unwanted behavior”, and influencing public opinion through information (Vith et al., 2019). Several researchers have drawn from sustainability governance literature and from empirical investigations to describe governance mechanisms that fit within each. Below are presented some core mechanisms that are relevant to sharing of household products. These concepts will support the discussion of results in Chapter 6:

- **Regulation:** This involves the use of traditional forms of authority through enforcement and sanction regulations. Through this mechanism, municipalities may control the spread of the SE, or support them through regulatory confirmation of their operations (Voytenko Palgan et al., 2021). This mechanism has been the most addressed by SE literature (Barile et al., 2021). Issues that have called for increased regulation are related to employees rights (for example, employment status of Uber drivers), legal loopholes, and sharing initiatives (SIs) that lack a precise geographical delimitation (Vith et al., 2019).
- **Provision:** This constitutes “the shaping of practice through the delivery of particular forms of service and resource”. When governing by provision, municipalities may supply SIs with services, financial support, material and infrastructural means, or withdraw them (Voytenko Palgan et al., 2021). It is argued that provision of sharing infrastructure is one of the most important municipal tasks in the pursuit of more sharing urban system and more sustainable cities (Agyeman, 2013; Barile et al., 2021).
- **Enabling:** This refers to the role of municipalities in “facilitating, coordinating and encouraging action through partnership with private- and voluntary-sector agencies, and to various forms of community engagement” (Voytenko Palgan et al., 2021). Municipalities use this mechanism through persuasion and incentives, subsidies, and gatherings that enable collaboration between stakeholders (Palm et al., 2019; Voytenko Palgan et al., 2021). Barile et al. (2021) also mention that municipalities may establish public or private partnerships and encourage awareness of SIs through public communication.
- **Collaborating:** This mechanism, consisting in the partnering of municipalities with SIs, emphasizes the importance of collaboration in governance of complex urban sustainability

challenges (Voytenko Palgan et al., 2021). (Palm et al., 2019) identify this as one of the main mechanisms used in Swedish cities. In collaboration, there is an equal relationship between the city and other actors, so there is no formal steering by the city (Palm et al., 2019), as opposed to the “enabling” mechanism.

2.4.1. Research gaps regarding governance of the SE

Despite the recognition that governance is vital for coordinated and sustainable development in the SE, the literature on the SE from an urban governance perspective is scarce (Barile et al., 2021; Ma et al., 2018). Other than conceptualization of governance mechanisms, knowledge of the governance of the SE has involved empirical mapping. Palm et al. (2019), for example, conducted a study in Sweden, where all cities analyzed made use of all the identified governing modes, although with a primary focus on governing by authority through partnership. (Barile et al., 2021) also mapped practices and policies deployed in 75 worldwide cities and tested the impact of municipalities governance on the city. Few examples are seen where suggestions are provided on suitable governance mechanisms for the SE (with an example seen in Liu and Chen (2020), where they provide regulatory suggestions for mobility sharing). While it is stated that municipalities should develop procedures that help them clarify which types of sharing to support to enhance sustainability (e.g., through LCA assessments (Mi & Coffman, 2019)), there is a lack of knowledge about the creation of such procedures, and about actionable information specifically aimed at the governance of the SE.

3. Research approach & methodology

This chapter provides detail on the methods used throughout the work and defines the theoretical perspectives that influenced the research approach.

3.1. Research design

This research work is organized around the three research objectives (ROs), see Figure 1. The work has a descriptive and exploratory character. Descriptive research “describes phenomena as they exist” (as intended in RO1 and RO3), while exploratory research “looks for patterns [...] rather than trying to test or confirm hypotheses” (as in RO2) (Vogt, 2005). From this, it follows that the research design is inductive.

Within RO1, diverse aspects of consumption and sharing are quantified. An estimation of the consumption of shareable products in Gothenburg neighborhoods was conducted using the SEsam method (sub-chapter 3.2.2); first with data from a national expenditure survey, and second with data from a survey conducted by the researcher (sub-chapter 3.2.4). Further, an estimation was made of the attitudes towards consumption and interest and participation in sharing by Gothenburg residents. For this, stakeholder collaboration with the city (sub-chapter 3.2.3.) led to the identification of consumption and sharing variables to analyze, to the provision of data from a survey conducted by the city (sub-chapter 3.2.4), and to thematic and statistical analysis of the variables (sub-chapters 3.2.5 and 3.2.6). Some results from the latter part are included in the appended manuscript.

In RO2, the data generated in RO1 is used to identify patterns that could be used for the governance of the SE. Patterns are identified from three perspectives: product groups, demographic groups, and neighborhoods. Descriptive and inferential statistics were utilized, and data visualization was done through geographic information systems (GIS). All statistical procedures are briefly covered in sub-chapter 3.2.6. The product profiles and demographic profiles are presented in the appended manuscript, and the neighborhood profiles were developed to be presented at the International Society of Industrial Ecology (ISIE) Conference (2023).

For RO3, sharing is addressed as a tool for overall sustainability, expanding to the social and economic dimensions. Thematic analysis was performed on an open question from the survey conducted by the city, where the perceptions of the population about the SE are studied. The population's perceptions were presented in the Act Sustainable Research Conference (2022).

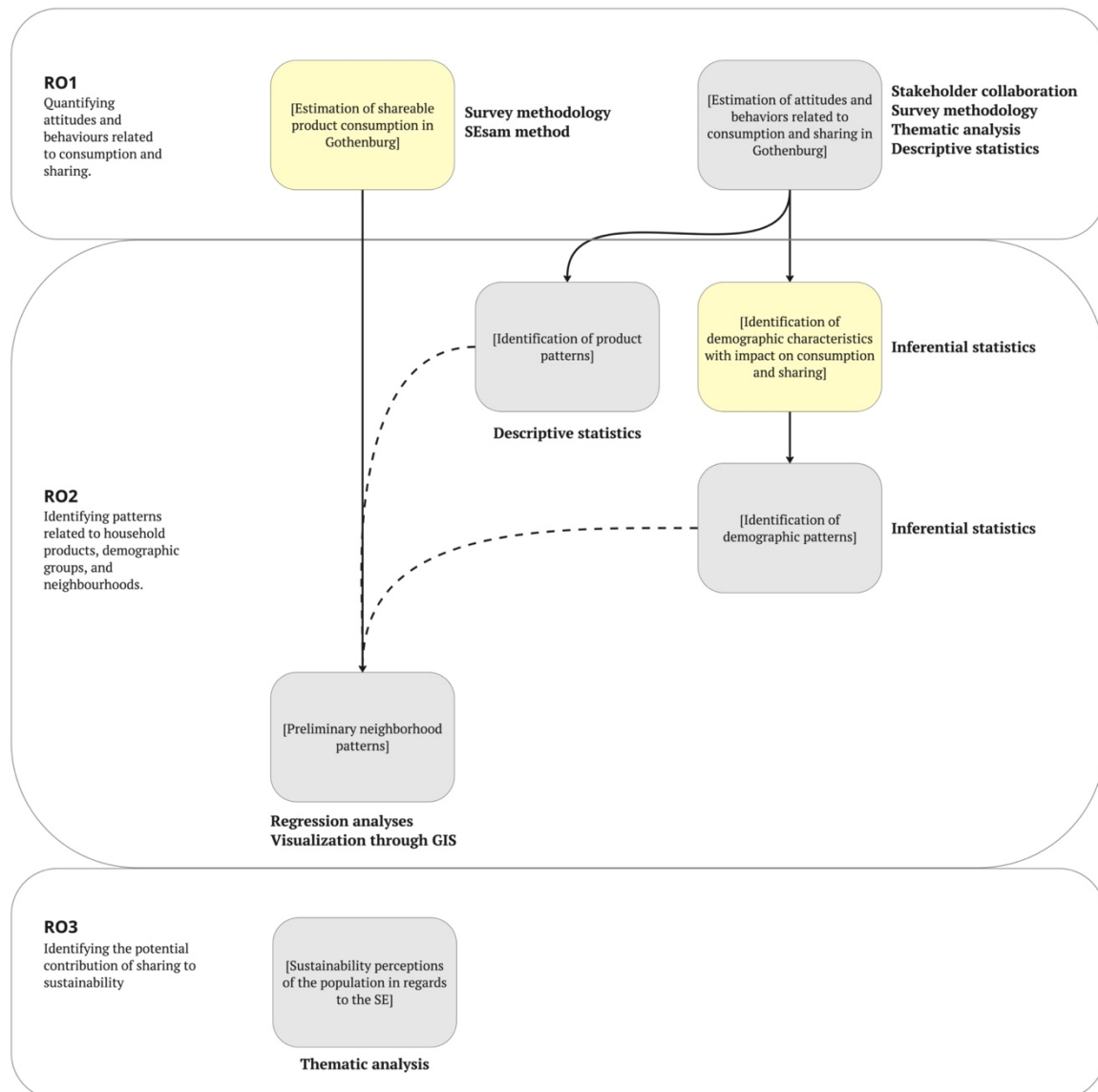


Figure 1 - Research design. The boxes represent the outcomes produced within each objective – grey boxes are presented in findings, while yellow boxes are preliminary steps undertaken. Next to each box in bold letters are the methods utilized for each step. The arrows indicate how the outcomes contribute to each other. Pointed lines are addressed in future work (Chapter 5).

3.2. Overview of methods

3.2.1. Literature studies

Literature studies were conducted to identify gaps in research and inform the ROs, as well as to discuss results. While no systematic review has been conducted, all reviews in the thesis have been “systematized” (as per Grant and Booth (2009)) by following an adapted process of Livoreil et al. (2017) (see Figure 1).

Search string: (“sharing economy” OR “collaborative consumption”) AND (“sustainability” OR (“impacts” OR “effects”) AND (“social” OR “economic” OR “environmental”))
Databases/search engines: Google Scholar and Scopus
Types of sources: Academic and grey literature

Figure 1 - Example of search string used, databases/search engines selected, and types of sources considered in a systematized review in the thesis.

3.2.2. Estimating neighborhood consumption of shareable products

For the estimation of household product consumption through the SEsam method (2020) expenditure data from the Swedish Household Budget Survey (HBS) (Statistiska Centralbyrån, 2013) were transformed into mass or item consumption at the neighborhood scale. According to Whetstone et al. (2020), this information is helpful to devise localized schemes for the SE. While Whetstone et al. present examples of mass consumption of shareable products in two different Gothenburg districts for 2012; in this research the estimation is expanded to all neighborhoods in Gothenburg. Further, it was intended to update the estimations using recent expenditure data. However, due to a 9-year delay in the release of HBS data; a second estimation was made for 2021 using additional survey data (described in sub-chapter 3.2.4.).

Summary of the method

The HBS 2012 provides information of household expenditure in products and services. In the SEsam method, each expenditure registered in the HBS is classified according to which household archetype it belongs to depending on the disposable income level in the household, the type of dwelling, and whether there are children in the household. Then an average consumption is calculated for each product and per archetype. A database of conversion factors from price to mass and number of products is used to convert average expenditure per product and per archetype into average mass or item consumption (see Equation 1). Finally, the consumption per neighborhood is calculated by combining the average product consumption by household archetypes with census information stating the proportion of household archetypes within each neighborhood (see Equation 2).

$$C_{ap} = \frac{(\sum_{H=1}^n E_p) * f_p}{\sum_{H=1}^n Hhbs_a}$$

C_{ap} = Consumption/archetype/product (units)

E_p =Expenditure/product (Swedish crowns)

$Hhbs_a$ =Households per archetype in HBS (units)

F_p =conversion factor from price to units (Swedish crowns/units)

Equation 1 – Calculating product consumption per archetype. Based on Whetstone et al.'s method (2020).

$$C_{np} = \sum_{a=1}^{12} (C_{ap} * Hcensus_a)$$

C_{np} = Consumption/neighborhood/product (units)

C_{ap} = Consumption/archetype/product (units)

$Hcensus_a$ =Household per archetype in census (units)

F_p =conversion factor from expenditure to item

Equation 2 – Calculating product consumption per neighborhood. Based on Whetstone et al.'s method (2020).

