Integrating

Ecodesign for Sustainable Products Regulation into Organisational Practices

- A case study of Kvadrat Really

Source: Kvadrat Really

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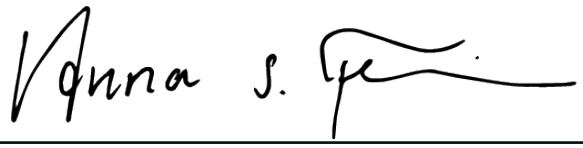

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Abstract

The Ecodesign for Sustainable Product Regulation (ESPR) is an EU initiative aiming to improve circularity, energy efficiency, and overall environmental sustainability supported by product performance and information requirements. This case study examines how the organisation Kvadrat Really, is affected by this regulation, and how potential ESPR-related challenges can be translated into organisational opportunities. A review of academic and grey literature reveals a gap in understanding how to implement the ESPR requirements into organisational practices. Furthermore, companies operating at the intersection of textile recycling and the furniture industry, such as Kvadrat Really, may encounter unidentified challenges that have not been adequately addressed in the development of the ESPR. The methodological framework for the analyses is based on the Action Nets- and Political Process Theories in combination with methods from social science, technical studies and design practices. They investigate the organisation internally and externally by examining current knowledge flows, interactions, practices, and relationships. Lastly, a concrete action for how Kvadrat Really can incorporate ESPR strategies into their daily operations is discussed with actors from the parent organisation Kvadrat, the product facility Convert and Kvadrat Really. ESPR and organisational challenges related to data collection, responsibilities in the value chain, take-back systems, maintenance, repair and general product longevity were discussed. Finally, an action plan is suggested containing four areas for further development and implementation: Definition of the actor's role in the value chain, collection of sufficient data to ensure complete product quality, establishment of a repair and maintenance service and a reevaluation of the relationship between Kvadrat and Kvadrat Really to enhance stronger ESPR strategies across shared value chains.

Keywords: *Furniture Industry, Textile Industry, Post-consumer, ESPR, Eco-design, Ecodesign for Sustainable Products Regulation, Supply Chain, Transparency, Fibre-to-Product*

Table of Abbreviations

Abbreviation	Explanation
ANT	Actor-Network Theory
B2B	Busines-to-Business
CE	Circular Economy
CEAP	Circular Economy Action Plan
CoC	Code of Conduct
DM	Development Manager
DPP	Digital Product Passport
EFIC	The European Furniture Confederation
EoW	End-of-Waste
EPD	Environmental Product Declaration
EPR	Extended Producer Responsibility
ESPR	Ecodesign for Sustainable Products Regulation
F&D	The Founder & Director
LCA	Life Cycle Assessment
MIL	Material Innovation Lab Manager
P&P	Purchaser and Planner
PPT	Political Process Theory
R&D	Research & Development
RCS	Recycling Claim Standard
RQ	Research Question
SC&O	Senior Vice President of Supply Chain and Operations
SD	Sales Directer
SMEs	Small and Medium-sized Enterprises
SoC	Substances of concern
SPI	Sustainable Product Initiative
STS	Science and Technology Studies
SUB-Q	Sub-question
VOC	Volatile Organic Compounds
WFD	Waste Framework Directive

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Ecodesign forordningens betydning for tekstiler	DM&T		Online	Webinar	Get a better understanding of the current status of ESPR in the textile sector	-
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kvadrat

Source: Kvadrat Really

1. Introduction

During the opening speech at the 2023 World Circular Economy Forum, Tim McPhie, the spokesperson for Climate Action and Energy at the European Commission, stated:

"We need to develop an economy where products and materials are reused, repaired and recycled instead of thrown away, where circular business models become mainstream, and where waste from one industrial process becomes a valued input for another"

(Tim McPhie, 2023)

The growing environmental concerns and the increasing scarcity of natural resources have led to a global shift towards sustainable development (European Environment Agency, 2022). In response, regulatory frameworks such as the Ecodesign for Sustainable Products Regulation (ESPR) have been introduced to help industries minimise their ecological footprint while maintaining economic viability (European Commission, 2022; European Parliament, 2009). Formulated by the European Union, the ESPR aims to improve the sustainability of products by integrating environmental considerations into the product lifecycle, thereby promoting a circular economy (CE) (European Commission, 2022). Furthermore, the concept of circular business models was advanced by the Ellen MacArthur Foundation in 2012, which presented it as a significant business opportunity (Ellen MacArthur Foundation, 2012). However, this regulation is also relevant for companies that already incorporate principles of CE in their business models to reduce environmental impact and enhance resource efficiency.

One of the most waste-generating industries is the textile industry, due to the large volumes generated in low quality, and the complex composition of textiles. This often includes a mix of natural and synthetic fibres, which is challenging to recycle. (Ellen MacArthur Foundation, 2017). The traditional disposal methods for textiles are landfilling and incineration, which contributes to environmental degradation and resource wastage (European Environment Agency, 2022). Consequently, this concern is fostering innovative recycling practices; an example is Kvadrat Really, which recycles textile waste into new tabletops, a process that aligns with the principles of the CE by extending the life cycle of textile materials and reducing the demand for virgin resources (ibid).

This master thesis aims to identify the specific focus areas outlined by the ESPR together with the relevant actors by developing an action plan for implementing ESPR and improving the circular economy. This involves a case study of Kvadrat Really. This case is selected due to an initial study identifying significant challenges within the organisation, which are relevant to consider in the context of the new regulation. Additionally, a key reason for choosing this case is the organisation's unique position, being subject to requirements from both the textile and furniture industries. The case will extend by

firstly analysing the organisation's current practices, investigating how the ESPR affects Kvadrat Really, and proposing improvements based on the analysed key findings and participatory infrastructuring. However, before the analysis, it is essential to have the base knowledge of the coming regulation, the markets and the examined organisation, Kvadrat Really.

1.1 The Ecodesign for Sustainable Products Regulation

ESPR builds on several Union policies, illustrated in Figure 2 (Dansk Standard, n.d.). The initial foundation is the European Green Deal from 2019, which is a set of policy initiatives and strategies for ensuring a *"resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use"* (European Commission, 2022, p. 3). In March 2020, the European Green Deal announced a new industrial strategy for Europe and a Circular Economy Action Plan (CEAP) (European Commission, 2021). This strategy outlined various initiatives and policy measures to strengthen Europe's industrial base, promoting a "twin transition" to a more sustainable, responsible- and digital economy (European Commission, 2022). CEAP mainly aims to drive the growth of markets for climate-neutral and more sustainable products within and beyond the EU market. It consists of different policies, one is "the Sustainable Product Initiative" (SPI) (European Commission, 2022, p. 3).

Figure 2 - EU's Sustainability Policy to ESPR.

The core object of CEAP and the SPI is to broaden the former product scope to go beyond energy-related products and encompass a wide range of products and sectors, to make "*more sustainable products the norm*" (European Commission, 2022). SPI was further implemented through "the EU Strategy for Circular Textile" and "Construction Product Regulation" (ibid.). Additionally, CEAP initiatives such as "Empowering Consumers for the Green Transition" and the Commission initiative on "Green Claims" will improve consumer information and prevent greenwashing (ibid.). Additionally, these strategies necessitate the industry to reflect on the choice of materials and recycling in the design phase, reduction of energy and resource consumption in production, and implementation of waste prevention and reduction measures. The main policy instrument under SPI is ESPR (Anthesis Group, 2023).

ESPR requires companies that introduce products into the EU market (including importers, distributors, and online sellers) to deliver data concerning the products' performance and information which encounters:

Performance requirements**:** Concern product durability, reusability, upgradability, and repairability, energy and resource efficiency, recycled content, carbon and environmental footprints, and the presence of chemical substances that inhibit the reuse and recycling of materials, (European Commission, 2023a).

Information requirements: Mean general information regarding storing, performance, use, maintaining, repairing, recycling, disposal and possible substances of concern (SoC) (European Commission, 2022).

The Digital Product Passport (DPP): Is a tool for collecting and sharing the above-mentioned information regarding the product and its supply chain (European Commission, 2023b).

Furthermore, transparency regarding the disposal of unsold or returned products is required as part of the control against the ban on the destruction of unsold goods and is urged to be settled by co-legislators (European Commission, 2023a). According to Anthesis Group (2023), we are now moving from the "Adoption Phase" (2024-2025) into the "Implementation Phase" (2026-2027) where the first *Delegation Act*[1] will be shaped. This will be replaced by the "Application and Enforcement phase" (2026-2027) where products, after the transition period, must comply with the new requirements (including ecodesign, information and DPP requirements). They suggest that for a business to prepare for the ESPR one should first asses the regulation against the context of the specific business, then develop strategies and finally implement the ESPR solution.

1 Delegated acts are non-legislative acts adopted by the European Commission that serve to amend or supplement the non-essential elements of the legislation (*Delegated Acts - EUR-Lex*, n.d.)

1.2 Textile Waste and Recycling

According to Fletcher (2010), the first step in changing textile waste management systems is to understand the definition of waste to redefine its value. Through the past decades, the textile industry has more than doubled its production, while the length of each garment being used until discarded has decreased by around 40% (Papamichael et al., 2024). These industry conditions are important in understanding textile waste (Thürer et al., 2017). Another condition is the high volume of low-quality products being made in the fashion industry, which results in an increasing number of clothes with limited resource value from the beginning (Warp, 2019). It is crucial to redesign the valuing of products and resources to change into new production strategies (Karell & Niinimäki, 2019). Landfilling and incineration are conventional methods for handling waste in the textile industry (Huang et al., 2024), and are currently the primary destination of textile waste (Hedrich et al., 2022). This destination of textile waste is closely connected with the linear "take-make-waste" logic, where resources are not produced with reuse or recycling in mind (Hedrich et al., 2022).

To redefine the meaning of textile waste into something of value calls for looking into its value before it is categorised as waste. Craftsmanship[2] is valued through the amount of time in making. The process of *slowing* is connected to the principles of the CE (Ellen MacArthur Foundation, 2023; Lawless & Medvedev, 2016). Circularity embraces the strategy of turning waste into value again, by life-extension practices such as reusing, upcycling and recycling (De Oliveira Neto et al., 2022).

To understand the challenges and possibilities within textile waste management, it is important to define the differences between textile waste as pre-consumer and post-consumer (See Figure 3).