3.2.3. Collaboration with local government

Collaboration was established with representatives from Gothenburg city's Democracy and Citizen Service (Göteborg Stad, 2023). These representatives were simultaneously involved in the Sharing Cities Gothenburg (SCG) testbed (see sub-chapter 1.4.2.), henceforth referred to as "SCG representatives". The collaboration consisted in the identification of the knowledge needs of the city, mutual provision of data, and consultation during the research process. The co-creation process included a workshop with the SEsam research team and an SCG representative. In the workshop, the knowledge gaps from the SCG testbed were matched with data available from SEsam and a survey previously conducted within the SCG testbed (SCG survey) (see sub-chapter 3.2.4.). An example of the ideas generated in the workshop can be seen in Additional Material - Figure A.1.

3.2.4. Questionnaire surveys

Data has been obtained from two independent questionnaire surveys: one conducted by the SEsam research team (SEsam survey) and one conducted by SCG through the Institute for Quality Indicators AB (Institutet för kvalitetsindikatorer AB (2021)).

SEsam survey

The SEsam survey was conducted following the process described by Blair et al. (2013), where I designed the pre-test and final questionnaires and elaborated the sampling strategy. The survey was designed with the initial goal of studying how the consumption of shareable products per archetype and per district had evolved from 2012 (HBS data) to 2020-2021. Some secondary goals were to obtain data about the household stock of shareable products, to estimate what proportion of households within each archetype participated or expressed interest in participating in SE initiatives and regarding which specific products, and finally, to obtain geographical granularity of the variables. Ultimately, results were used for RO1 and RO2.

The survey had a cross-sectional design, thus collecting data at a single point in time (Bell et al., 2018). Most questions in the survey were closed-ended, except for those referring to sharing interest and habits. The questionnaire surveyed behaviors (amounts consumed, participation in the SE) and attitudes (desire to participate in the SE). Questions about demographic characteristics related to Whetstone et al. (2020)'s archetypes and to other characteristics compatible with Gothenburg Census (Göteborgs Stad Statistik och Analys, 2022).

To improve participation rates, the survey included an introduction providing information about the purpose of the survey, confidentiality of the data provided, and auxiliary information was provided when referring to terms possibly unknown to the respondents (e.g., disposable income, sharing economy).

A pre-test was conducted by students, where they distributed the survey, obtained feedback from respondents, and identified questions that needed modification. Further feedback was obtained from SCG representatives.

For the data collection, participants were contacted through social media, including the spread of the survey link in diverse Facebook groups. The survey was hosted in the web-platform SurveyMonkey (SurveyMonkey, 2023). The web-survey modality was chosen due to the low cost and speed. Furthermore, a higher sample could be reached through web surveys, although the rate of response might be lower.

Additional details regarding population, sampling strategy, quotas and questionnaire are shown in the appended manuscript Jiménez Encarnación et al. (2023).

SCG survey

Results from the survey conducted by SCG in 2021 were utilized. The goal of the SCG survey was to obtain detail about the attitudes and behaviors in Gothenburg related to the sharing economy. The results were compatible with similar studies conducted in the other Swedish cities Malmö and Karlstad. Further detail about this survey can be seen in the appended manuscript (Jiménez Encarnación et al., 2023).

3.2.5. Thematic analysis

Thematic analysis was utilized in all ROs and performed on qualitative data to extract implicit and explicit meaning from linguistic material (Flick, 2014). The process involved coding, where the researcher labeled excerpts of data to identify, organize and interpret the text (Miles et al., 2019).

For RO1 and RO2, the questions in the SEsam survey referring to sharing of products were open-ended (*i.e.*, *Which product types are already obtained/provided by the household through sharing initiatives (SIs)?*, *Which product types would the household like to obtain/provide through SIs?*). Responses were coded in-vivo (*i.e.*, textually), and then grouped into deductive themes corresponding to the study's product groups (see Figure 2). For RO3, the question referring to participants' perceptions about the SE was coded deductively along two dimensions: positive-negative-neutral and environmental-social-economic (see Figure 3)

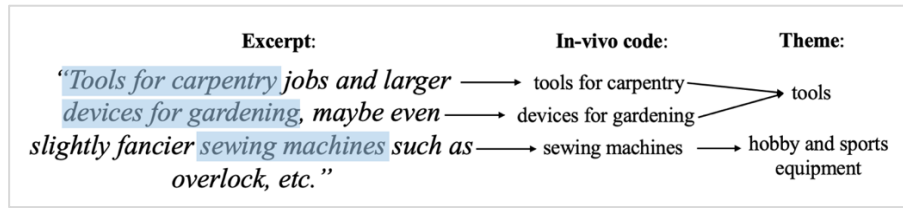


Figure 2 - Example of in-vivo coding and deductive themes in RO1 and 2.

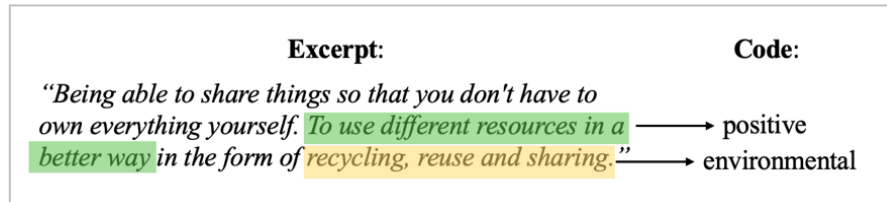


Figure 3 - Example of deductive coding in RO3. Green underlining refers to the positive-negative-neutral dimension, and yellow underlining refers to the environmental-economic-social dimension.

3.2.6. Statistical analysis

Statistical analysis can help identify patterns and relationships between variables, and to evaluate the significance of the relationships (Bell et al., 2018). In this thesis, descriptive statistics are used in all ROs through stating mean values and percentages. Additionally, inferential statistics were performed in RO2 to assess the significance of the independent variables in relation to dependent variables for the identification of demographic patterns. These analyses are detailed below, while specific variables addressed are seen in appended manuscript – Table 1:

Logistic regression analysis was used to examine the relationship between categorical independent variables and binary dependent variables. An example is whether gender (categorical variable: male/female) has a significant effect on being “very interested” in sharing (binary variable: yes/no)

Linear regression test showed if there’s relationship between an independent variable - whether continuous or categorical- and a continuous dependent variable. An example refers to the question “How many of the [following] products did your household buy in the last year?”. In this case, the relationship between an independent continuous variable - age (categories: 18-24, 25-44, 45-64, and 65+), and the dependent continuous variable - amount purchased (categories: 1-9, 10-20, 21-30, 31-40, 41-50, 51+) was tested. Alternatively, the analysis could be made in relation to an independent categorical variable, such as type of dwelling (categories: house/apartment).

Zero-inflated Poisson model, a linear model, was used when the data presents an excess of zero counts. An example is seen for the variable reflecting a “very positive” attitude towards sharing activities, where most participants were not “very positive” towards any sharing activity (e.g., count of activities for which “very positive” attitude is registered= 0).

The difference of proportions test was used to assess the statistical difference between two percentages in a sample. It is evaluated whether the difference is statistically significant. In the thesis, this is used to analyze the question “Are there product types that the household already

obtains/provides through sharing initiatives (SIs)?". These analyses were performed to confirm the logistic regression results due to the small size of the sample.

After performing statistical analyses, the product patterns were identified by observing the relative position of each product within each variable considered, while the demographic patterns were constructed by identifying demographic characteristics that had statistical significance both within consumption and sharing variables. Here, variables were analyzed for "extreme" results to avoid desirability bias (i.e., whether respondents were "very interested" rather than "interested" in the SE).

3.3. Research perspectives of the author

My ontological and epistemological perspectives align with *post-positivism*, a stance that recognizes the strengths of empirical research while accepting that the subjectivity of the researcher and the context in which research occurs impacts the results (Robson, 2002). Within post-positivism, a mixed-methods design is often ideal to bridge the need for empirical data with the concept of subjectivism. For the intended aim, quantification of consumption, impacts, and sharing activities are suitable for quantitative approaches; while behaviors and attitudes underlying consumption and sharing, as well as the complexities of governing SE initiatives, are suited for a qualitative approach.

The research is also developed under the multidisciplinary field of industrial ecology (IE). IE stands "between science and technology, between research and activism, and between objectivity and normativity" (Allenby, 2006), seeking to understand behaviors within the complex interactions of human and natural systems. Hence, IE can integrate more ontologies besides the positivism and scientific realism of other quantitative sciences. Within IE, it is common to perform variance-based studies with quantitative analyses of large-n samples, which is reflected in the top-down approach and wide scope covered in this thesis. Nonetheless, this can eventually lead to the selection of future cases for the study of smaller, purposive samples.

Considering the definition of sustainability, I reflect on the following aspects: According to the pairs of opposites delineated by Hedenus et al. (2022), this work adopts a *low substitutability approach*, as the goal is to prevent unnecessary use of materials rather than maintaining current consumption rates by developing ways to alleviate the impacts. Along the same line, my vision of the SE relies upon *lifestyle changes*. While information and communication technologies (ICT) are considered a defining factor for the growth of the SE; the use of technology relies upon people choosing to change their habits. Nonetheless, in the current socio-technical regime, individuals often do not have the means to transition to sustainable lifestyles effectively. As this work provides information to facilitate governance of the SE, it can be placed in the middle of the *individual-political* action spectrum. Finally, a society where purchases are reduced to the necessary points to *sufficiency*, but I consider this process would happen gradually, where a slow increase of SE encouraged by local authorities can be considered *reformism*. Considering these positionings, the thesis supports a *strong view of sustainability*.

Finally, I reflect upon my role as a researcher: Some research objectives addressed in this thesis were decided along with representatives from local government (see sub-chapter 3.2.3.), and the results should provide evidence for decision-making at the local government level. This coincides with Pielke Jr (2007)'s definition of the *science arbiter*, who focuses on issues

brought up by decision-makers but stays removed from explicit considerations of politics. However, considering my personal convictions, a better fitting role would be a mix between an *honest broker* (who integrates several different stakeholder perspectives into the research) and *issue advocate* (who seeks to reduce, rather than expand, governance options). These concepts could influence the future work suggested in this thesis (see Chapter 5).

4. Findings

In this chapter, findings are presented related to each research objective (RO). First, descriptive statistics on the attitudes and behaviors related to consumption and sharing are presented. Then, the identified patterns related to product groups, demographic groups, and neighborhoods are introduced. Finally, perceptions of the population regarding the SE, including its sustainability potential, are presented.

4.1. Attitudes and behaviors related to consumption and sharing

These results characterize the general population in Gothenburg regarding consumption and sharing. Here, more emphasis is given to sharing activities:

Consumption behaviors

In the SEsam survey, 30% of respondents were classified as having a very high consumption/household (over 51 products during the year). The product with the greatest variability was clothes, with a median of approximately 10 units/person/year. Children articles also present high variability, but the category was also mainly composed of clothes. Other categories showed purchase of 1-5 items/person/year (see Figure 4).

Consumption attitudes

In the SCG survey, most of the population felt that they owned an appropriate number of products (60%), while only about a third considered they owned too many things. Nonetheless, over 80% were either positive or very positive towards reducing their consumption in the following 5 years (see Figure 5 – upper tier).

Sharing behaviors

In the SCG survey, 89% of the respondents engaged in at least one SE activity sometimes or often. The activity with the most participants was donating products, while the ones with least engagement were renting to and from private persons and exchanging clothes (see Figure 5 – lower tier). In the SEsam survey, fewer respondents stated they already shared products, especially in the provider role (see figure 6 in sub-chapter 4.2.).

Sharing attitudes

In the SCG survey, 95% of respondents were either positive or very positive to one or more sharing activities. However, a large variability was perceived per activity. The activities with most acceptability were reparation and renting from a company, while the least popular were renting to and from private persons (see Figure 5 – middle tier). In the SEsam survey, more respondents wanted to consume rather than provide (see figure 6 in sub-chapter 4.2.); though proportions changed by product group.

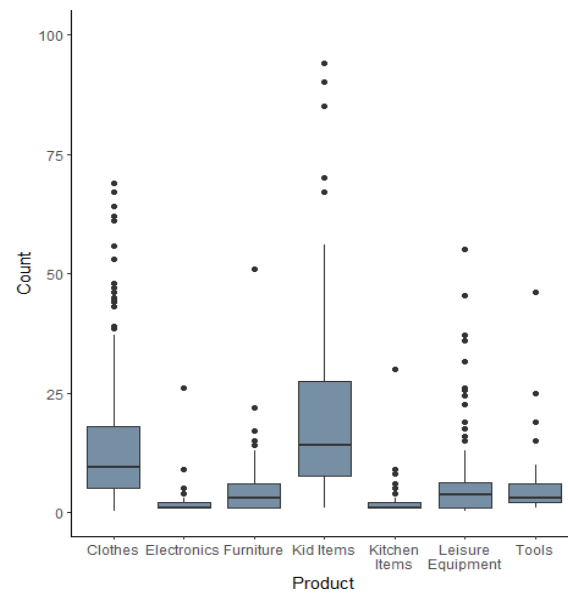


Figure 4 – Consumption behavior. The boxplot shows the variation in consumption of the various product groups using SESam data. The figure depicts the product groups of clothes [12 product types], electronics [11 product types], furniture and decoration [5 product types], children's articles [11 product types], kitchen equipment [8 product types], leisure equipment [10 product types] and tools [3 product types] From Jiménez Encarnación et al. (2023).

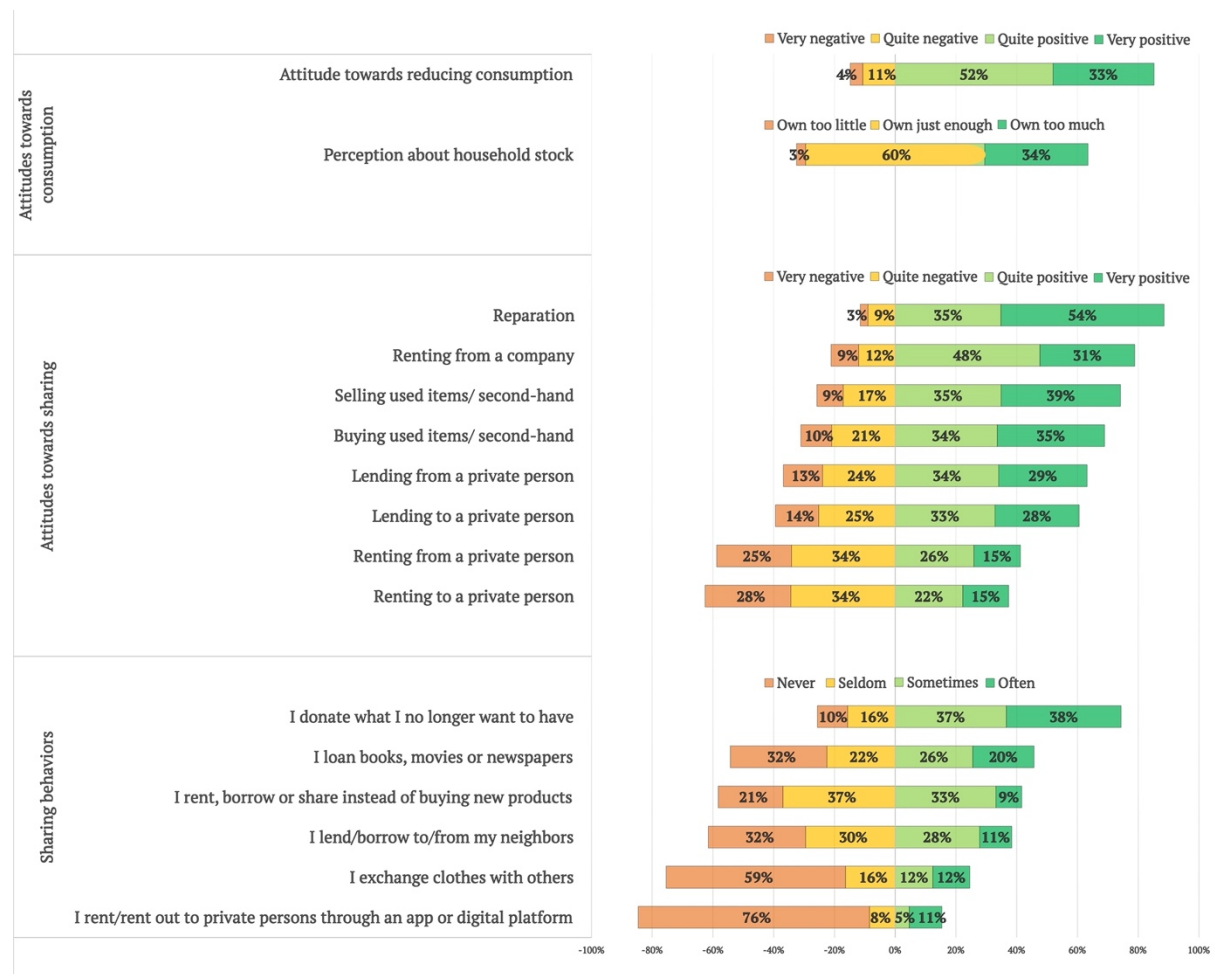


Figure 5 - Stacked bar diagram representing the variables considered to assess consumption and sharing attitudes from the SCG survey. The 0% represents the boundary between negative and positive answers. For example, in the “reducing consumption” variable, the responses to the left were negative (4% - very negative attitude, 11% negative attitude) while the responses to the right of the 0% were positive (52% positive, 33% very positive). Neutral answers are placed in the center (as in “owning too much – 50% represents just enough).

4.2. Patterns related to household products, demographic groups, and neighborhoods

4.2.1. *Product groups*

The results suggested that there are two main patterns in how products are consumed and shared (Jiménez Encarnación et al., 2023) (see Figure 6).

First, products with higher values in the consumption dimension are combined with lower values in the sharing dimension. The main example is clothes, which were the product group with the highest reported consumption (items/year), and that people most believed they owned too much of. However, neither the levels of interest (6%) nor current participation (5%) from the user/consumer role were very high. Notably, 18% of respondents stated that they were already providing clothes through the SE, and 15% were interested in doing so in the future. Electronics and furniture also had relatively high consumption values but were not considered to be owned too much and had lower interest in sharing. Those interested in sharing furniture mainly cited party and event products rather than “permanent” furniture (like foldable tables and chairs.)

Second, products with lower values in the consumption dimension are combined with higher values in the sharing dimension. The main examples were tools and leisure equipment. These product groups had the highest interest and participation in sharing, but the levels of consumption and belief that they own too much are lower. The most notable attitude-behavior gaps were also perceived for these product groups (see Figure 7). For leisure equipment, there is 15% more interest than participation for the user/role and 6% more for the provider role; and for tools, 20% more interest than participation for the user role, and 23% more interest than participation for the provider role. A similar pattern is seen for kitchen equipment – except that, although consumption was relatively low, respondents did believe that they owned too much.

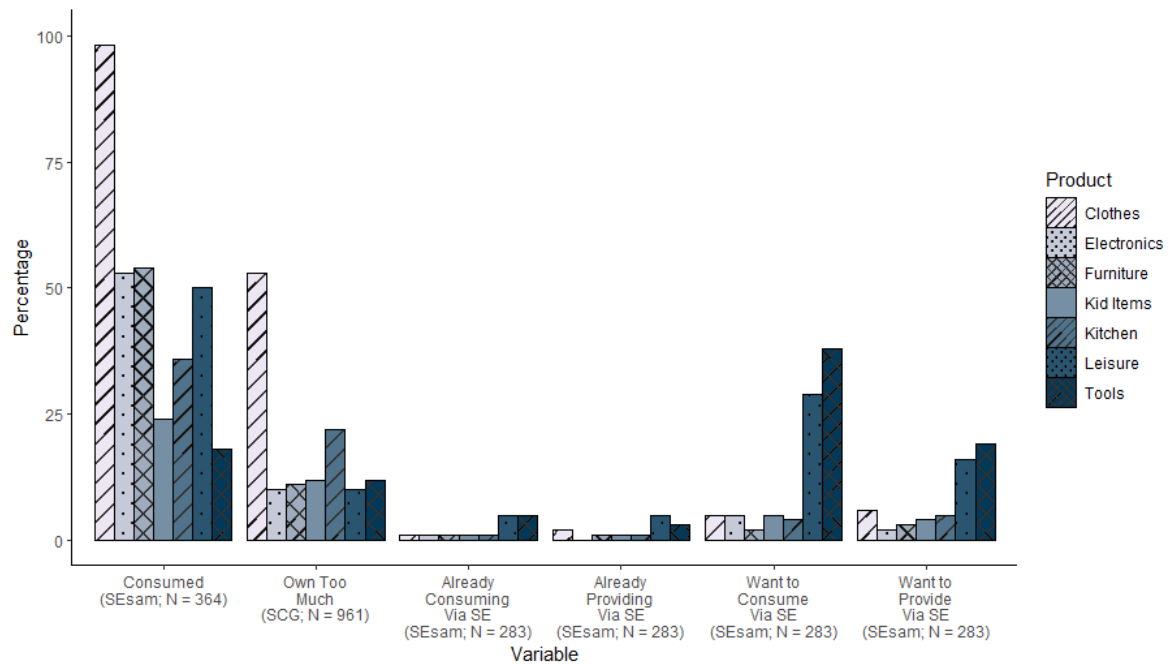


Figure 6 - Summary of results for RO1. Note the mixture of variables from the SEsam and SCG datasets and the changing sample sizes. The bar chart depicts the product groups of clothes [12 product types], electronics [11 product types], furniture and decoration [5 product types], children's articles [11 product types], kitchen equipment [8 product types], leisure equipment [10 product types] and tools [3 product types].