2 The skill of making things, especially by hand (Cambridge Dictionary, 2024a).

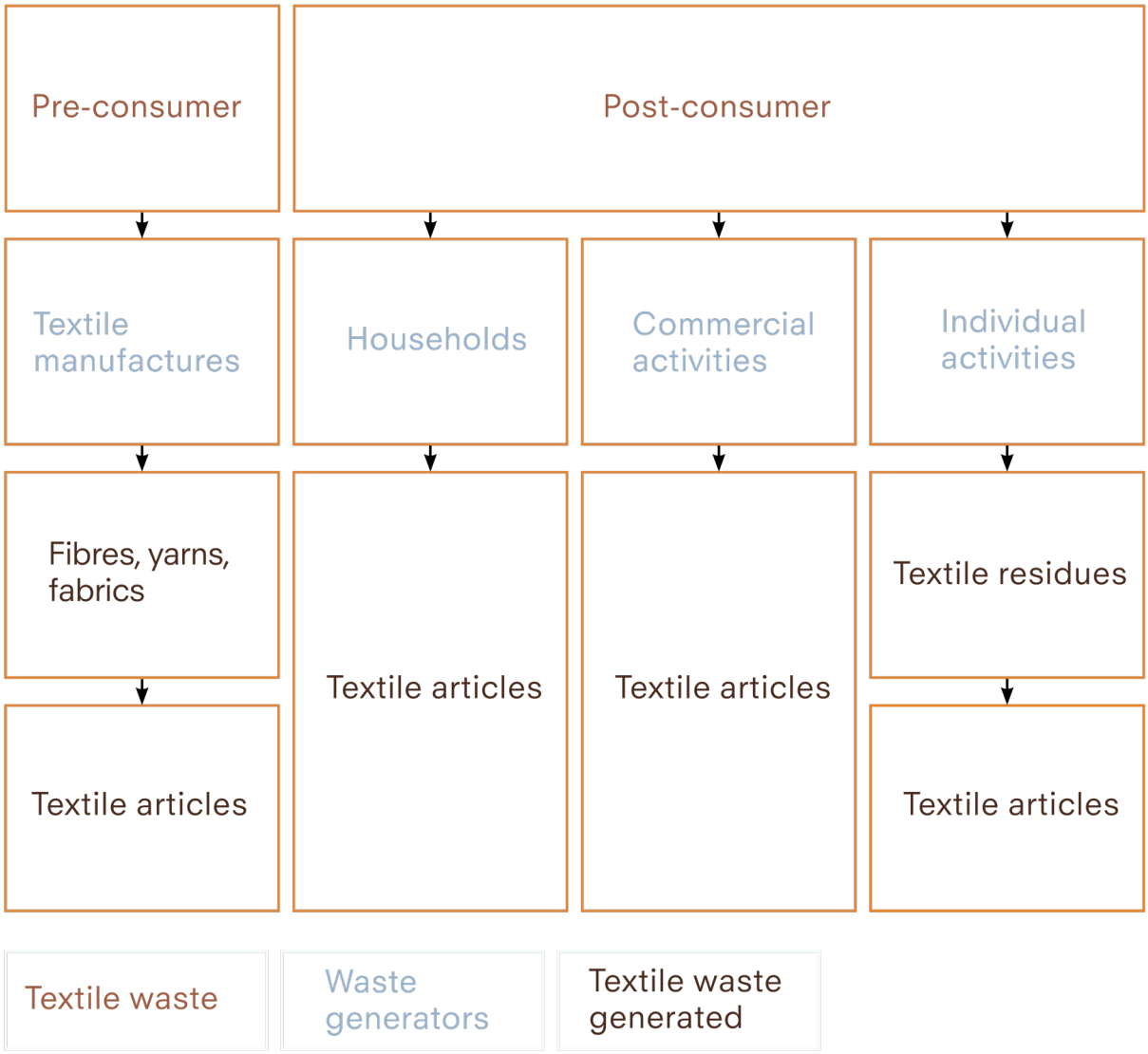


Figure 3 - The difference between post- and pre-consumer waste.

As illustrated in Figure 3, pre-consumer textile waste comes from manufacturing scraps and leftover fabrics (Crang et al., 2022). The most common reasons happen as a result of technical features in the manufacturing process (e.g. cutting) (Aus et al., 2021). The cut-offs from production are less suitable for reuse as the fibres are shorter, on the other hand, it is the preferred feedstock for mechanical recycling, as there usually is more data available from pre-consumer waste (Pierri et al., 2023a). End-consumers generate post-consumer textile waste after the product has served its intended purpose (Pierri et al., 2023a). The most identified reasons consumers dispose of textile products are material damage, wear and tear, physical and emotional attachments or changes in fashion trends (Leonas, 2017).

According to Hedrich et al. (2022), the European waste problem will accelerate by 2030, as waste volumes are predicted to increase to 8.5-9 million tons. This is the result of increased consumption and population growth, as well as the coming obligation for separate collection systems for textile waste handling, which is to be implemented on the 1st of January 2025 according to the Waste Framework Directive (WFD) (European Commission, 2023b). The existing sorting capacities in Europe are below the required capacities, which results in used textiles exported outside of the EU (Pierri et al., 2023b). Over the last two decades, the exports have tripled, reaching 1.7-1.8 Mt in 2019 (European Environment Agency, 2023). A consequence of this is a loss of resources that could otherwise be reused or recycled into new products. Increasing the amount of collected textile waste and improving the sorting systems will be crucial to processing the amount of textile waste into recycled materials (Hedrich et al., 2022). Currently, the European Commission is working on a definition for sorting textile waste, as there are no minimum criteria for this (European Commission. Joint Research Centre., 2021). The task of sorting and classifying textiles is a complex process where manual sorting is still the most dominant method (Hedrich et al., 2022). A common issue for recyclers is the need for well-sorted feedstock, as the ability to sort the textiles by accuracy and at scale is crucial for the recycling industry. The sorting of material is done by distinguishing between fibre composition, colour, quality and chemical treatment (Papamichael et al., 2024). Textile sorters have an essential role in transitioning toward circular value chains, as this is where the textile waste is categorised into what can be reused, recycled, downcycled and what needs to be incinerated. One of the major issues of recycling on a large scale is the various chemicals in the textiles and the recycling process itself which can come from a mix of other recycled products into textiles (e.g. PET bottles) (Bour et al., 2023). To successfully scale Europe's textile recycling industry requires collaborative work with other disciplines (Hedrich et al., 2022).

Recyclers are struggling to access well-sorted textile waste as the current sorting and pre-processing are not at scale yet (Hedrich et al., 2022), which results in discarded textile waste ending up with 73% being burned or landfilled, around 12% is recycled and only 1% is reused (Papamichael et al., 2024). Textile recycling is a crucial solution for the textile industry to transition from a linear to a circular system. However, the chal-

lenges lie within the scaling of the recycled market, especially on the supply side e.g. from recycling technology, education of workers and capacity (Hedrich et al., 2022). According to Uncu Akı et al. (2020), correct sorting is necessary to solve the barrier between the amount of textile waste and the small percentage currently being recycled. If textile waste was managed properly, it could significantly reduce the overall impact of the textile sector (Beton et al., 2014).

Within the textile recycling industry, multiple options for recycling exist, depending on the input material and the purpose of the output. In Figure 4 below, the different recycling methods are visualised:

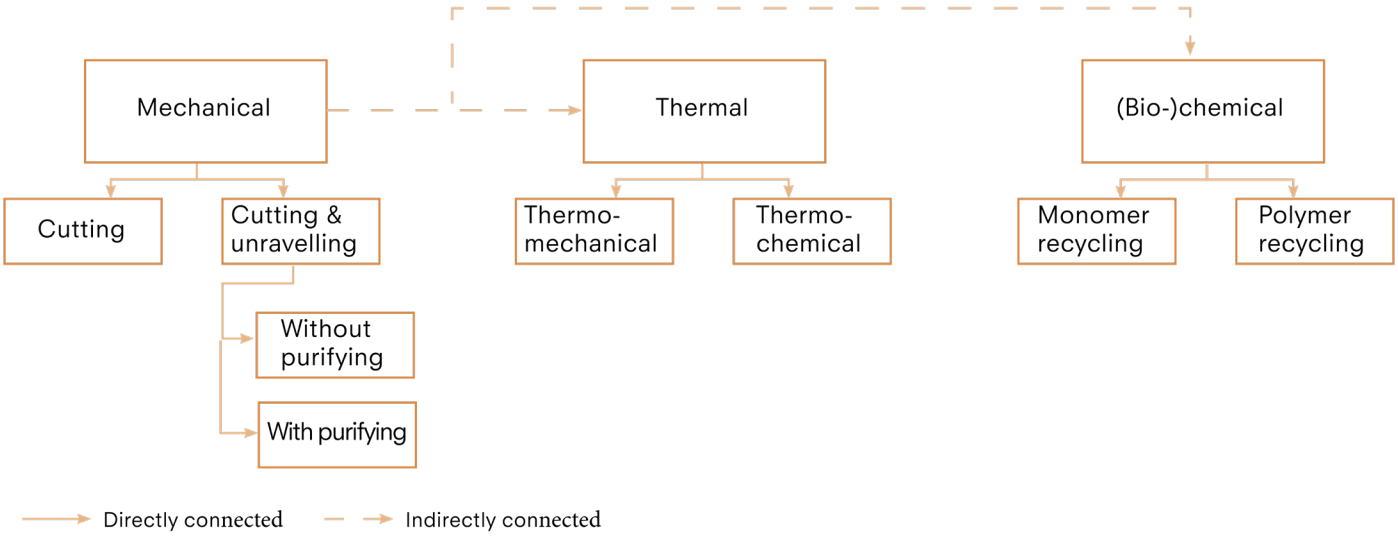


Figure 4 - The different recycling methods.

Knowledge of the fibre composition is crucial due to the limitations that mixed fibre composition may have on the consistency and quality of the recycled product (Pierri et al., 2023a). A consequence is that today only 1% of textile waste is recycled through the fibre-to-fibre method, as it needs a curtain scale for the production to function (Hedrich et al., 2022). Chemical recycling means that the material goes through a pulping process through spinning, which is effective when recycling nylon or PET (e.g. viscose, lyocell) into textile fibres again (Pierri et al., 2023b). This master thesis focuses on the mechanical recycling process, which is the main technology used in the industry, as it is both a low-energy and cost-efficient method (Pierri et al., 2023b). The first step of mechanical recycling consists of a pre-treatment which includes the removal of non-textile components (e.g. buttons, zippers), this leads to the tearing[3] process. The more advanced mechanical process is to after the tearing, reduce the textile articles into textile fibres in a tearing process (Roos et al., 2019). Mechanical recycling is often used for the automotive industry, furniture stuffing or wall coverings, where quality is not crucial (Hedrich et al., 2022). The recycling of textile waste can be categorised into two types: closed-loop and open-loop (See Figure 5), based on whether the material is circulated into the same production cycle as its original product or if the product is changed into a

3 To pull or be pulled apart, or to pull pieces off (Cambridge Dictionary, 2024b).

new product loop (Huang et al., 2024). Currently, the closed-loop is mostly seen in recycled fibres, yarns and garments. Open-loop recycling is suitable for a broad spectrum of materials and can offer a wide spread of recycled products focusing on non-wovens (Huang et al., 2024).