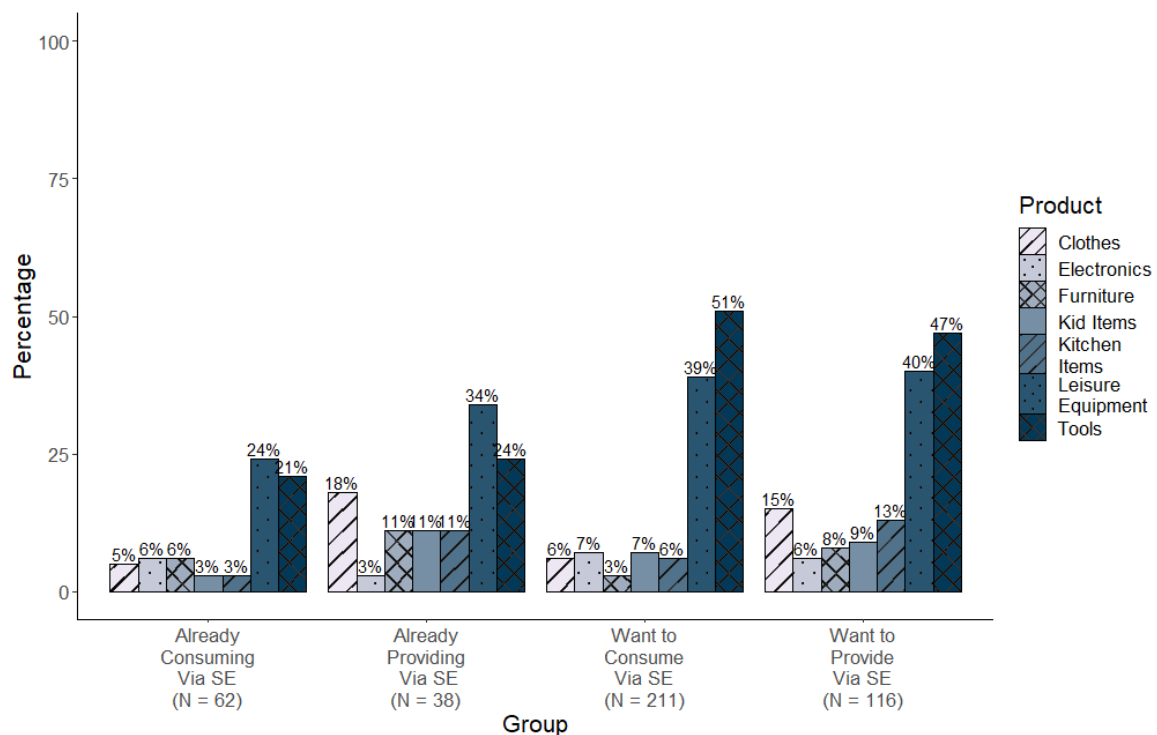


Figure 7 - Bar chart comparing the variables in the SEsam survey related to sharing in RO1. Note that the sample sizes differ in base of the number of respondents who submitted an answer for each variable. The bar chart depicts the product groups of clothes [12 product types], electronics [11 product types], furniture and decoration [5 product types], children's articles [11 product types], kitchen equipment [8 product types], leisure equipment [10 product types] and tools [3 product types].

4.2.2. *Demographic groups*

The results suggested that there are three main patterns related to how demographic groups in Gothenburg consume and share (Jiménez Encarnación et al., 2023), based on the regression results shown in Figure 8 and Figure 9. The patterns are organized according to their importance, considering the number of variables where the demographic characteristics had statistical significance, and the level of statistical significance identified:

The demographic characteristic with the most influence over consumption and sharing variables was gender. In the results, men were less likely than women to believe that they owned “too much”, less likely to have a “very positive” attitude towards reducing their consumption, and less likely to be “very interested” in sharing activities (irrespective of whether activities involved permanent or temporary transactions).

The second characteristic with the most significance was age. Respondents aged 65 or older were less likely to report “very high” consumption levels, but more likely to believe that they owned “too many” products in comparison to the youth category. Further, they were less likely than the youth category to be “very positive” towards sharing activities, particularly for being providers. Respondents in the middle age category showed a similar profile, except that they did not present significance for believing they own “too much” compared to the youth group. Here, as age increases, the significance increases for not consuming “too much”, for believing to own “too much”, and for not being “very positive” towards sharing. Unlike gender, age seemed to have no effect on being “very positive” towards reducing consumption.

The only characteristic with significantly positive associations to consumption and sharing variables was education level. Respondents with post-secondary education were more likely than those with primary education to believe that they owned “too much” and were the only demographic group with statistical significance in having a “very positive” attitude towards all sharing activities. No significance was identified for the variables considered in the SEsam survey.

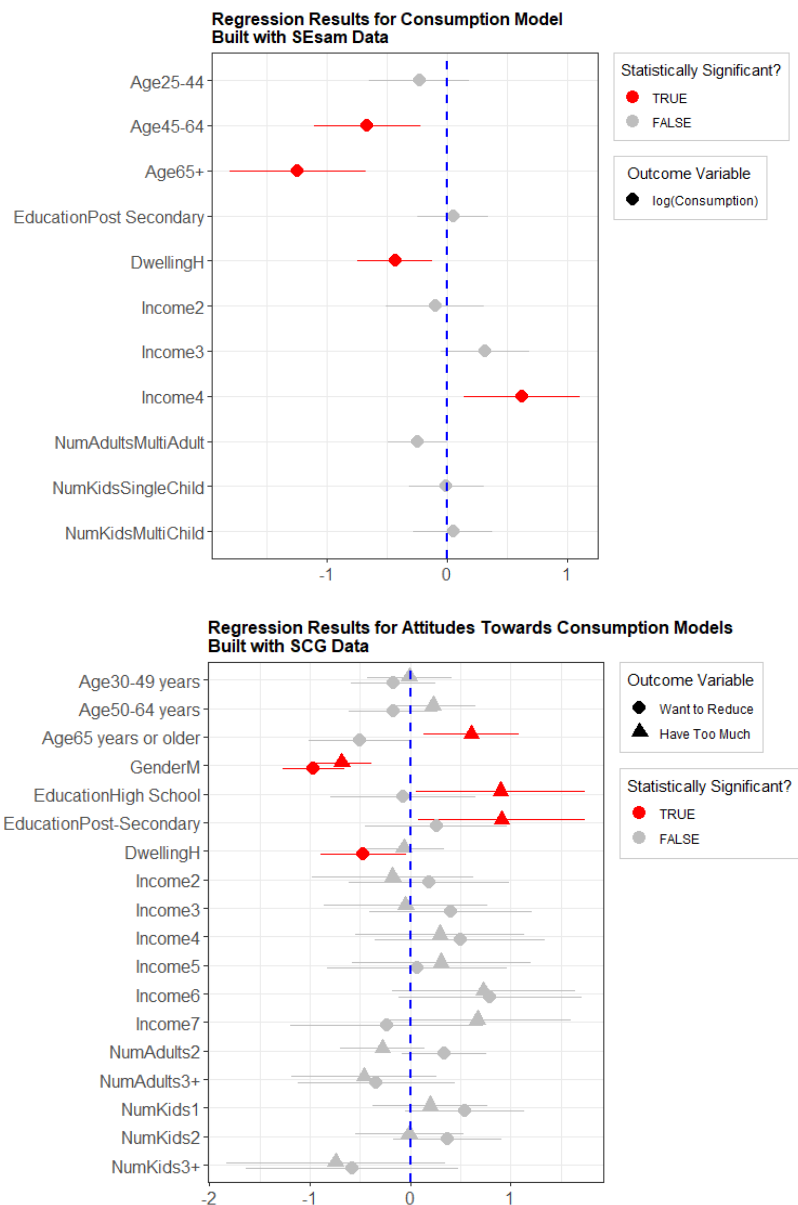


Figure 8 – Top: Regression results for the SESam outcomes variables associated with product consumption during past year. $N = 188-271$ depending on outcome variable. Bottom: Regression results for SCG outcomes variables associated with attitudes towards own product stock and towards reducing consumption. $N = 802-829$ depending on outcome variable. Each symbol represents a different outcome, the location of the symbol is the point estimate of the coefficient, and the bars represent the 95% confidence interval of the estimate. Symbols and bars in red are statistically significant at an $\alpha = 0.05$ level. Note that log (Consumption) is a continuous outcome while the others are binary.

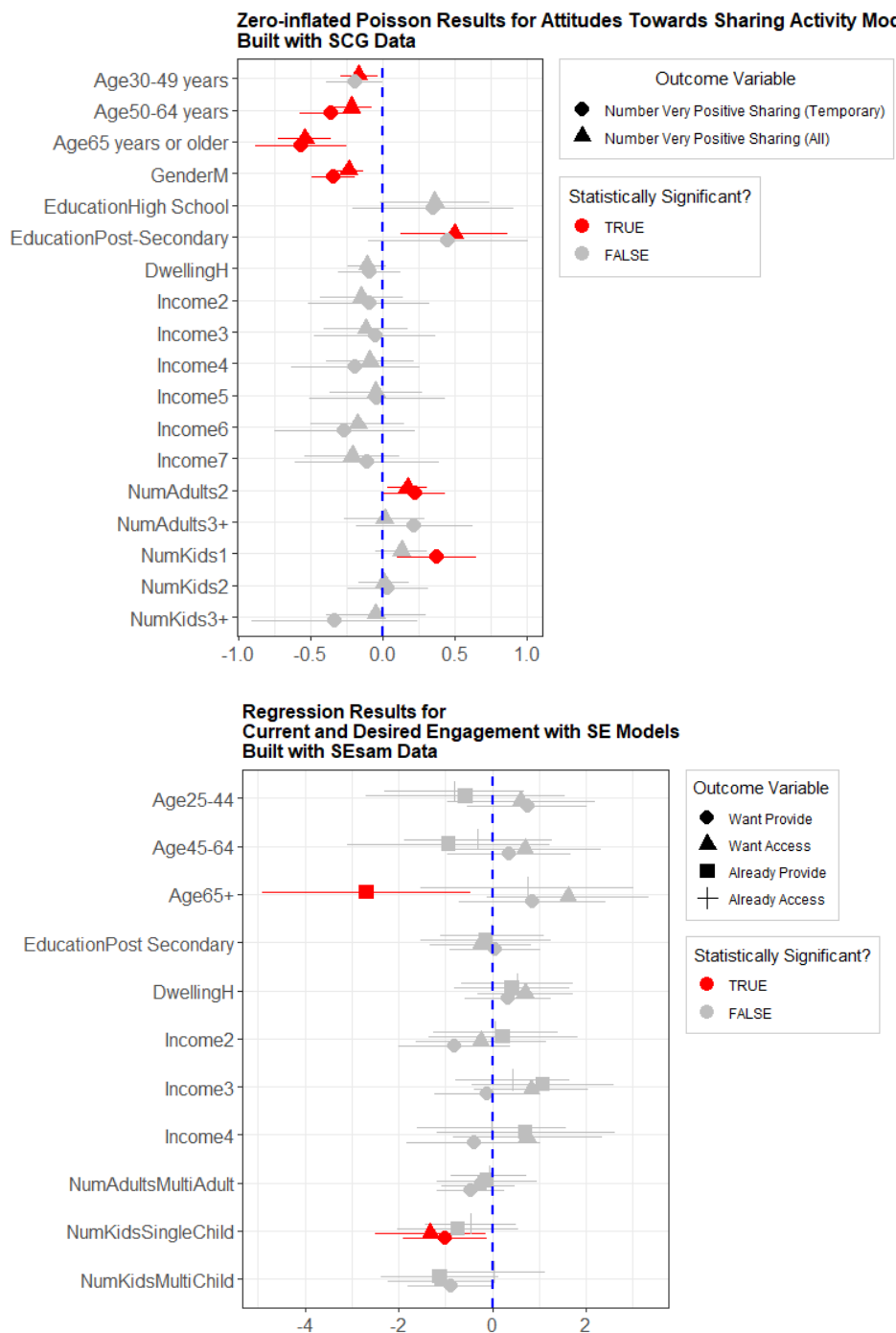


Figure 9 - Top: Regression results for SCG outcomes related to attitude towards sharing activities. $N = 829$ depending on outcome variable. Bottom: Logistic regression results for outcomes regarding current and desired engagement with SE. $N = 188-211$ depending on outcome variable. Each symbol represents a different outcome, the location of the symbol is the point estimate of the coefficient, and the bars represent the 95% confidence interval of the estimate. Symbols and bars in red are statistically significant at an $\alpha = 0.05$ level.

4.2.3. Neighborhood patterns

For the identification of neighborhood patterns, two separate calculations are presented. The first one refers to estimation of the total mass amounts consumed in each neighborhood, based on the Swedish household budget survey (HBS) statistics for 2012, while the second refers to the estimation of the total number of products consumed in each neighborhood, based on the SEsam survey for 2021. See Gothenburg's neighborhoods and districts in Additional material – Figure A.2.

Mass estimations per neighborhood using the HBS 2012 (kg/neighborhood)

Values were estimated for consumption of shareable products in Gothenburg (measured in tons) using data from the HBS 2012 and the SEsam method. A mean estimate of 170 tons of furniture and household equipment per neighborhood was calculated. 90 tons were seen for electronics and hobby equipment, 35 tons for clothes and 2 tons for accessories. Patterns by product did not change per neighborhood (i.e., each product held the same position independently of neighborhood). The neighborhoods which consistently had the highest total consumption were in the central district (e.g., Krokslätt, Lunden, Masthugget, and Kungsladugård); except for one neighborhood (Kvillebäcken). The neighborhoods with the lowest values (e.g., Arendal, Högsbo, Linnarhult, Rödbo and Gunnilse) were spread throughout the three remaining city districts (see Figure 10). Furthermore, the highest and lowest rankings are very similar to the number of households per neighborhood, but regression results did not show a significant correlation.

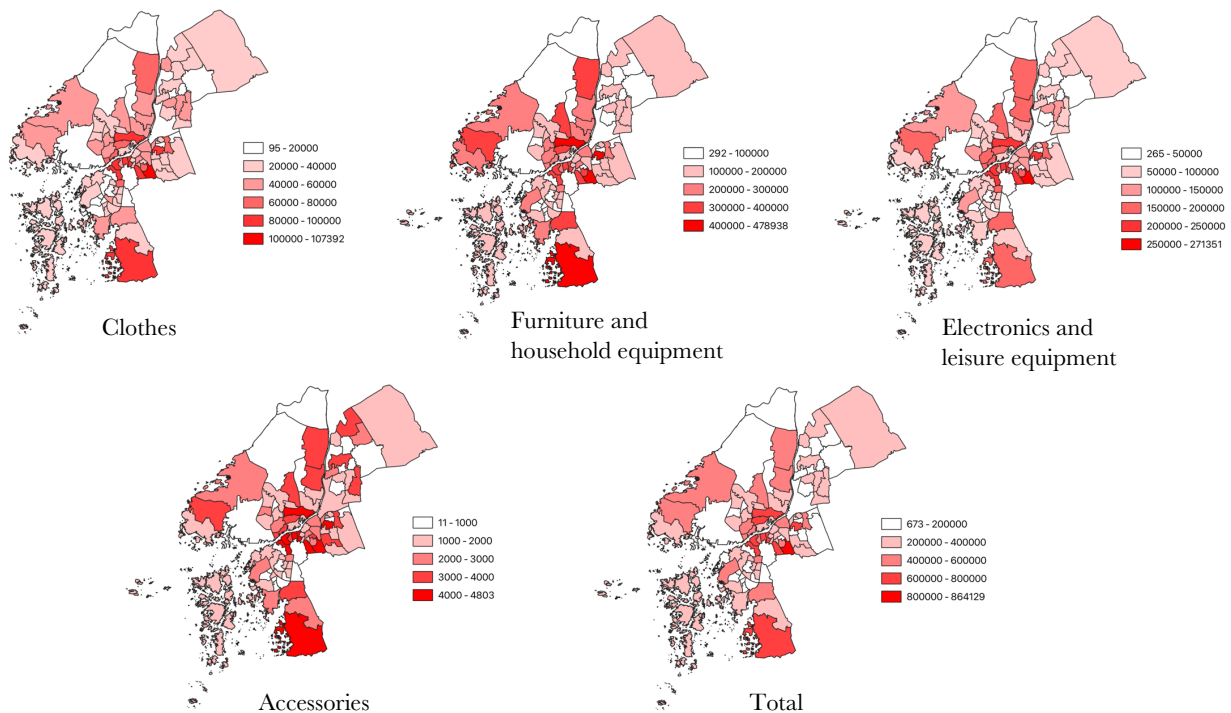


Figure 10 – Estimations of mass consumption in neighborhoods for each product group. These results were calculated in kg/neighborhood by using the data from the HBS 2012.

Item estimations per neighborhood using the SEsam survey data 2021 (item/neighborhood)

For the consumption of shareable products in Gothenburg (measured in items/neighborhood) (see Figure 11), a mean estimate of 60.000 clothes items per neighborhood was calculated. When observing patterns per neighborhood, clothes were invariably consumed the most, followed by either children's articles or hobby equipment. The rankings of furniture, electronics, tools, and kitchen articles were more variable. Children articles and leisure equipment were estimated around 12.000, furniture 5.000 and the rest of categories around 2.000 items. When observing patterns per product, the neighborhoods which consistently had the highest consumption were in the central district (e.g., Olivedal, Lunden, Masthugget) except for one neighborhood (Eriksberg); and the neighborhood with the lowest values were spread throughout the three remaining city districts (e.g., Arendal, Högsbo, Linnarhult, Rödbo and Gunnilse). These patterns follow closely the number of households per neighborhood, especially for clothes, tools, and leisure equipment (see figure 12). Consumption of children articles has more association to the number of households with children per neighborhood, while the patterns for furniture, kitchen and electronics seem to concentrate around central neighborhoods.

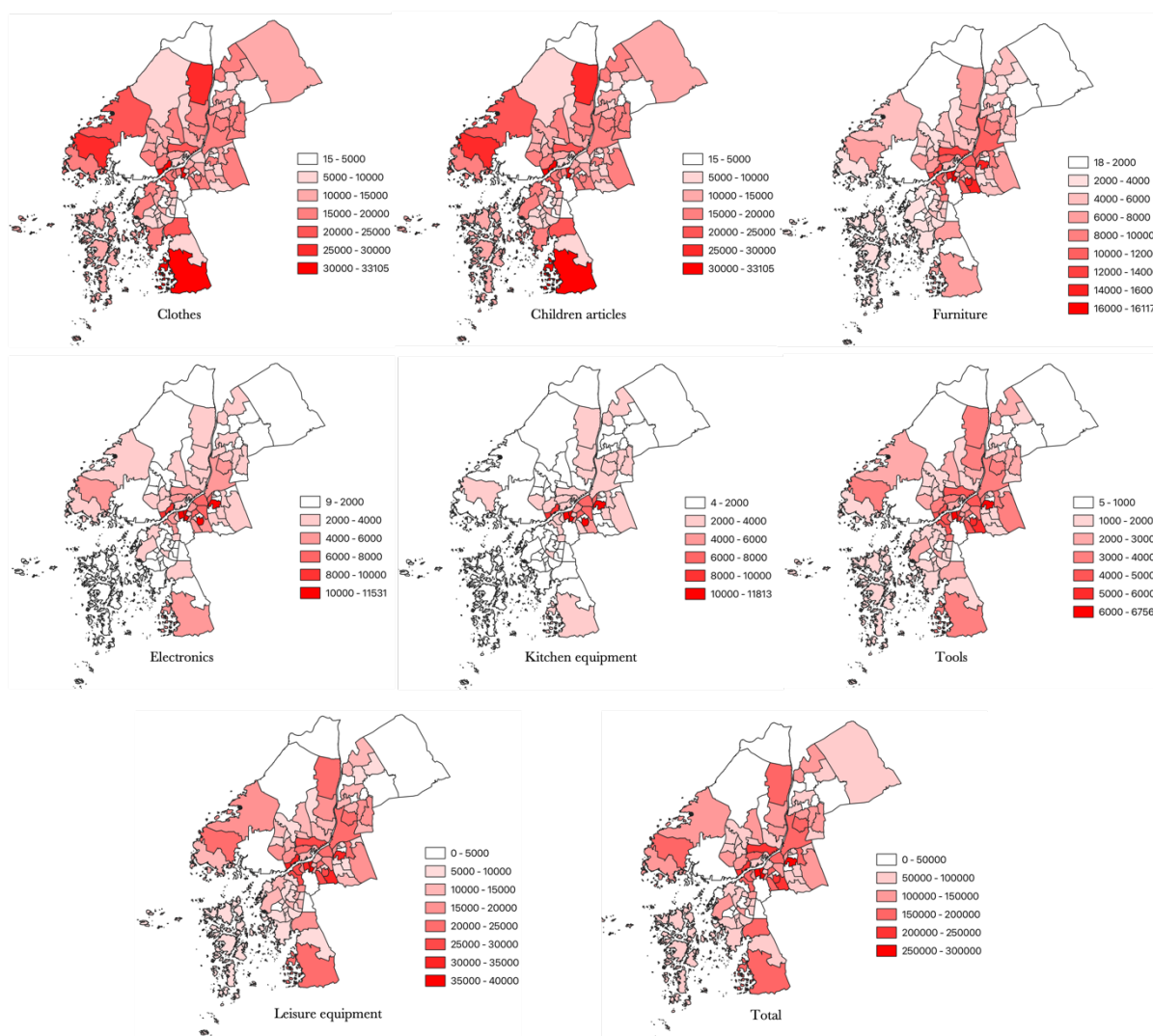


Figure 11 - Estimations of item consumption in neighborhoods for each product group. These results were calculated in items/neighborhood by using the data from the SEsam survey 2021.

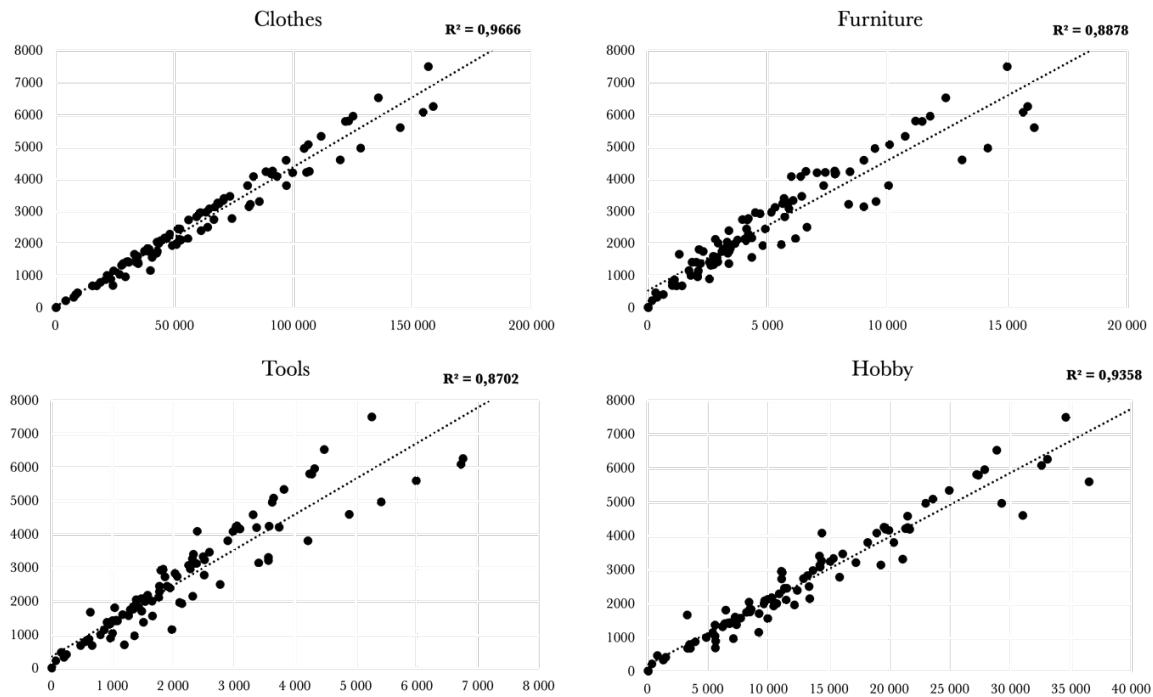


Figure 12 - Linear regression for clothes, tools, furniture, and hobby equipment vs. household number

4.3. Perceptions of the population regarding contribution of sharing to sustainability

Results show that 57% of participants were acquainted with the concept of SE. From 506 answers selected for further analysis, it was most common to provide descriptive/neutral statements. Here, themes were related to actions in the SE (“renting”, “lending”, “co-buying”) and products (“cars”, “tools”). Further, 11% had an exclusively positive view of the SE and 9% exclusively negative. While only 2% of responses were classified as “mixed”, these were analytically interesting, as they included more elaborate responses (congruent with “thicker” descriptions as coined by (Charmaz, 2014)). These considered both pros and cons of the SE, or stated conditions that the respondents thought were necessary for the success of the SE (“cheaper but poor quality”, “the will of individuals opposes the will of manufacturers”).