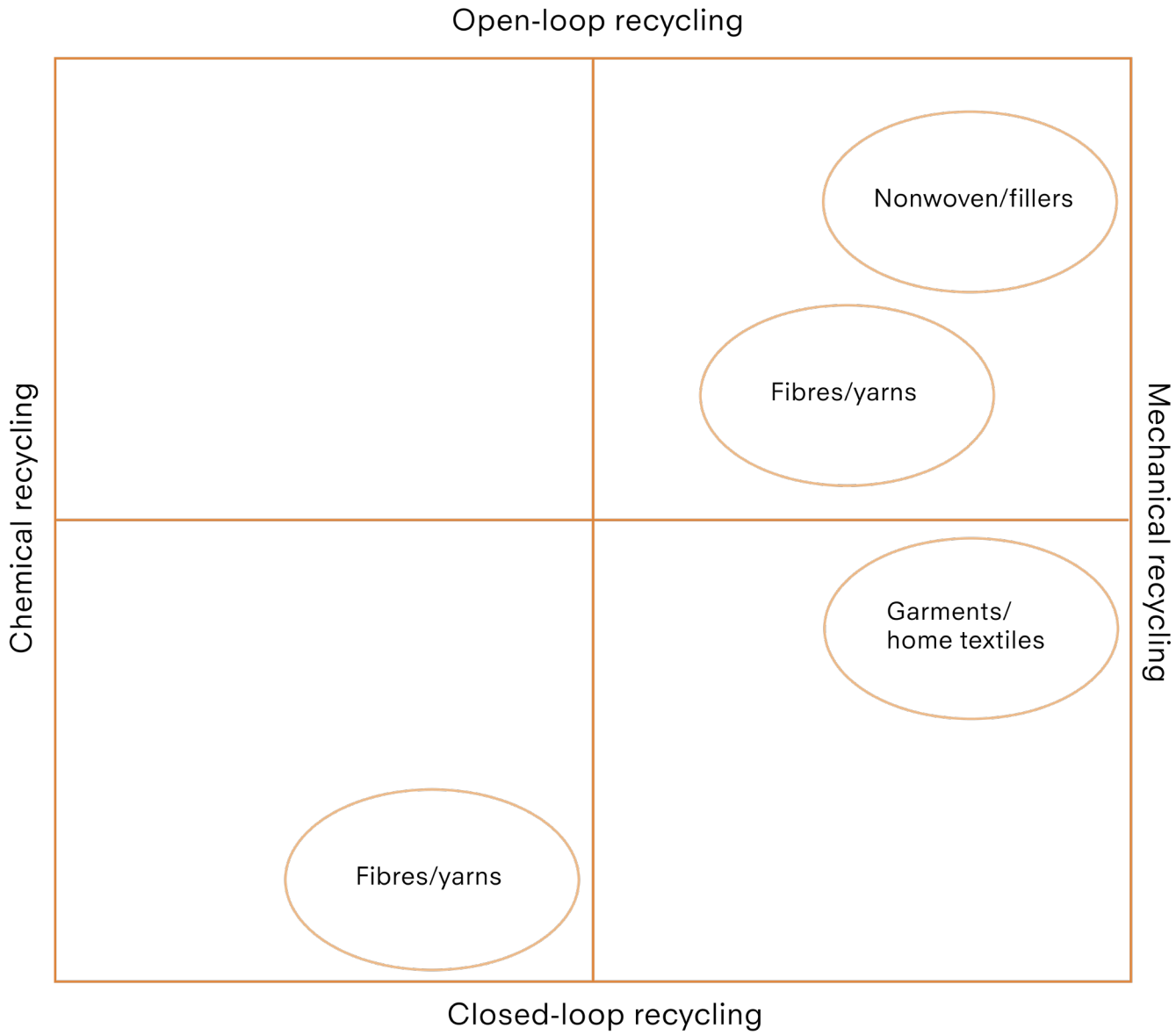


Figure 5 - Open- and closed-loop recycling.

The open-loop recycling system opens up the opportunity to change a waste material from one industry to a valuable one in another, as mixed fibres and other inputs are possible to use here. This speaks to the CE approach of redesigning the idea of material fabrication and resource purpose into favouring discarded textiles for re-purpose and recycling (Jørgensen & Remmen, 2018). Scaling up textile recycling can be a tool for making a significant impact by tackling both ends of the production spectrum: reducing the need for virgin materials by incorporating recycled ones while also addressing the issue of end-of-life waste that currently persists (Hedrich et al., 2022).

1.3 The Furniture Industry

The furniture industry is dominated by small and medium-sized enterprises (SMEs), with the EU market accounting for 23% of the whole furniture market (European Commission, 2014). Craftsmanship still has a vital role in the industry, but production itself has developed into an assembly industry, where performing production systems are more important. The Environmental Product Declaration (EPD), is a crucial tool of today's furniture market to declare the product's environmental properties (E. P. D., 2020). The current competitive driver in the furniture market is the company's ability to be innovative in materials and technologies. This has resulted in the EU furniture industry investing in more machinery and product development in the last few years (European Commission, 2014). If the furniture market wants to create innovation, it needs to meet the market requirements as well as the ecological requirements (Karell & Niinimäki, 2019). The European Commission is focusing on the environment by directly affecting the industry through directives such as the Volatile Organic Compounds (VOC)[4] Directive, the WFD and the ESPR (European Commission, 2023b, 2023a).

The changes in climate concerning the industrialised production system are driving a shift in the way companies are prioritising. With the EU Commission prioritising novel strategies to tackle material waste, there's a need for transparency in supply chains and a push for companies to adopt new approaches in reconstructing production methods to ensure accountability for resource usage, quality, and waste management (Hedlund et al., 2020). As mentioned in section 1.1 furniture is a priority group with textiles and electronics (European Commission. Directorate General for Environment., 2020). The linear business model does not consider actions such as reuse, repair, and recycling of materials, and does not prioritise quality, durability, and recyclability in production processes (European Parliament, 2020). Focusing on CE principles such as *slowing, narrowing, closing* and regeneration of resource loops can foster innovation while meeting the regulatory and ecological requirements (Bocken et al., 2021). The European Furniture Confederation (EFIC) points out the importance of training within the value chain to transition to a CE, where research, collaboration and innovative digital skills are crucial to advance the CE in the European furniture industry (EFIC, 2021). According to Pedersen et al. (2019), the knowledge and methods on how to transition are only at the starting point, despite a long tradition of research in the field of sustainability. To transition the furniture industry from a linear business model into a circular one will need an iterative approach to develop and test circular value propositions to a common understanding (Thürer et al., 2017).

4 Volatile Organic Compounds (VOCs) are organic chemicals that easily evaporate at room temperature. They come from both natural sources and human activities, such as industrial processes and vehicle emissions. They can cause health issues and contribute to environmental problems, such as smog and ozone formation (United States Environmental Protection Agency, 2024).

1.4 Kvadrat Really

Kvadrat Really, formerly known as Really, was established in June 2013 by Wickie Meier Engstrøm and Klaus Samsøe (ownr, n.d.). In January 2015, the company's majority (51%) was sold to Kvadrat A/S, one of Europe's leading fabric producers, and subsequently renamed to Kvadrat Really (Kvadrat, n.d.b; ownr, n.d.). With the fusion, Kvadrat Really is committed to aligning with Kvadrat's politics as their Sustainability Strategy for example recycling to minimise waste and utilising recycled materials as inputs for new products (Kvadrat, 2023) (Appendix 1).

1.4.1 Convert

The production occurs at Convert, located in Nors, in the northern part of Jutland. In the summer of 2022, Kvadrat acquired the majority of Convert (66,67%), while the remaining percentage of ownership is still held by the original owners (Kvadrat, 2023, p. 9). The allocation of ownership means that Kvadrat Really's production process must be planned and coordinated with Convert's production of their products and other of Convert's customers such as Søuld, Pluumo and Tiny Gardens (Appendix 2) (Convert, n.d.). Depending on each customer's requirements, the production facility utilises various input materials, ranging from seaweed to wood to cotton and mixed textile fibres. With this constellation, the factory workers at Convert, often undertake extensive cleaning and material switching to preserve and ensure the products' high quality (Appendix 1).

1.4.2 Kvadrat Really's Tabletop

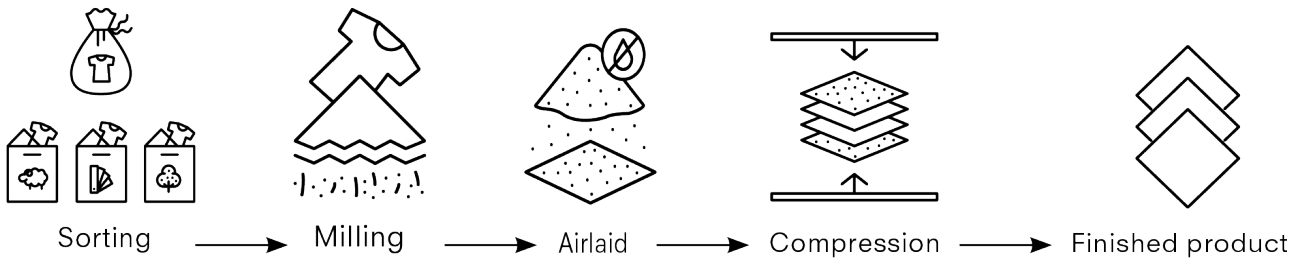


Figure 6 - The sourcing and production processes of Kvadrat Really's tabletop.

The tabletops consist of 70% post-industrial textile waste and 30% bio-binder. The textile waste is mechanically shredded into fibres at a recycling facility. Afterwards, the fibres are transported to Convert. Figure 6 roughly visualises Convert's manufacturing process, where the fibres are combined with a bio-based binder by the use of air-laid technology and created into felted mats. These mats then go through a heating and compressing process to produce solid pieces. As illustrated in Figure 7, the tabletops consist of six layers and a melamine surface.