When coding for sustainability values, 81% of responses did not make explicit or implicit mentions of sustainability. Environmental values (“circularity”, “saving resources”) were mentioned in 9% of the responses, same percentage as for economic values (“saving costs”, “not having to buy”). Social values were less commonly expressed (5%) (“cooperation”, “friendship”). About 4% of the responses mentioned themes within more than one sustainability dimension. While it was most common to identify sustainability themes in positive and neutral responses, these were also found in mixed and negative responses (e.g., “equality that does not work”).

About 43% of the sample indicated an inaccurate perception or lack of knowledge about the SE, and thus these were not coded for the above dimensions. However, the answers underwent thematic analysis to assess the extent of misconceptions. Amongst these responses, it was common to see references to shared expenses within the household (“sharing the household economy with partner”), or implications of politics (“communism”). Response excerpts within each coding dimension can be seen in Table 1, as well as percentages for each category.

Table 1 – Percentage of responses and response excerpts along each coding dimension (positive-negative-mixed-neutral; no sustainability – environmental – social – economic). These percentages are based on the 506 answers that presented accurate perceptions of the SE.

	No sustainability implications 11%	Environmental 3%	Economic 2%	Social 2%	Environmental and Economic 1%	Environmental and Social -	Economic and Social -	General sustainability 1%
Positive	"Easy solution to share things you don't use often", "Practical", "Super good! Libraries are the best example"	"It's good and environmentally friendly", "I very good, reduces wastage of resources", "To make better use of resources by recycling, reusing and sharing"	"Better economy", "Keep down costs"	"Cooperation", "Justice", "Friendship", "Thinking long-term, not selfish, and more common"	"Ecological and economic sustainability. Win-win for everyone!", "An incredibly cost-effective, consumption-smart way to share resources. Something we should do more of."	-	-	"Sustainability", "Be in agreement, save, environmentally conscious"
Mixed	"Positive but more complicated", "More space [at home] but larger responsibility", "Cute thought that doesn't work"	"Partly positive but it feels like it's a way for use to continue consuming like before, just in a more sustainable way. I wish we would consume less instead"	"Cheaper but may not always be available and possibly poor quality", "Good! Use it regularly myself. The problem is that I think many people charge too much"	There is a lot of borrowing [...], helping each other in smaller towns, which I am positively disposed to, [...] But some people only feel solidarity with their own ethnic group or family, and don't care about others [...]."	" [...] The total production decreases. [...] At the same time, private individuals can reduce their cost [...] it is more difficult to get such a change though, as the will of private individuals opposes the will of the manufacturers. "	-	0,2%	"Own or use things together in a group. Positive: Lower energy use and cheaper. Negative: Conflicts always arise because rules for use cannot be made clear enough. There are always careless and zealous people in a group."
Negative	"Not for me", "I prefer to have my own things [...] so that I can use them whenever I want"	"An invention of the green party where the poor share everything while the rich have their own things"	"Stingy", "Uncertain working conditions, gig economy, loss of income due to non-payment of VAT, [...] the rich get richer and the poor poorer."	"Equality that does not work"	"Politically correct expression that I think is unclear. There are many other ways to be frugal and consume less."	-	0,2%	-
Neutral	"Several people using the same things", "Carsharing", "To rent, loan or resell things instead of owning"	"Sharing things, less consumption", "A circular situation", "Things circulating, being reused and recycled"	"That you can share expensive tools or a car", "Can't afford the thing but don't want to be without it"	"To take advantage of the resources that already exist in my surroundings and to contribute to others getting the same idea"	"Probably didn't notice that word before but guess it's about sustainable economy with reuse."	0,2%	-	-

5. Ongoing work and further steps

This chapter presents other research work that has been ongoing, and how these are the base for future work that will support the governance of the SE for sustainability. The sub-chapters concern a library of sharing initiatives (SIs), a library of impacts of the sharing economy (SE), and the integration of spatial analysis for the governance of the SE.

5.1. Library of initiatives

To explore the role of different sharing initiatives (SIs) in increasing sustainability beyond the dematerialization potential of the products they offer, it is planned to elaborate a library of SIs. Here, SIs would be collected, and information would be gathered about their location, platform model, offered products, and success and challenge factors. Collecting knowledge about the service providers (whether businesses or organizations) could contribute to elaborating a framework for decision making regarding SIs, as suggested by Mi & Coffman (2019) (see sub-chapter 2.4.1.). Further, this information can be essential to support collaborative forms of governance, and mechanisms such as “provision”, “enabling” and collaborating” (see sub-chapter 2.4).

This work has been initiated through the supervision of the master thesis work by Li (2021) (see Table 2) and through surveying the Smarta Kartan (2023b) (i.e., a map with Gothenburg’s SIs elaborated by the organization Kollaborativ Ekonomi (2023)). For Li, the aim was not to be comprehensive but to sample SIs with different combinations of products, participants, actions, and platforms. For Smarta Kartan, the database only covers SIs that “do not involve selling or buying, are open for everyone, are small-scale, aimed at a local level, and not popularly known” (Smarta Kartan, 2023a). While Smarta Kartan’s criteria theoretically benefit environmental and social sustainability, they do not align with the descriptive and exploratory character of this work. Therefore, future work will cover a greater scope of SIs in the city through desk research and literature review. This library might also include sharing rooms in housing companies, and informal online initiatives such as Facebook sharing groups. Success and challenge factors of the SIs (highlighted by Frenken and Schor (2017) as a research priority) could be surveyed through stakeholder interaction, in line with the researcher’s transition towards an honest broker role (see sub-chapter 3.5.). The list is then to be classified according to an adaptation of the framework in Li and coupled with a library of impacts (see sub-chapter 5.2).

Table 2 - Library of SIs. Here, each SI is classified according to the products they offer, the sharing actions they offer, the participants that are taken under their platform, the participants and the platform type (Adapted from Li (2021))

	Shareable products								Sharing actions				Participants				Platform type		
	Mobility	Books	Toys	Tools	Clothes	Equipment (sport, musical, electronic)	Furniture	Appliances	Sale-buy	Lend-borrow	Donate	Swap	Private individual	Businesses	Municipalities	Organizations	Online-markets	Second-hand stores	Multifunctional sharing places
Sharing Initiatives																			
Streetbank		✓	✓	✓		✓				✓			✓	✓			✓		
Hygglo	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓			✓		
Peerby	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓			✓		
Swapshop		✓	✓	✓	✓				✓		✓	✓	✓	✓			✓	✓	
Thredup					✓				✓				✓	✓		✓			
Getground	✓									✓			✓	✓			✓		
Campanda	✓									✓			✓	✓					
BabyQuip			✓							✓			✓	✓		✓	✓		
Fretish						✓				✓			✓	✓			✓		
Style Lend					✓					✓	✓	✓	✓		✓		✓		
Återbruket	✓	✓	✓	✓	✓		✓		✓				✓	✓				✓	
Holmens Marknad	✓	✓	✓	✓	✓		✓	✓	✓				✓	✓	✓		✓	✓	
Fritidsbanken						✓				✓			✓		✓			✓	
Leksaksbiblioteket			✓							✓			✓		✓			✓	
Franssons Hörna			✓	✓			✓		✓	✓			✓	✓					✓
Kvibergs Marknad		✓	✓	✓	✓				✓	✓			✓	✓	✓				✓

5.2. Library of impacts

To identify the sustainability potential of different sharing initiatives (SIs) in the library, it is planned to elaborate a compressive library of impacts from the SE.

This work has been initiated by Whetstone et al. (2020), and continued through the supervision of de Boer et al. (2021)'s master thesis work (see Table 3). So far, the library includes carbon footprints for the consumption of household products and a few studies of sharing impacts. Future work would entail a literature review to include missing products and more recent studies. The library would allow more detailed knowledge into the potential impacts of SIs in Gothenburg (such as expected carbon and material footprint savings through sharing of specific products), but could also help to assess the status of the research field critically and to point out gaps in terms of assessing impacts of the SE. This would add to RO3 in the form of empirical data, but would also address the research need that Geissinger et al. (2019) pointed out (see sub-chapter 2.3.1.).

So far, this research work has focused on the local government perspective and on the private individuals/household's perspective. Through this library, there is also the possibility to include the SI perspective. As potential impacts are identified, it could be assessed whether initiatives recognize, fulfill, or market said potential. The latter could be achieved by surveying SIs' websites for sustainability themes, following up on the work by Geissinger et al. (2019).

Table 3 - Example of library of impacts (Adapted from de Boer et al. (2021))

Product	Carbon footprint [kgCO ₂ e/kg]	Weight [kg/unit]	Carbon footprint [kgCO ₂ e/unit]	References
Jeans	21	0,447	9,39	(Roos & Larsson, 2018) (Whetstone et al., 2020)
T-shirt	14	0,38	5,32	
Jacket	27	0,38	10,26	
Children clothes	14	0,201	2,81	

5.3. SE in Gothenburg from the spatial perspective

Following up on the research needs identified by the SCG representatives (see sub-chapter 3.2.3. and Additional Material – Table A.1), a next step into the research is to continue developing the geographical perspective through spatial analysis. This information could aid local governments in the governance of the SE through spatial planning and development. The importance of a spatial perspective in sharing is highlighted by Sánchez-Vergara et al. (2021), who say the concept of “place” affects the performance of sharing, and by Demailly and Novel (2014), who mention that the geographical scale of sharing affects its environmental impacts.

This would unify several outcomes and future work presented throughout this licentiate thesis. First, the results from the identification of neighborhood patterns (RO2) would be refined. Further work would entail disaggregating product categories in the mass estimations, normalizing the results in the mass and item estimations, investigating what factors determine the variance in the products where no pattern was identified, and investigating the role of different demographic characteristics in both estimations. Furthermore, it would be investigated whether more patterns can be perceived by using the consumption and sharing variables from the SEsam and SCG surveys. For this, characteristics could be clustered as in Li (2021). It is also planned to integrate the information about geographic location of the SIs in the library (sub-chapter 5.1.), which would help assess the accessibility and reach of SIs

through spatial analysis (Stavroulaki et al., 2023). Finally, it would also be possible to integrate results from the demographic and product perspectives, supported by statistics about demographic characteristics throughout Gothenburg (Göteborg Statistik och Analys, 2021) (see figure 13).

A challenge for developing the spatial perspective is the lack of uniformity in the spatial disaggregation of data. Thus, the work involves identifying appropriate methods to address this challenge.

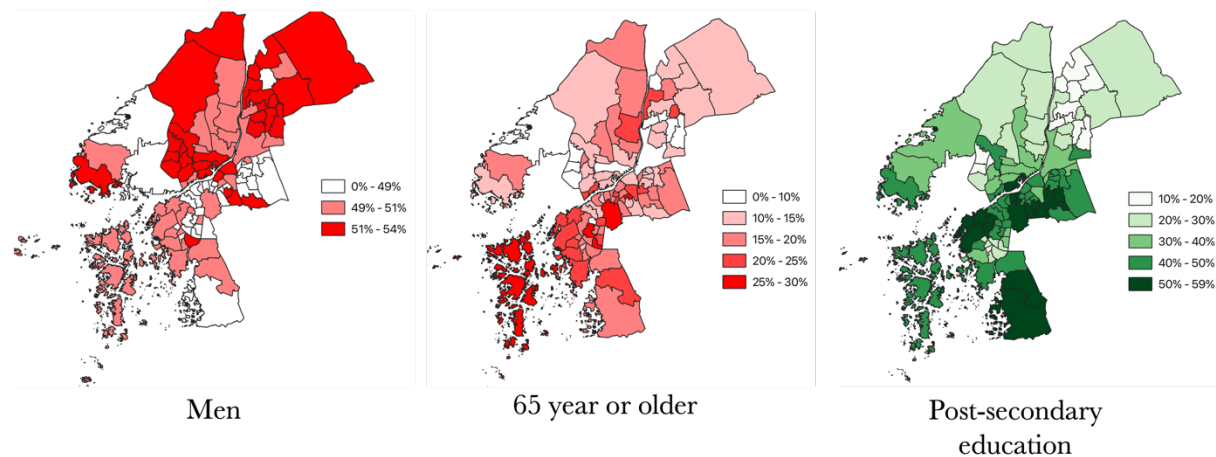


Figure 13 – Geographical distribution of demographic characteristics highlighted in RO2.

6. Discussion

In this chapter, the findings are discussed considering extant literature. Further, limitations in the work are highlighted, methodological choices are discussed, and a conclusion for the work is presented.

6.1. Behaviors and attitudes of Gothenburg's population regarding consumption and sharing

Through RO1 it was intended to present a general picture of the potential for dematerialization through the SE in Gothenburg. Results showed that most respondents feel comfortable with their product stock, and only about a third think that they own too many things. Considering that Sweden has consistently been amongst the highest consumers in Europe (Eurostat, 2022), it could be worth to examine the population's perception of their consumption. Otherwise, overall behaviors and attitudes regarding sustainable consumption and sharing were positive, which mirrors Sweden's attitudes and behaviors towards sustainable actions (Bassi, 2023). However, there was high variability regarding attitudes and behaviors for each sharing activity. Activities with the most acceptability were generally B2C and could be considered more established forms of sustainable consumption (Codagnone & Martens, 2016), while P2P models were the least engaged in. Furthermore, attitude-behavior gaps were seen as is common for other sustainable practices (Moraes et al., 2012); and different levels of attitudes and behaviors were seen depending on the role. The lower interest and participation from the provider role could be related to the lower interest and participation in P2P forms, as participants don't need to provide in B2C models.

The good attitudes towards SE activities and towards reducing consumption portray Gothenburg as good grounds for the uptake of sharing instead of purchasing. Whether the attitudes transition into behaviors is something to be addressed by authorities (see sub-chapter 6.4.). Furthermore, efforts needs to be made so that "less established" forms of sharing are accepted and engaged in by the population, considering that P2P models are amongst the most sustainable (Curtis & Mont, 2020).

6.2. Consumption and sharing patterns

This RO was meant to generate specific and actionable knowledge to facilitate local governance of the SE, by focusing on patterns in the data that were relevant for dematerialization potential.

6.2.1. Products groups

The results suggested a relatively higher interest in providing clothes rather than accessing them through the SE, which might be explained by the large stock of clothes in the households (inferred from the high yearly level of purchases). The interest in providing might be associated to activities such as donating to second-hand shops (which had high percentages of engagement in RO1), since clothes renting remains a niche activity in the Nordic countries (Pedersen & Netter, 2015). It is possible then, that this translates into the general population maintaining a high level of consumption, and some donating or selling the clothes when no longer necessary. Similarly, other research points out that there is a disconnect between what people want to borrow and what people want to lend out due to different values associated to each role

(McLachlan et al., 2016). In Gothenburg, local regulation documents identify clothes as a hotspot due to their high environmental impacts (Göteborgs Stad, 2017), so local authorities could explore how to prompt the population to lower clothes consumption, how to achieve a critical mass of both users and providers in clothes sharing, and to promote other sustainable patterns that do not rely on a P2P model.

Further, for tools and leisure equipment, the lower consumption values might be explained by these having a longer lifespan (Curtis & Lehner, 2019), therefore high yearly consumption rates are not expected. On the other hand, higher values in the sharing dimension might be due to the products having a less “personal” character than clothes (with less hygiene concerns and less use for personal expression of style (Becker-Leifhold & Iran) and being used more sparsely (Ellen Macarthur Foundation, 2016)), which makes them more attractive for sharing. Furthermore, tools are regularly used as an example of the SE in Sweden (Göteborgs-Posten, 2019; IVL Svenska Miljöinstitutet, 2020; Karlstads Kommun, n.d.), and sports equipment are offered through a well-established sharing organization called Fritidsbanken (2023). Even if consumption values were not so high, these two categories, along with electronics and adult and children’s clothes might contain critical raw materials (European Commission, 2020). Therefore, they are relevant targets for reducing consumption through sharing from the material perspective. Also, these products were the ones with the most prominent attitude-behavior gaps. Therefore, local authorities can invest in shifting this gap, even if higher sharing would not contribute to a significant reduced yearly item consumption.

6.2.2. Demographic groups

While the original intention was to identify groups that had high consumption levels, interest in reducing and interest in sharing, no single demographic characteristic presented such “immediate” potential for dematerialization. Instead, specific conditions were identified for gender, age, and education level. In comparison to results in RO1, the demographic patterns show where to focus to transition the population into stronger attitudes/behaviors, such as being “very interested” in the SE. Also, more negative associations to the selected variables were found than positive, which highlights the necessity of shifting negative attitudes and behaviors.

Men had highly significant negative associations to reducing their consumption and to participate in sharing, in comparison to women. In other studies, men report weaker environmental attitudes than women and participate in more unsustainable consumption patterns (Räty & Carlsson-Kanyama, 2010; Zelezny et al., 2000), while being less affected by environmental degradation (OECD Publishing, 2021). It is therefore important to explore the motivations of this demographic group, and to devise strategies to make sustainable consumption habits more appealing for them.

Regarding age, research about consumption patterns across the life cycle of individuals points out that around age 40, consumption increases to accumulate assets before pension, and in older ages this rate decreases, possibly to save money (Gourinchas & Parker, 2002). This might explain why despite their lower likelihood to consume too much, seniors were also more likely to believe that they own too much. Considering a potentially large product stock, conditions could be created to improve their accessibility to act as providers in the SE. Miller et al. (2020) explores how the SE might support older people, mentioning that it might reduce costs and provide opportunities to generate income, though barriers such as technology accessibility must be addressed. Further, considering seniors experiencing higher levels of isolation in Sweden

(Folkhälsomyndigheten, 2022), conditions could be created for accessing products through community-based initiatives as delineated by Acquier et al. (2017).

Finally, the only pattern where the demographic characteristic was a significant positive predictor for the variables considered was the educational level. With this data, significance was only seen for variables representing beliefs and attitudes (thinking of owning too much, being very positive towards sharing activities) but no significance was seen towards variables that represent behaviors. While some research indicates that individuals with higher education levels have higher ecological footprint due to increased salaries and living standards (Ferreira et al., 2023; Zhang et al., 2015), it is also seen that higher environmental values and intentions to adopt sustainable consumption behaviors might lead this group to lower their footprints (Al-Nuaimi & Al-Ghamdi, 2022; Zhang et al., 2015). Some also identify that education is related with more sharing (Andreotti et al., 2017), particularly of mobility (Aguilera-García et al., 2020) and accommodation (Alizadeh et al., 2018).

6.2.3. *Neighborhoods*

Results for the mass consumption patterns through HBS data 2012 indicated that across neighborhoods, furniture and household equipment was the most consumed. While furniture and household equipment did not relate to any highlighted product pattern in the previous subchapter, sharing of these products might be relevant for reduction of waste amounts. According to the Swedish Nature Conservation Society, furniture is the product category where consumption has increased the most intensively between 2009 and 2019, with sofas being responsible for 500 kg of waste and dining sets 235 kg waste (Naturkyddsforeningen, 2021). Thus, including mass estimations adds another dimension to the exploration of dematerialization potential in terms of product patterns. As for neighborhoods, further studies were recommended to determine factors that affect the patterns.

Results for item consumption patterns through SEsam data 2021 indicated that across neighborhoods, the clothes were invariably the most consumed in items. Nonetheless, clothes consumption has stagnated in Sweden since 2018, and a significant decrease was seen during the covid-19 pandemic (Holmberg, 2021), which indicates a favorable trend. Although the results were not normalized, it is still relevant for governance to locate where the highest amounts of items could be found, as this could influence the viability of P2P models (how many products can be found in an area to be shared), as well as the resulting environmental impacts related to transport of products (Demailly & Novel, 2014).

6.3. **Contribution of the SE to sustainability according to participants**

The purpose of this RO was to initiate the work towards understanding the sustainability potential of the SE in Gothenburg besides dematerialization, and to identify action points for governance from the participants' own perspectives. At this point, this is achieved theoretically rather than empirically.

The results show that little over half of respondents were familiar with the SE. Although this is positive, it is not surprising that almost half were unfamiliar; considering that the definition of the SE is also contested amongst academics (Acquier et al., 2017). The high levels of lack of knowledge in RO3 despite the relatively high levels of participation and positive attitudes seen in RO1; and the stark difference between the percentage of positive impressions between the quantitative analysis in RO1 and the qualitative analysis in RO3, could potentially be

attributed to lack of knowledge about the SE (i.e., not being aware of which actions are relevant but still participating in them).

More importantly, through this RO was generated qualitative knowledge on themes to be strengthened by governance, such as “safety”, “saving money”, “sustainability”; and themes that highlight barriers to be overcome, such as “unpractical”, “unsafe work conditions”, “personal conflicts”. In terms of sustainability, identified themes were in line with the connotations in previous research, including “circularity”, “saving resources”; “saving costs” and “not having to buy” (Hossain, 2020). Several responses indicated replacing purchases, which points towards dematerialization potential. Fewer responses included themes within the social dimension, but also backed up well-documented benefits as “cooperation”, and “friendship”. The lower association of SE to the social dimension mirrors previous research that states that in the SE, social aspects do not have much importance for private individuals nor businesses compared to other motivations (Hossain, 2020; Plewnia & Guenther, 2018)

6.4. Governance reflections

Good conditions for reducing consumption through the SE are seen in Gothenburg, as there are generally positive attitudes towards reducing consumption and towards sharing activities in the population, as well as local authorities who display proactive and collaborative types of governance for the SE. The knowledge generated in this thesis could support a more effective transition towards sharing instead of buying through evidence-based governance interventions. While this thesis does not aim to provide specific recommendations for governance, some broad reflections are presented:

A main thing to address is the attitude-behavior gap (RO1). Regarding this, pro-environmental behavior results from a complex interplay of internal (knowledge, values, attitudes, feelings) and external factors (infrastructure, political action, socio-cultural factors, economy). In this way, the lack of sufficient external possibilities and incentives to share can hinder the adoption of this behavior, even if the intrinsic factors are favorable (Kollmuss & Agyeman, 2002). Governance mechanisms can contribute to both. For example, for hindrances related to demographic patterns (RO2), a first step could be influencing public opinion through the “information” mechanism, as per Vith et al. (2019) and similar to “enabling” as per Barile (2021). For seniors who have large stocks, fostering internal factors is important, but also external conditions could be improved through providing access to social sharing (Acquier et al., 2017). Often, non-for-profit initiatives struggle to remain functional, so local governments could support them by the “provision” and “enabling” mechanisms Voytenko Palgan et al. (2021), where funds and infrastructure could be crucial (e.g., subsidizing rental costs for premises). The highly educated groups already present favorable internal factors, so governance could tackle external factors, for example, by supporting initiatives close to educational sites.