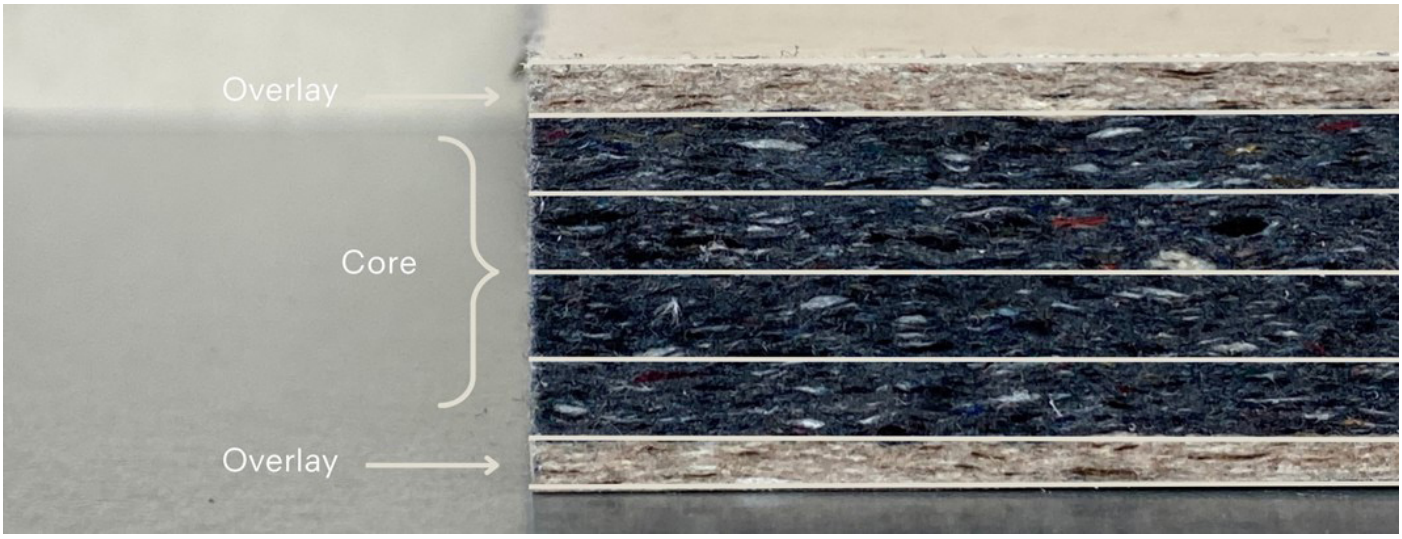


Figure 7 - Visualisation of the different layers the tabletop consists of.

Kvadrat Really's primary market focus is on office spaces, where there is a preference for furniture in understated colours to promote a focused and calm work environment. As a result, the tabletops are available in five different colours within the blue, grey, black, and cream-white colour palette (Kvadrat, n.d.-a) (Appendix 2).

2. Literature Review

The literature review represents the existing research and development in the textile and furniture industries and their preparation and implementation for the Ecodesign for Sustainable Products Regulation practices. By examining recent academic- and grey literature the aim is to contextualise the research field's existing knowledge and to identify areas of knowledge gaps. The review is the foundation for establishing the relevance of the chosen research focus and highlights its potential contributions to advancing the field. By including grey literature as a source of information, the research project can incorporate *"relevant contemporary material in dynamic and applied topic areas where scholarship lags"* (Adams et al., 2017, p. 433). Whereas, the academic literature demonstrates research from 2017 until today. As this research concerns a regulation that is progressing and adjusted, each development is crucial in the literature review to understand and analyse the most present knowledge in the field.

Figure 8 visualises the approaches and selected literature for the literature review. Further descriptions are written in the following sections (See sections 2.1 and 2.2).

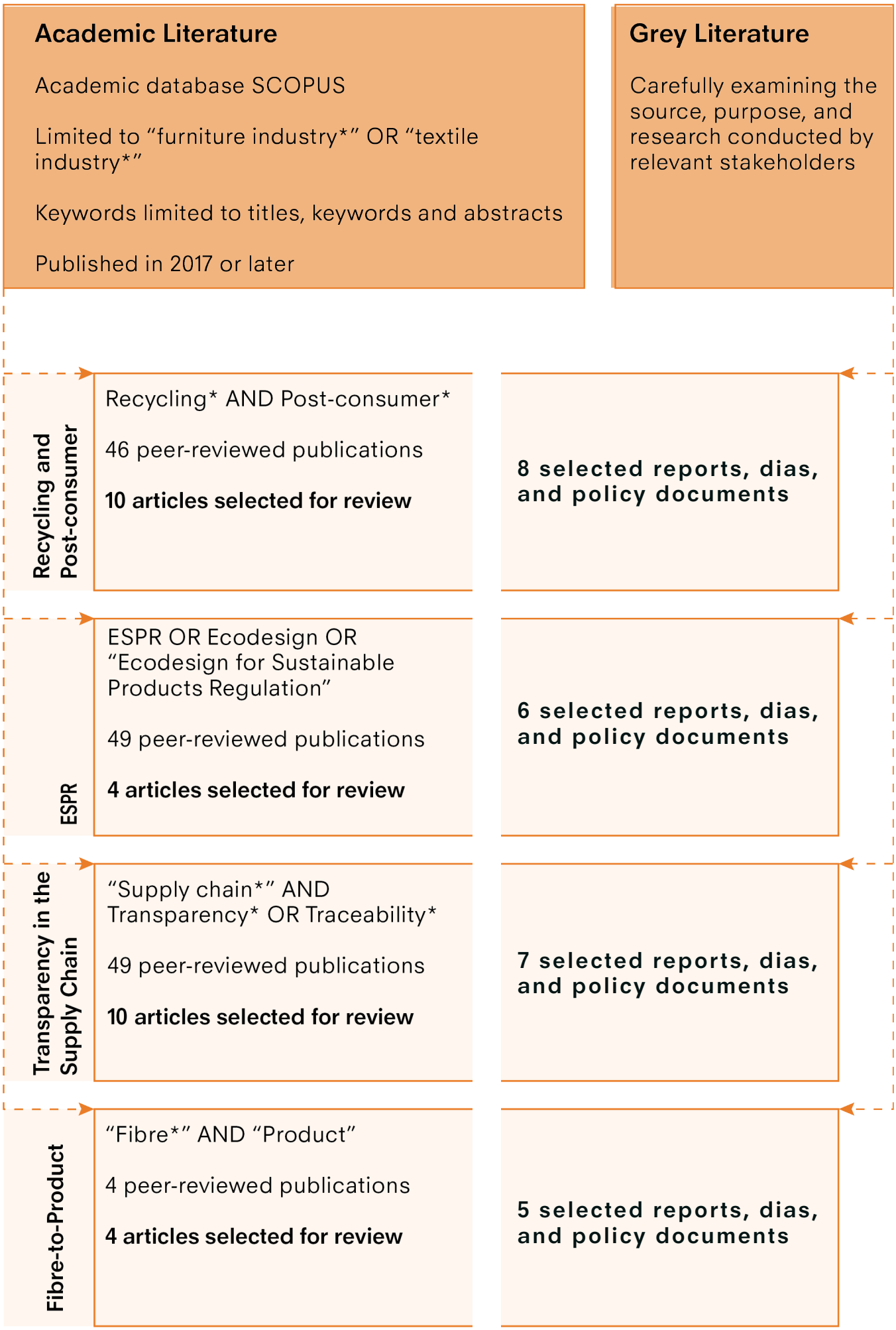


Figure 8 - Overview of the selection of literature

2.1 Academic Literature Review

In March 2024, the research group searched the academic database SCOPUS. The search was limited to the furniture- and textile industries, in English-language papers published in 2017 or later. In the initial phase of formulating the literature review, one implemented an “AND EU” command within the primary search parameters, thereby constraining the search scope to publications originating specifically from the European Union (EU). This modification yielded search outcomes comprising between 5 and a maximum of 17 publications, indicative of a comparatively limited amount of relevant literature. Consequently, it was decided that this result fell short of providing a comprehensive basis for the literature review. Subsequently, the “AND EU” command was rescinded from the search parameters.

The master thesis used a systemic approach to conduct the literature by utilising a combination of selected keywords following further research of the sources’ references if relevant to the keywords. The search focus was narrowed to the title, keywords, and abstract, resulting in 148 peer-reviewed publications. To ensure the quality and relevance of information the research group applied a set of criteria to filter the search results. The following criteria helped to identify the most relevant and reliable sources of information for the research project: 1) The articles that focus on regeneration within the textile or furniture industries, 2) The articles are no older than seven years, and 3) The articles contribute to the review. From the applied criteria, the peer-reviewed articles were narrowed down to 28 articles.

2.1.1 Recycling and Post-consumer

Several studies provide an overview of textile waste management and recycling technologies in the current research field with different approaches and perspectives. For example, Schmutz and Som (2022) provide quantitative insights into post-industrial textile waste generated within Swiss companies. The study found that incineration was the most commonly used end-of-life treatment for textile waste due to the lack of market and recyclers taking care of textile waste. Furthermore, Stanescu (2021) provides a roadmap for sustainable textile waste management by synthesising existing recycling techniques and presenting good practices in the field. Sandin and Peters (2018) compare the environmental impact reduction through reuse and recycling, showing that reuse is more beneficial than recycling. However, concerning recycling and post-consumer waste management, there are already promising approaches to promote recycling within the textile industry. In addition, Turnbull et al. (2020) study end-of-life textile recycling and new technologies into economic models. Sandin & Peters (2018) and Turnbull et al. (2020) both address how new solutions are emerging, but logistical structures are not fully in place for industrial progression.

Baloyi et al. (2024) review recycling techniques like enzymatic fibre separation and textile waste classification through infrared spectroscopy, noting that post-industrial textile waste is most commonly recycled, with open-loop recycling predominant. Navone et al. (2020) also support enzymatic fibre separation for recycling wool/polyester blends. Riba et al. (2020, 2022) explore infrared and near-infrared spectroscopy with deep learning for quick textile material identification, enhancing sorting and recycling.

Other studies focus on recycling textile waste into value-added products. Islam and Bhat (2019) research how recycled textiles can be used for thermal and acoustic insulation. Malinverno et al. (2023) studied workwear textile waste in Swiss companies to identify the need for circular workwear textile management. The researchers determined that close collaboration with all stakeholders of the textile life cycle chain is necessary for logistically managing the circular economy sustainably. The last paper in this review focuses on the Extended Producer Responsibility (EPR) policy, which leads to an increase in post-consumer textile collection and recycling. This policy can improve collection and recycling rates, identify solutions for current and future challenges, and create opportunities for fashion producers and recyclers (Bukhari et al., 2018).

The studies reviewed highlight various approaches and perspectives towards textile waste management and recycling. Although there are promising approaches and emerging technologies, logistical structures need to be in place to facilitate the industrial progression towards sustainable closed- and open-loop recycling. Future research in this field should focus on the development of efficient and scalable recycling technologies, the creation of circular economy strategies, and the promotion of sustainable practices by all stakeholders in the textile life cycle chain.

2.1.2 The Ecodesign for Sustainable Products Regulation

Given the typical time length for academic publications to undergo review and publication, less scholarly material exists addressing The Ecodesign Directive from 2022 and the enacted regulation from 2024. Most of the academic literature available concerns ecodesign as a design approach and tool to reduce the product's environmental footprint: Zhang et al. (2018) draw on *General Principles for Eco-design Product Assessment* to conduct a quantitative Life-Cycle Assessment (LCA). The study aims to reduce the environmental footprint of Chinese polyester–cotton textile production, and through an LCA improve the "design framework". Similarly the Brazilian case study on "Ecodesign in the Furniture Industry" (Pereira et al., 2018). These studies operate outside the EU's jurisdiction and are not directly subject to European regulation, but must comply if they wish to export to the EU. Salo et al. (2020) share a similar focus on "*products and incremental technological changes*" (p.2). The quantitative statistical study examines the motivations for eco-innovation and the implementation of ecodesign tools within companies in the Nordic textile and information technology sectors. They reveal that "ex-

ternal" motivations, such as regulations, are not the primary drivers for implementing ecodesign tools in business operations in the textile industry. In this industry, legislation was identified as the 9th most important reason. In contrast, legislation emerged as the most important factor for the IT sector.