Furthermore, clothes were a highlight both in the product and geographic patterns, but the levels of interest for sharing weren’t remarkable. Here, the “fostering” mechanism (McCormick & Leire, 2020) might be relevant, as it consists in making niche behaviors more attractive to the population. With the “providing” mechanism, the city can also create their own initiatives that focus on clothes or furniture and household equipment. This governing role is recommended when there is insufficient interest from the citizens, but the initiative is worth promoting due to its sustainability benefits (WEF, 2017), thus appealing to the higher acceptability of B2C models. As for the themes identified in RO3, strengthening the positives,

and addressing the hinders would presumably require collaborative forms of governance, as many of these themes are related to SIs operations. Negative factors, such as “uncertain work conditions”, might be addressed by “regulating” mechanisms.

Finally, the ongoing and future work will generate more knowledge to support evidence-based governance. For example, the quantification of consumption in different geographic areas pointed out that the consumption of clothes is quite homogenous, so governance mechanisms could be generalized throughout the city, but further work on geographical patterns could elucidate patterns that should be governed in specific areas of the city (e.g., spatial distribution of demographic patterns in Figure 13). Furthermore, the work regarding the library of initiatives (see sub-chapter 5.1.) could provide information about specific challenges of the SIs that might be alleviated by governance, and the location of SIs will clarify whether the offer of SIs is sufficient for the conditions in each neighborhood.

6.5. Methodological reflections

Regarding methodology, the workshop format could help stakeholders such as Gothenburg city to select variables that provide information adapted to their sustainability goals. For example, during the workshop with the SCG representative, an exercise like the one in Additional Material - Figure A.1 was performed but focused on social sustainability. It can also be highlighted that the approach allowed to identify the specific needs and challenges of the city. A collaborative approach is suitable to address the different interests of stakeholders in the SE (Ma et al., 2018), and in this case, the city also engaged in a “providing” governance mechanism by facilitating their data for research.

Regarding the wide scope of products and sharing actions considered, this allowed to perceive results that deviated from the general estimations: for example, the variation in the attitude-behavior gap according to products, the variation of engagement depending on the role considered, and the variation of interest in sharing according to the product considered. This also allowed to make comparisons between categories and so to reduce the fragmentation in the SE field (Gurău & Ranchhod, 2020).

6.5.1. Iterative character of the research

As most research, this project has undergone iterations where the data analysis has led to reformulating the aim, scope and objectives (Gould, 2011). Below are some examples of iterated elements:

Aim of the thesis and data sources – From method development to explorative study

In line with the SEsam project, the original intent was to continue developing the SEsam method to quantify the sustainability benefits of implementing SIs in cities. However, the delay of HBS data prevented from updating 2012's estimations. The SEsam survey was performed to continue the process, but the sample size and the non-probability sampling limited the generalizability of the results and therefore it was not an appropriate base for method development. In this way, the research was better suited for an exploratory approach.

Scope – Reconsidering what's important

In line with the intention to develop a method, the original scope for demographic groups referred to household characteristics only. However, results in sub-chapter 4.2.2 and other

research have pointed towards the importance of individual characteristics within sharing (e.g., (Politis et al., 2020; Sarkar et al., 2020)), therefore the scope was expanded. In terms of product groups considered, mobility was originally included, but it was observed that mobility has been covered extensively within the field of SE (Hossain, 2020).

RO2 – From prioritization to pattern identification

During the workshop with the SCG representative (see sub-chapter 3.2.3.), it was decided to identify which demographic groups, products, and neighborhoods to prioritize in the governance of the SE. However, the data analysis demonstrated that a lot of baseline information had to be generated before moving on to prioritization.

A main challenge was seen for deciding prioritization criteria. Given that no product could be identified where there was a high consumption and a potential to replace that by sharing, it was difficult to select one single set of prioritization criteria that could be applied across the board (e.g., is it better to prioritize products that are consumed in high amounts, even if the interest is relatively low? Or is it better to prioritize products purchased less regularly, as people might find it easier to transition into sharing them?). Similarly, no demographic group had significantly high consumption, desire to reduce it, and interest in sharing.

Also, in further discussions with SCG representatives, it became apparent that the goal of the prioritization was not clear, as there are many different governance mechanisms that could be applied depending on the characteristics of the case.

6.5.2. Limitations

Sampling: A main limitation of the study is the non-probability sampling utilized in the SEsam survey and its smaller samples. This made it harder to detect statistical significance in RO2 and severely limits the generalization of results. Because of this, all results from the SEsam survey must be taken as an indication and should be confirmed with studies with larger populations. Further, it must be recognized that by analyzing two independent surveys, the analyses concern two different groups. Nonetheless, both underwent post-stratification and had samples roughly matching Gothenburg statistics (see in Appendix of the appended manuscript – Table C.1).

Consumption: Although questionnaire surveys are recognized as a flexible way to obtain data from in a standardized way (Blair et al., 2013); the yearly consumption derived from the SEsam survey might have been affected by the self-reporting format, leading to over- or underestimations Beegle et al. (2012). Further, using only the number of purchases during a single year as a measure for consumption favors products that are bought more frequently, but which might not necessarily be more resource intensive.

Timing: the time of the data collection might have had an additional impact on the results. Both surveys were performed during the covid-19 pandemic, which can mean that the income and consumption variables have been affected. Other studies done during the pandemic in Switzerland and Sweden show that the purchases of leisure equipment such as books increased, while products in the clothes category decreased (Esposti et al., 2021; Holmberg, 2021).

Sustainability: In this thesis, sustainability is mainly measured by the potential of dematerialization through reducing consumption in number of items. The underlying conceptualization for dematerialization can be questioned, as previous studies have shown that reducing consumption in combination with adopting circular behaviors does not guarantee a

direct reduction of material footprint (Junnila et al., 2018). Also, to achieve a richer understanding of the potential for sustainability through the SE (or even for additional environmental benefits such as reduction of greenhouse gas (GHG) emissions), other metrics could be included in the consumption dimension (e.g., household product stock, material intensity of products, life cycle assessment values (Martin, 2018; Zamani et al., 2017)).

Conceptualization: In RO1, desirability bias (i.e., people responding what is deemed as “socially acceptable”) could be inflating the results. To avoid this, only the positive extreme answers were analyzed for each variable in RO2. However, this decision might leave out other products and demographic groups with interesting patterns.

Survey variable categories: The lack of compatibility between some of the socio-economic categories in each survey (age, income, and gender) made it difficult to normalize results across the surveys. Not including gender as a variable in the SEsam survey can be seen as a major limitation, considering that the most significant results of the SCG survey were related to this characteristic. Further, non-binary and other gender identities were not considered in the SCG survey. Also, in the SCG survey, the categories included within sharing interest questions were not the same as in sharing behaviors questions, which makes it difficult to compare between sharing attitudes and behaviors. Finally, product groups were distinct across surveys and although normalization was easy, assumptions were still made from the research team and from the respondents (see Appendix of appended manuscript– Table D.1).

Thematic analysis: For RO3, a limitation pertains the intent of the question analyzed. The question was not specifically aimed at gaging attitudes, which can be a weakness, but also to a certain extent bypasses the social desirability bias. Other limitations are the subjective perspective of the researcher (although this is acknowledged with the post-positivist positioning), the fact that only one researcher has performed the coding, only one round of revisions has been made (except for the social themes through Gkagkalidis (2022)’s master thesis), and the fact that Swedish is not the native language of the researcher.

7. Conclusions

This thesis has aimed to generate detailed knowledge about consumption and sharing, to aid local authorities in governance towards sustainable household consumption. The research is consolidated through the research objectives RO1 - Quantifying behaviors and attitudes of Gothenburg's population regarding consumption and sharing; RO2 - Identifying consumption and sharing patterns from the perspective of household products, demographic groups, and neighborhoods; and RO3 - Identifying the potential contribution of sharing to sustainability from the participant perspective. The aim has been addressed through a mixed-methods design involving collaboration with local government representatives, statistical and qualitative analysis of variables within two questionnaire surveys, and the application of the SEsam method. The sustainability focus has been dematerialization through the SE by preventing trade-offs, and to a lesser degree, social and economic sustainability.

Quantitative analysis results indicated that about a third of respondents consumed within the highest bracket considered, and about a third thought they own too many household products. Nonetheless, most respondents are comfortable with reducing their consumption in the next five years. There were relatively high interest rates and participation in sharing activities, but these were very variable according to the activities and products considered. Notably, mediated P2P forms were the least interesting and participated in. Higher rates were seen for wanting to be a consumer in the SE than to be a provider, with a similar pattern in the actual participation. For the matter of dematerialization, gender, age, and level of education were statistically significant. This means that other demographic characteristics do not reliably predict the considered variables. Regarding products, clothes were the most interesting case: They were the most consumed, the most owned, and one of the only products with more activity and interest on the provider side, though sharing values were not remarkable. Tools and leisure equipment were the products with the most positive attitudes and the highest participation rates. In terms of mass consumption per geographic area, furniture and household equipment were the most relevant group. Otherwise, the neighborhoods ranked highest for consumption (both in mass and items) follow approximately the rankings of household density. Still, more work needs to be done in terms of normalizing results and assessing the impact of different demographic characteristics.

Qualitative analysis results supported that there are more positive perceptions of the SE rather than negative ones, and the themes identified were congruent with extant literature. Positive aspects might be reinforced by governance, while negative ones can be taken as hindrances to overcome. While most responses did not explicitly mention sustainability, the SE is related by many to circularity, saving resources, saving money, and to a lower degree, to cooperation and friendship. Despite relatively high levels of interest and participation in at least one SE activity in the results above, about half of the respondents were unfamiliar with the term.

The results contribute to the growing but still scarce literature on how to achieve the sustainability potential of the SE, particularly for household durables, and to the theoretical study of second-order effects such as increased consumption. The wide scope of the research in terms of products, SE activities, and roles allows for easy comparison between cases and to reducing the fragmentation in the SE field. On a practical level, the identification of patterns provides actionable points for governing the SE and can lead to the identification of various applicable mechanisms. Finally, the cooperation with the city highlighted the importance of a collaborative approach in ensuring the sustainability of the SE. While the methodology and

results apply to the Gothenburg context, they could be used as inspiration for other Swedish municipalities and in similar international contexts.

Future research involves refining the results for the estimation of consumption values per neighborhood as well as integrating the sharing dimension into the identification of geographical patterns. Also, a library of local SIs will be finalized along with a library on potential impacts such as GHG emissions and material use. These will expand the knowledge in the SI perspective and generate information on other actionable points for the governance of the SE towards sustainability.

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