Bour et al. (2023) have conducted a study that focuses on identifying SoC in recycled textiles and assessing regulatory gaps. In the discussion, Bour et al. criticises the proposed Ecodesign regulation reliance on REACH assessments, which, according to them, is inappropriate for establishing a circular textile economy. Instead, they suggest a re-evaluation of REACH that supports potential circular systems by relying on an improved risk assessment of chemicals in the product's multiple life cycles to support more accurate toxicity data.

Based on these studies, the existing literature predominantly focuses on quantitative analysis, offering a comprehensive overview of Ecodesign tools, principles and methods. However, there is a lack of case studies examining the impact of ESPR on the furniture and textile recycling industry.

2.1.3 Transparency in the Supply Chain

Different technologies have been suggested to ensure transparency. Hauschild and Coll (2023), divide technologies into three categories: *"Automated Data Processing, Reporting Platforms and Dialog platforms"* (p.4). Automated Data Processing implies the technologies *Blockchain* and *Internet of Things*. Reporting Platforms contain *Audits* and *Complaints systems* and Dialog platforms contain *Multiple-Stakeholder Initiatives*. A majority of the scholarly material found discusses blockchain. Blockchain is a secure digital ledger that stores information in a decentralised manner through a chain of blocks recording transactions (Agrawal et al., 2018; Ahmed and MacCarthy, 2021; Alves et al., 2022; Brun et al., 2020; ElMessiry and ElMessiry, 2018; Hauschild and Coll, 2023). This technology is said to be promising in improving transparency, enabling traceability, and supporting sustainability in complex supply chains, but it is also criticised for being undeveloped, too technology-focused, and with a medium degree of authenticity in the information provided (Ahmed and MacCarthy, 2021; Hauschild and Coll, 2023; Stellmach et al., 2022). In Hauschild and Coll's study (2023), audits are classified as the technology providing the least authentic information. This is due to current practices that the interview stakeholders experience as affected by potential conflicts of interest and lack of transparency.

Kumar et al. (2017) highlight regulations as a key driver for pushing the agenda of more traceability within the supply chain, but no literature is found describing this connection in depth. Additionally, existing literature lacks an exploration of organisations' internal

challenges with data collection for transparency and traceability.

2.1.4 Fibre-to-Product

The disposal of textile waste is a significant environmental challenge, which promotes the exploration of innovative upcycling technologies to reduce its negative effects. Within the literature review, four relevant articles were found. One article discusses repurposing discarded textiles, such as old garments and fabrics, to create new clothes and accessories with unique designs (Marques et al., 2019). The researchers propose transforming textile waste into high-value products by encouraging designers to rethink traditional concepts by incorporating recycled materials from diverse sources. Another article, by Chang et al. (2023), highlights the recycling of textile waste from blue jeans, introducing an approach of upcycling blended textile waste by selective dye decolourising polyester-cotton blended textiles using ionic liquids and photocatalysts. A third article reviews existing studies on pyrolysis processes[5] applied to different types of textile waste. Lee et al.'s review intends to promote upcycling pathways by transforming textile waste into energy, such as gases, gaseous fuels, chemicals and carbon materials (Lee et al., 2023). The fourth article, by Möhl et al. (2022), investigates the development of textile semi-finished products, utilising medium-to-long cotton and flax fibres extracted from textile waste combined with a bio-based thermoplastic matrix. The study explores the production of hybrid yarns and woven fabrics, demonstrating the potential for creating composite materials for applications in the construction, automotive, and packaging industries.

In addition to Lee et al. (2023) investigating fibre-to-energy conversion, there is a discernible gap in research on fibre-to-product across various sectors. While these fibre-to-product technologies differ in their specific processes and applications, they share common objectives of reducing textile waste, promoting resource efficiency, and advancing more sustainable practices in the textile industry. Each technology offers advantages and challenges, highlighting the importance of exploring diverse approaches to address the complex issue of textile waste management.

2.2 Grey literature

5 Pyrolysis is suitable for processing various types of textile waste and can produce a range of end products for different applications (Lee et al., 2023)

The textile and furniture industries are undergoing transformative changes driven by evolving regulatory frameworks towards applying more circular economy principles and a need for more transparency through their supply chains (European Commission, 2023). The development in the two industries combined with the regulatory frameworks constantly being adjusted and refined, the master's thesis argues the need to cover the grey literature from the "pressing world" to cover all aspects of the CE within the regulatory field of textile waste and the ESPR. This literature review explores the key areas shaping these industries through four sections to provide a comprehensive understanding of current trends, challenges, and strategies shaping the current landscape of the textile and furniture industries.

2.2.1 Recycling and Post-consumer

The textile industry's resource use and waste generation have prompted a reevaluation within the "Circular Economy Action Plan" (CEAP), emphasising value creation and capturing (European Environment Agency, 2021). SITRA (2019) highlights how efficient textile waste management and remanufacturing are crucial for sustainability. The challenges in obtaining resource and recovery models concern feedstock sourcing, regulatory compliance, and material quality, as this requires a trustful collaboration through the supply chain with different stakeholders (Lehtinen, 2023). As mentioned in section 2.1.1 non-recyclable textile blends require advanced sorting for recycling, which calls for technological solutions (Sahimaa et al., 2023). One technical solution to this seen in the market is NIR sensors which offer quality assurance by scanning the material to enhance recycling efficiency (Trads et al., 2024). The sorting and recycling company NewRetex is one example of a company using this technology to scan post-consumer waste from municipalities to define the resource origin and further the possibility of recycling. Feedstock consistency is vital for scaling textile recycling and attracting investments (Hedrich et al., 2022). Section 2.1.1 concerning *End-of-waste* (EoW) criteria for textiles is complex due to legal definitions, with mechanical recycling as the primary method (Pierri et al., 2023). The grey literature agrees with the academic literature review in terms of the need for scalability in systems for handling EoW while considering resource variability (Thürer et al., 2017).

2.2.2 Ecodesign for Sustainable Products Regulation

Policy frameworks, like the "Ecodesign for Sustainable Products Regulation", play a crucial role in promoting circular business innovation. The 2019 EEA briefing underscores the need for systemic changes and policy-driven sustainability across the textile value chain. Innovations such as Patagonia's "Worn Wear" marketplace, Caterpillar's modular parts, and Fairphone's easy-to-repair smartphone showcase how businesses prioritise sustainable practices. However, barriers like organisational culture and the need for ecosystem partnerships hinder circular advancements (European Environment Agen-

cy, 2021; SITRA, 2019). Design choices impact a product's environmental footprint, with 80% determined during the design phase. Standards like ISO IEC 62430:2019 guide environmentally conscious design, and the upcoming ISO/DIS 59040 aims to standardise product circularity data, further supporting sustainable design (Technical Committee CEN/CLC/JTC 10, 2023). The DPP offers a structured digital tool for capturing product and supply chain data, enhancing transparency and responsible consumption (Anthesis Group, 2023). It aligns with the EU's focus on supply chain traceability, particularly in the textile sector, though challenges remain in translating design guidelines into actionable recycling practices (Trads et al., 2024). One example is the footwear brand Roccamore which has, in collaboration with the company SPOOR[6] developed a QR code tagged in the products for the customers to scan and understand each step from the animal that comes from the finished shoe in front of them (roccamore, n.d.). Following the Textile Labelling Regulation, the ESPR categorises textile products exclusively made from textile fibres. Certifications like EU Ecolabel and Blau Engel prioritise toxicity, material use, and waste. Notably, 35% of textile chemicals are in dyes, 56% of material production is polyester, and 23% is cotton (Joint Research Centre (JRC) Day 1, 2024). Following the criticism of the reliance between Ecodesign regulation and REACH, the JRC (2024) proposes simplifying EU Ecolabel criteria by harmonising with other eco-labels, involving third parties for compliance, and incorporating recyclability and packaging criteria aligned with ESPR standards.

2.2.3 Transparency in the Supply Chain

Technical innovation is crucial for developing processes of more transparency and reusing textile waste through collaboration across the value chain (European Environment Agency, 2021). In circular supply chains, renewable energy and bio-based materials are vital, along with the use of globally standardised RFID[7] technologies, to enhance operability and identification. This integration drives efficiency, waste reduction, and added value through reliable lifecycle data (SITRA, 2019). Circular supply chains focus on restoring and regenerating resources, involving all lifecycle actors and necessitating broad sector collaboration, underpinned by shared responsibility and trust (Kristensen, 2020). To establish functional circular supply chains, new actors are needed to design durable textiles and manage upscale sorting and recycling (Sahimaa et al., 2023). Industry organisations should transition to business models that extend from raw materials to post-consumer stages, involving sorting, recycling and spinning mills after reaching customers (Sports Group Denmark, 2024). Danish textile brands can achieve control and transparency by forming partnerships across the value chain or through ownership, enabling them to reduce environmental impacts from water, chemicals, and energy consumption (Trads et al., 2024). Hedlund et al. (2020) highlight the need for innovative tools like

6 SPOOR leather is fully traceable all the way back to the animal and farm.
This enables full transparency in the value chain, through data and documentation and provides a guarantee of responsible sourcing on the leather (SPOOR, n.d.).

7 RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.

Value Stream Mapping to improve collaboration across the textile supply chain, allowing organisations to identify and reduce waste, thereby creating value.

2.2.4 Fibre-to-Product

Innovation is not solely technology-based; it is an iterative process that includes developing new markets and service opportunities, opening the door for new circular design systems (European Environment Agency, 2021). Developing markets for circular design systems involves creating products with multiple lifecycles and designing for modularity and disassembly to facilitate resource circulation across sectors (Kristensen, 2020). “The EU Strategy for Sustainable and Circular Textiles” commands significant shifts in the strategies of the furniture industry. Companies like Holmris prioritise circular service solutions with sustainability and social dimensions at their core, implementing take-back systems, altering product/resource loops, emphasising CO2 data on their products and passing on used furniture to institutions or young people who can not afford to buy themselves. Their RECRAFTED collection showcases products crafted from open-loop recycled materials from different industries e.g. old wooden tabletops taken back and shredded into a new wooden tabletop made from composite wood (Holmris, 2024). The established furniture brand Hay is exploring certifications to meet ESPR requirements, focusing on design practices that facilitate easier part separation and modification (Hay, n.d.) Meanwhile, TAKT prioritises transparency and external certification, blending craftsmanship with natural materials and durable construction technologies. Their comprehensive strategy considers design from inception to end-of-life, ensuring products are flat-packed, repairable, disassemblable, and recyclable by separating each material component (TAKT, 2024).

2.3 Conclusion of the Literature Review

The literature review provides valuable empirical insights for the master thesis by illustrating the current landscape and identifying gaps in the academic and grey literature. Innovative recycling and upcycling technologies offer promising solutions for reducing textile waste and promoting sustainability. However, their scalability and integration require robust logistical support and stakeholder collaboration. Additionally, while current academic research largely focuses on quantitative analyses of ecodesign methods, there is a pressing need for more case studies exploring the impact of political regulations on industries like furniture and textile recycling. Bridging this gap the master thesis will focus on practical applications that can advance the CE objectives within the furniture and textile industries necessitating the selection of methods that facilitate the negotiation process in collaboration with Kvadrat Really. This will be achieved through the utilisation of boundary objects, as elaborated in section 4.5.1. Furthermore, traceability

and transparency are crucial for sustainable supply chains, yet further research is needed to understand the regulatory impacts and internal organisational challenges. Embracing technological advancements and fostering collaborative efforts are essential to achieving circularity through better resource usage in the textile industry. The Grey literature explores this through case examples of QR code tags on footwear in collaboration with supply chain operators which demonstrates suggestions of technological advancements. In general, the grey literature demonstrates more examples of how companies within the textile- and furniture industries work with the principles of ESPR and CE as Holmris which has multiple CE service systems or TAKT which has built its core on the principles of slowing, narrowing and closing. The gaps between the academic and grey literature are the lack of knowledge concerning open-loop systems between different sectors and the challenges and opportunities which exist operating within this crossfield.

3. Research Design

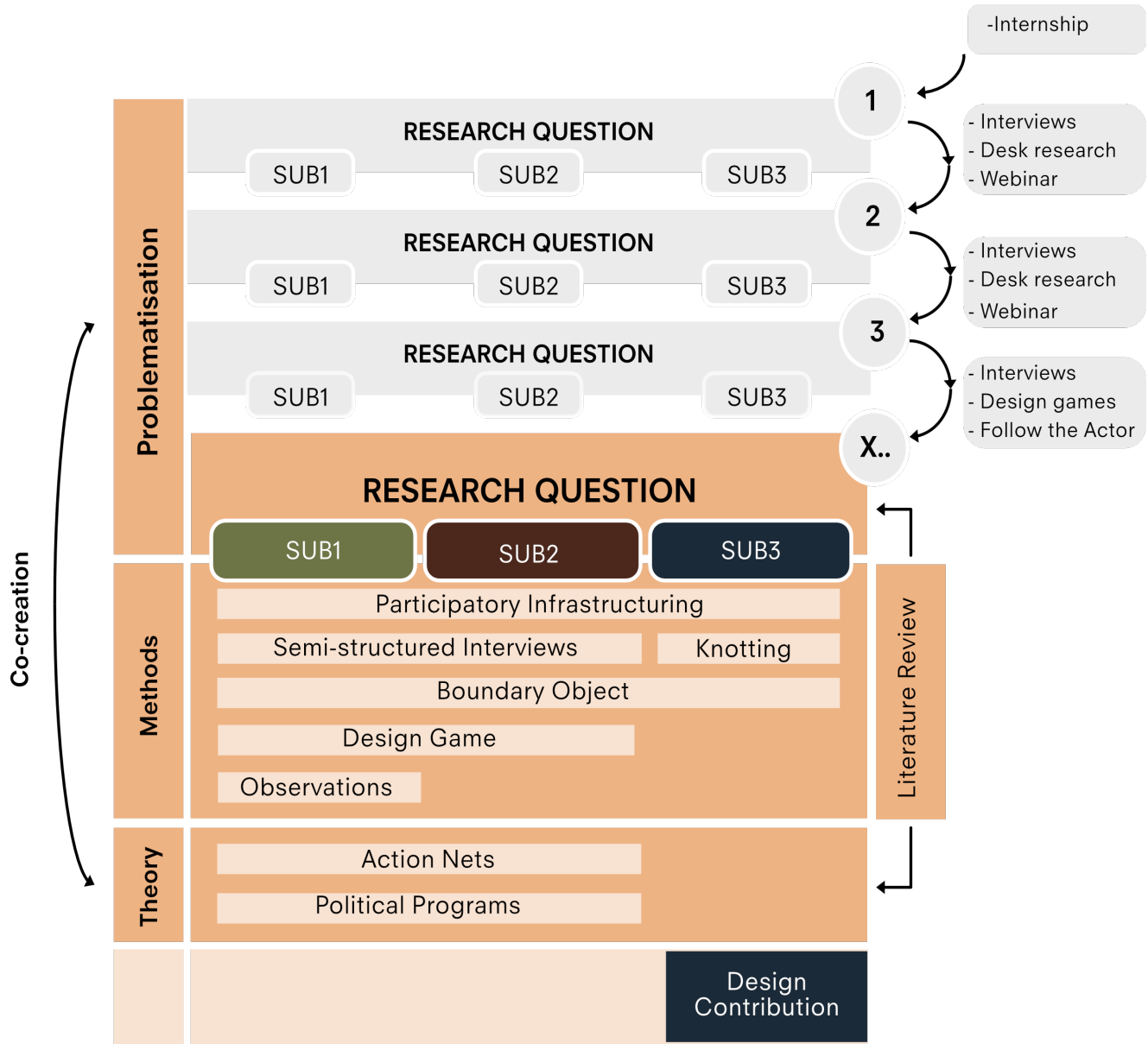


Figure 9: Research Design.

Figure 9 illustrates how the research, of this case study, is designed. The study is based on a problem-oriented approach, allocating much of the empirical findings to the problematisation phase (Burrell & Morgan, 1979). An initial study (the internship) laid the foundation for this case study, giving the research group a fundament of knowledge to form a more focused and detailed exploration from. The research question and design contribution are reviewed in a co-creating process with the actors, ensuring that the design contribution will interest the collaborators and ease further implementations. This is done in an iterative process, where the research question is reevaluated as new findings from the literature, webinars, interviews, desk research and field trips are added.

This process forms the main research question, which is:

How might The Ecodesign for Sustainable Products Regulation challenge the existing textile waste- and furniture markets and how can Kvadrat Really translate the challenges into opportunities from input material to final product and within the organisation?

This question will be answered through the following three sub-questions:

1. *How do the data and knowledge flows challenge the interactions, practices and relationships around and within Kvadrat Really?*
2. *How might ESPR cultivate the challenges and opportunities that already exist within and around Kvadrat Really?*
3. *Which actions can Kvadrat Really implement to strengthen its position in the textile waste- and furniture markets affected by the ESPR in the future?*

The structure of the sub-questions is inspired by a suggestion from the industry that proposes that for a business to prepare for ESPR one should first asses the regulation against the context of the specific business, and then develop strategies (Anthesis Group, 2023) (see section 1.1). Sub-question one is designed to investigate the internal context of Kvadart Really through the theories and the methods appearing in Figure 9. Sub-question two investigates the context of the influence of ESPR through the same theory and sub-question three investigates the development of organisational ESPR strategies with methods from knotting, participatory infrastructuring and design game.

The methods used to collect the empirical data are based on approaches from *social science* and *participatory design* (see Figure 9). The theoretical framework for analysing the empirical findings combines theory from social science, technological studies and organisation management (see section 4). In a mixed theoretical approach, visible practical dynamics in the organisation are analysed through the Action Nets Theory and the invisible dynamics through the Political Program Theory (ibid). This research design and methodology is an example of how future research and practical application of the ESPR in an organisation can be conducted.

4. Methodology

This research project serves as the final assignment for the Master's program in Sustainable Design Engineering. The program includes interdisciplinary components by integrating methods from social sciences and technology studies with technical subjects and design practices (Aalborg University, 2022). These components form the foundational methodology upon which this project is built.

Social Science encompasses disciplines that study human behaviour and societies (Sciences, 2021). This project studies actors in the organisation by conducting qualitative research through interviews, observations, and a questionnaire.

Science and Technology Studies (STS), is an interdisciplinary field that examines how social, cultural, and political dynamics influence and shape science and technology, and how these developments, in turn, impact society, politics, and culture (Macnaghten, 2010). Technology is not limited to physical artefacts or tools but also encompasses processes, techniques, concepts and systems of knowledge (Latour, 1987a). In this context, ESPR is understood as a systematic tool designed to address social, political and economic issues.

In the master thesis, the theory is used as a framework for a practical approach to comprehending complex realities (Sil & Katzenstein, 2010a). It provides a lens through which the researcher can perceive and interpret phenomena and be guided in attention towards key concepts, variables, and mechanisms (Popper, 1962; Sil & Katzenstein, 2010a). The methods applied are the researcher's tool for collecting knowledge and the theory is the language that structures and organises it (ibid). In this master thesis, the practical implications of Action Nets Theory and Political Process Theory are explored by scaffolding them upon which the analysis and discussions are constructed.

4.1 Action Nets Theory

The Action Nets Theory, originating from Actor-Network Theory (ANT), provides valuable insights into studying organisational practices (Czarniawska & Joerges, 1996; Lindberg & Czarniawska, 2006). This theory does not give a final answer as Czarniawska (2004) states that *"Action nets must be the starting point, not the result of a study"* (p. 783). Further, she explains its explorative approach by describing action nets *"as 'empty concepts,' to be filled with contents until it is clear what label might be put on them"* (ibid, p.783).

Action Nets Theory and ANT propose that actions connected through *translation*, produce; actors, objects, and networks. Translations can be interpreted in a dual sense: linguistically, as engaging in dialogue and explaining intentions, and non-linguistically, as the process of transforming one action into another at the point of connection. This dual interpretation highlights the communicative and transformative aspects of translation within collaborative and interactive contexts. The primary point is translating actions into one another by coordination, e.g. factory workers cleaning up the machines before a new production of tabletops is an example of connecting the actions. By connecting each action through the entire action nets, the action net is established; the connections need to be stabilised and maintained continuously (Lindberg & Czarniawska, 2006).

Action Nets Theory has a greater emphasis on the actions, which is defined as a movement or event that can be attributed to a social order in which it takes place. It also encompasses how the actions define the actors and the networks (Czarniawska, 2004). According to Action Nets Theory, organising entails connecting various collective actions by a pattern institutionalised within a specific time and space (Lindberg & Czarniawska, 2006). Hereby, actors and objects do not necessarily need to be aware of or interact with each other to influence one another (Czarniawska, 2004). Additionally, actors exist in different sizes. Callon and Latour (1981) do not distinguish between *macro-actors* (institutions, organisations, social classes, parties, and states) and *micro-actors* (individuals, groups, families) solely based on their dimensions as they perceive them to be equally important (Callon & Latour, 1981).

This master's thesis explores action nets within Kvadrat Really's organisation and their connections by investigating how actors and macro-actors, are involved in establishing and re-establishing the actions. The act of translation establishes meaningful relationships, as various entities, such as words, numbers, objects, and people, are translated into each other. The focus is to map and describe the practices, interactions, and relationships among actors and objects, particularly concerning the data[8]- and knowledge[9] flow. The research group aims to obtain profound insights into the complex organisational processes by examining these dynamics (Czarniawska & Joerges, 1996). Through this master thesis, actors' actions are observed to witness how their work is a collaborative effort rather than an individual experience. This allows us to move with them and between various points in an action net, gaining a deeper insight into their collective construction (Czarniawska, 2004).

8 Data consists of raw numbers and letters gathered through various methods, typically for reference, analysis, or calculation (Oxford English Dictionary, n.d.-a)

9 Knowledge combines information with personal understanding, allowing for well-informed judgments and effective action. It also involves recognizing an individual's position or title (Oxford English Dictionary, n.d.-b).

4.2 Political Process

The Political Process Theory comes from the field of Sience and Technology Studies (STS) and is primarily developed within management studies (Kamp, 2000). The theory describes organisational change processes when implementing a new technology (Dawson, 2000; Hvid et al., 2003; Kamp, 2000; McLoughlin et al., 2000). In change processes, multiple *political programs* often appear through the involved actors. Where the political program is experienced as a static temporary agenda, the political process is when these approaches are challenged, making them more dynamic and involving high levels of political negotiation, alliance building, conflict resolution and compromise among actors (Koch et al., 2003; Mcloughlin et al., 2000).

Political processes focus on the actors' goals, values, and agendas (Kamp, 2000). Depending on how these social actions unfold, some competing actors' or groups' different goals, interests and preferences might be legitimised, and others might not (Dawson, 2000; Kamp, 2000). Dynamics of power relations not only shape the conditions and opportunities for actors to participate in political processes but are also continually created, reconstructed and stabilised through political change processes (Kamp, 2000). In this master thesis, the analysis of the dynamics facilitates the change initiatives by directing which actors to select and invite to negotiate.

Political processes are driven by; *"external political activities and internal organisational politics"* that take place in the *"external business market and the internal history and culture of an organisation"* (Dawson, 2000, s. 41). In this master thesis, external political activity is represented by the ESPR, an external political market factor which the industry has to comply with. The internal drivers refer to Kvadrat Really, as an organisation, and how it adapts to external demands through their business objectives and contextual circumstances. The power struggles and negotiations around these factors are used to explain the decisions and actions performed in the organisation (Kamp, 2000). However, it can be tricky to analyse this as the processes of *"bargaining and accommodation"* are often not explicit (Dawson, 2000, s. 40).

Certain actors play a "driving role" in advocating for and facilitating change, commonly referred to as *change agents* (Dawson, 2000; Mcloughlin et al., 2000). Change can appear in the shape of new concepts, that the change agent wishes to implement (ibid). Koch (2003), describes *"concepts as socially constructed political programmes that hold intentions of change"* (p.42) and as something that is; *"practised in companies, as the answer to badly understood complex conditions and rapid changes"*(ibid, p.49). In the context of this master thesis, the concept like "sustainable strategy" or "CE" is introduced to Kvadrat Really to make the company more "sustainable".

Concepts like these are often not final before being introduced to the company but bend and negotiate in complex political processes within the company (Koch et al., 2003). Concepts of change can be revealed through the organisational narratives that are told around and within the organisation. These narratives contain different knowledge perspectives and understandings, offering insights into the political programmes by revealing the prejudges, limitations, and socio-political dynamics involved in constructing stories and validating specific positions or versions of events. The change agents need to be politically sensitive towards other actors' programs combined with a skilled narrator, to efficiently facilitate the change (Dawson & Buchanan, 2005).

In this master thesis, political programmes are used to describe the concepts inherent in the ESPR and to identify possible change agents. The theory is used when explaining decision-making but is less useful for making clear strategies for change (Mcloughlin et al., 2000). It will therefore be used as an approach and analytical tool to understand the more invisable dynamics of how actors' narratives and negotiations influence the processes of change, the motives behind the current activities and how it organise and reorganise the action network.

4.3 The Eclecticism of Action Nets Theory and Political Process Theory

Eclecticism refers to selecting and combining elements from various theories or approaches to create a comprehensive understanding of a particular phenomenon (Sil & Katzenstein, 2010). In this master thesis's context, the analytic eclecticism perspective is based on Albert Hirschman's (1970) observation that social scientists often rely solely on a single paradigm or line of causation, which can lead to less accurate predictions. While paradigms are functional, Hirschman warned that a narrow focus can lead to overlooking important factors and an increased risk of error (Hirschman, 1970). Organisations are complex entities influenced by individual behaviour, values, social dynamics, cultural norms, and institutional structures (Czarniawska, 2004; Kamp, 2000). Therefore, eclecticism can be particularly beneficial in synthesising diverse theoretical perspectives to gain a more nuanced and comprehensive understanding of the subjects. By drawing from multiple theories, researchers can develop richer and more complex explanations of organisational phenomena and enhance the practical relevance of the research (Sil & Katzenstein, 2010b).

Political Process Theory is employed with Action Nets Theory to develop a more comprehensive understanding of organisational phenomena to answer sub-questions one and two. Here, the aim is to use Action Nets Theory to analyse the network structures and

interactions within and around Kvadrat Really, while also emphasising the role of *power dynamics, interests*, and *political processes* in shaping organisational behaviour and decision-making that influence these networks. By synthesising insights from both theories (see Figure 10), the analysis will develop a more nuanced understanding of how actors navigate complex networks of power and influence to achieve their goals.

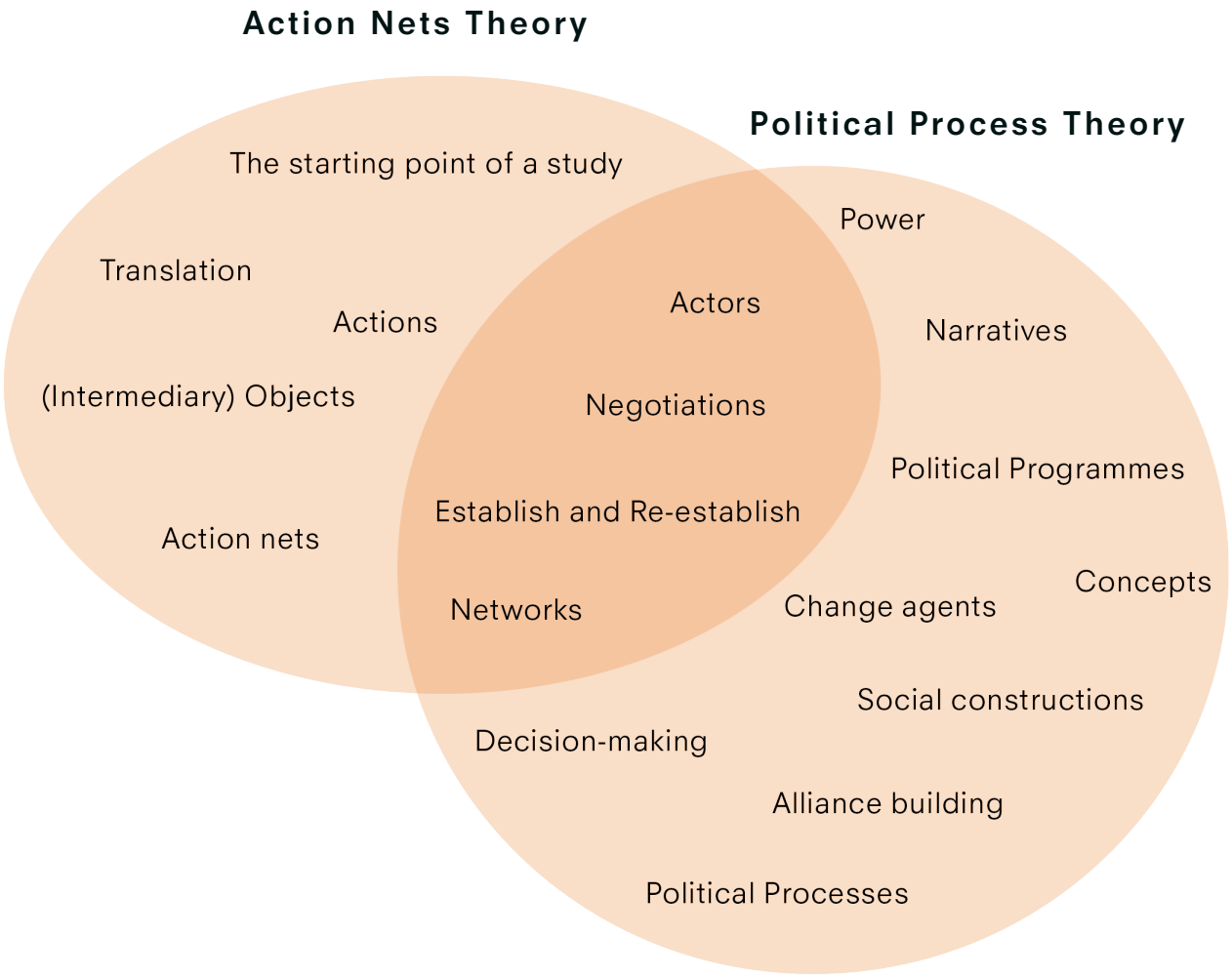


Figure 10 - Visualise how the two theories, Action Nets and Political Process, complement each other.

4.4 Semi-structured interviews

Interviews can be categorised as structured, non-directive, and semi-structured (Berg, 2001). In this master thesis, the semi-structured interview approach was employed to interview representatives from Kvadrat, Kvadrat Really, and Holmris. The objective was to gain insights into the current organisational landscape, the industries encompassing Kvadrat Really, and their managerial practices. The semi-structured interview format balances between structured and completely unstructured approaches. When constructing these interviews, two key considerations are paramount: The aims and focus of the interview, and an awareness of one's preconceptions regarding the interviewees' posi-

tions, professional backgrounds, and perspectives on the project. This method is utilised to gain a comprehensive understanding of the interviewees' perspectives on the case and their roles within it. The questions posed are designed to capture the interviewees' viewpoints from multiple angles, incorporating both preformulated questions that are systematically asked and the flexibility for interviewers to deviate from the script as necessary (Berg, 2001).

4.5 Objects

It can be difficult to navigate the exchange of data- and knowledge in collaborating with actors with different roles and backgrounds. Each individual has knowledge and assumptions, which naturally become the fundamental understanding that leads to what they do and believe (Kuhn, 1970). In a practice-based research study, it is crucial to observe what people do and how they interact in their work tasks to understand which actions are needed to solve their challenges (Carlile, 2002). According to Bourdieu (1977), it is through practice that one can understand and experience the dynamics of knowledge sharing that happens between actors. Knowledge can be seen as both a barrier and a source of innovation, as new knowledge can only appear if a mutual understanding between the actors is established (Carlile, 2002). Following objects and their movements between actors can help expose activities, connections, networks and processes (Latour, 1987b). These methods have the purpose of studying dynamics and activities across organisations. The results enclose the flows and translation of things, people and objects (Vinck, 2012).

4.5.1 Boundary Objects

A *Boundary Object* is a concept developed by Leigh Star (1989) to discuss knowledge barriers. It establishes a shared syntax or language for individuals to represent their knowledge by placing it between communities of practice. The boundary object provides a common ground for negotiation and collaboration that enables the actors to work together without fully settling each one's different perspectives and languages (Star, 1989). Through the establishment of a shared syntax across the boundary object, as noted by Carlile (2002), effectual boundary objects necessitate a shared syntax between actors, where they can work through semantic differences by making tacit knowledge explicit. Nonoka (1994), outlines this by explaining it as a space provided for actors to express and understand each other's differences, facilitating the generation of mutual understanding of knowledge (Carlile, 2002).

In the master thesis, the research group primarily utilised boundary objects, particularly through forming the structures of the actors' understanding of the system to identify

specific translations and which actions are happening in the translations. The boundary objects explore the roles and relationships of the various actors involved. In the analyses, a weighting scheme is used as a boundary object to facilitate negotiations between participants within a workshop. These boundary objects have provided valuable insights into the actors' daily tasks and the current challenges within the organisation's supply chain. Moreover, they've served as communication tools, enabling one to negotiate and identify the existing challenges from each actor's viewpoint.

4.5.2 Intermediary Objects

Intermediary Objects play a significant role across diverse fields, such as data collection, engineering practices, and analyses of daily interactions with actors (Vinck, 2012). They serve as manifestations of intentions, work patterns, and power relations, functioning as tools for translation. By utilising the concept of intermediary objects, one can identify numerous items that offer enhanced insights into actors' behaviours. In comprehending actions and relationships, intermediary objects focus on structuring the network and the outcomes of activities and practices, including data, materials, and publications (ibid). This approach enables a deeper understanding of relationships, activities, and practices that may be difficult to fully grasp through formal presentations (ibid).

In the context of intermediary objects in the master's thesis, "translation" refers to the notion that a shift from intention to realisation or from one context to another (e.g., from a policy document to a dataset) entails a transformation (Latour, 1987b). This transformation can lead to the creation of new possibilities. It is crucial to acknowledge that intermediary objects cannot be solely reduced to their author's original intention. Once materialised, these objects introduce something novel. Consequently, the resulting object may produce outcomes that differ from the initial intention through the process of translation. Through sub-questions two and three, the research group delves into analysing the impacts of implementing the ESPR focus areas on existing intermediary objects. One such object is the RCS[10] declaration form. This form currently defines the parameters for recyclers to communicate input waste textile fibre specifications to production.

4.6 Observations (follow the actions)

According to Latour (1987), the concept of looking at material objects and following their movements among different actors can provide insight into how activities are performed, how actors interact, and how networks and connections are established and re-established. This methodology is particularly relevant when studying activities that are not static but change over time and depend on the specific contexts. These activities often span across organisational boundaries involving multiple actors. The resultant

10 The Recycled Claim Standard (RCS) set the criteria for the third-party certification of recycled materials and chain of custody (Textile Exchange, 2024).

spaces involve the flows and translations of things, people and objects (Vinck, 2012). This master's thesis focuses on the movement of data and knowledge concerning the textile waste journey through various actions among actors within the supply chain of Kvadrat Really by utilising boundary objects and intermediary objects within the action nets to understand how the data and knowledge are established and re-established and which actions appear within this translation (Czarniawska, 2004; Vinck, 2012). Both approaches recognise the diversity of the social worlds within scientific domains by seeking to develop knowledge, objects, and social structures following the actions and their interactions.

4.7 Design Game

Organising collaboration between individuals with various competencies and interests can be challenging; therefore, frameworks are crucial to support cooperation (Brandt, 2006). The overall aim of design games is to help facilitate design processes between actors to create a space for negotiation and process development (Brandt & Messeter, 2004; Vaajakallio & Mattelmäki, 2014). Negotiation is central to boundary objects in this case a design game, following participatory design, which builds on the actors' different viewpoints and skills (Vaajakallio & Mattelmäki, 2014). Brandt & Messeter (2004) argue that negotiating with each other and making compromises are part of making decisions. The collaboration mainly occurs in an arranged setting with a predefined structure, rules and facilitation (Vaajakallio & Mattelmäki, 2014). By shifting the focus towards the design game, power relations might not be as present as the focus on the tasks and negotiation within the design game (Brandt & Messeter, 2004).

The outcomes of design games are not necessarily final design solutions but rather an understanding of the context in which the actors are involved and the potential within (Vaajakallio & Mattelmäki, 2014). The purpose of the design games in the master thesis is to understand the current action nets surrounding Kvadrat Really, by asking the actors to map and visualise how knowledge and data are translated from Kvadrat and further into the supply chain. Later, the design game is used to identify which actors are involved in solving the challenges, where they see the opportunities when implementing ESPR requirements, and to identify and negotiate which actions are needed to meet them. Through the facilitation of design games, mapping the following three-time frames can be possible: the world as it is, the near future and the speculative future (Vaajakallio & Mattelmäki, 2014).

4.8 Knotworking

Knotting or *knotworking* is a method rooted in *cultural-historical activity* theory (L. S. Vygotsky, Michael Cole, 1978) and the theory of *expansive learning* (Engeström, 2015).

Within the master thesis, knotting serves as a foundational framework to guide the discussion and exploration of Kvadrat Really's organisational challenges and potential opportunities during the influence of the ESPR. The goal is to strategically "tie" or "untie" meaningful knots, and strengthen Kvadrat Reallys' position in a market governed by ESPR.

The research group is inspired by Lindberg's & Czarniawska's, (2006) work in; *"*Knotting the action net, or organising between organisations*"*. The study highlights that collaborations become visible and change becomes achievable through actions within the network. While these relationships are often mutually beneficial, participants may not share identical objectives and agendas (Bødker et al., 2017). This aligns with Engeström's (2007) definition, which portrays knotworks as social production where traditional concepts of centralised control do not hold. Lindberg & Czarniawska (2006), further outline 'knotting' as *cognitive, emotional* or *mimetic* connections which can happen simultaneously. *Cognitive connections* involve the exchange of information among individuals, facilitating an understanding of, for instance, the chain of action in the textiles' journey from waste material at the recycler to a new product to the consumer. This exchange can happen through the utilisation of *boundary objects* (see section 4.5.1) such as pictures, mappings, documents or other materials. *Emotional connections*, on the other hand, are typically formed through direct face-to-face interactions, ideally fostering loyalty between the actors making them willing to connect actions (ibid). *Mimetic connections* involve individuals observing and learning from the actions and stories shared by others for instance through boundary objects. It is through the *translation* of ones practices, that connections are made and knots are tightened. Mimetic, on the other hand, does not always result in equivalence or tighter connections. Instead, it allows structures with loose connections, which can be just as good as tighter ones. These loose connections can be easier to establish as they do not disrupt existing structures (ibid).

Knotworking is beneficial when navigating activities *vertically* and *horizontally* across organisations (Lindberg & Czarniawska, 2006). Change in the action nets is made possible due to the inherently less stable and fixed nature of knots, in contrast to the more stable and enduring network (Bødker et al., 2017; Kaatrakoski & Lahikainen, 2016).

4.9 Participatory Infrastructuring

This method underscores the importance of involving diverse actors such as employees, organisations, and policymakers in decision-making processes in the development and mobilisation of a project (Bødker et al., 2017). Infrastructure is a key driver for innovation and extensive collaboration over time and among actors (Björgvinsson et al., 2010). In the context of the study on participation and democratising innovation, Björgvinsson et al. (2010) highlight the crucial role of infrastructure in fostering innovation, which necessitates prolonged and extensive collaboration among numerous actors. Design should be viewed as an ongoing process of *co-creation*, involving the collective interweaving of people, objects, and processes (ibid). In the context of this master's thesis, the study illustrates these practices and demonstrates how action nets, political processes and knotworking interplay participatory infrastructuring.

Bødker et al. (2017) note that design activities often receive the most attention when they are in the *front stage*, such as workshops or cooperative prototyping. Focusing on overlooked design activities: the *back stage* activities and the vertical and horizontal dimensions of participatory processes. They propose first exploring the vertical dimension by investigating how the actors engage in interactions across various political and practical contexts. Second, delve into the back stage aspect of design, encompassing the intricate activities that occur before, during, and after participatory workshops. Back stage activities encompass aligning actors, decision-making, and developing technological platforms, which are crucial but typically concealed. And thirdly, leverage the horizontal dimension which entails the micro-dynamics during workshops. This dimension considers the actors' influence, how they integrate into established networks across organisations, and how agencies and initiatives are distributed within these networks. According to Bødker et al. (2017), agencies refer to the capacity and ability of individuals or groups to act, make decisions, and influence within a given context. Specifically, they highlight "relational agency," which describes how professionals collaborate to improve their understanding and actions by aligning their responses to problems with those of others. This collective capacity grows as people work together, expanding their understanding and opportunities for action based on the situation.

In this master's thesis, the methodological approach included a case study in an organisational context involving design activities at multiple levels of authority and decision-making, from the factory workers to the Founder and Director of Kvadrat Really. The empirical knowledge was conducted through participant observation, semi-structured interviews, and policy document analysis to provide a comprehensive understanding of both front stage and back stage activities.

Source: Kvadrat Really

5. Analysis 1

This analysis explores the vertical dimension by investigating how the actors engage across various actions performed among actors and their political programs. In these actions, data- and knowledge are inscribed into flows which move through materialised boundary and intermediary objects in the action net through the following process; developing, producing, selling, using, and disposing of Kvadrat Really's tabletop (Vinck, 2012; Star, 1989). The theory of Action Nets by Barbara Czarniawska aims to organise the ongoing processes that take place around and within Kvadrat Really by tracing the dynamics of organising across actors and organisations to understand how they establish and re-establish stable action nets (Lindberg & Czarniawska, 2006). Based on the translation from different actors, the actions can diversify, the actors can change and the definition of the issue differ (Lindberg & Czarniawska, 2006). Furthermore, the theory of political processes helps us identify the actors' political programs, political negotiations and how they built alliances. In addition how new concepts, such as Kvadrats Sustainability Strategy, are introduced in the organisation and interrupt the actors' agenda (Mcloughlin et al., 2000; Kamp, 2000).

Sub-Q 1: *How do the data and knowledge flows challenge the interactions, practices and relationships around and within Kvadrat Really?*

5.1 Empirical Knowledge

The empirical knowledge is gathered through semi-structured interviews at Kvadrats' headquarts in Ebeltoft and Kvadrat Reallys' office in Copenhagen. Furthermore, the research group visited their production facility, Convert, in Nors, and followed the actors through the process of producing the tabletops (See Figure 11 & 12). Under the observations, the research group interviewed the factoryworkers.

Figure 11 - Following the actors at Convert.

Figure 12 - Semi-structured interviews at Kvadrat.

5.2 Kvadrat Really's Action Nets

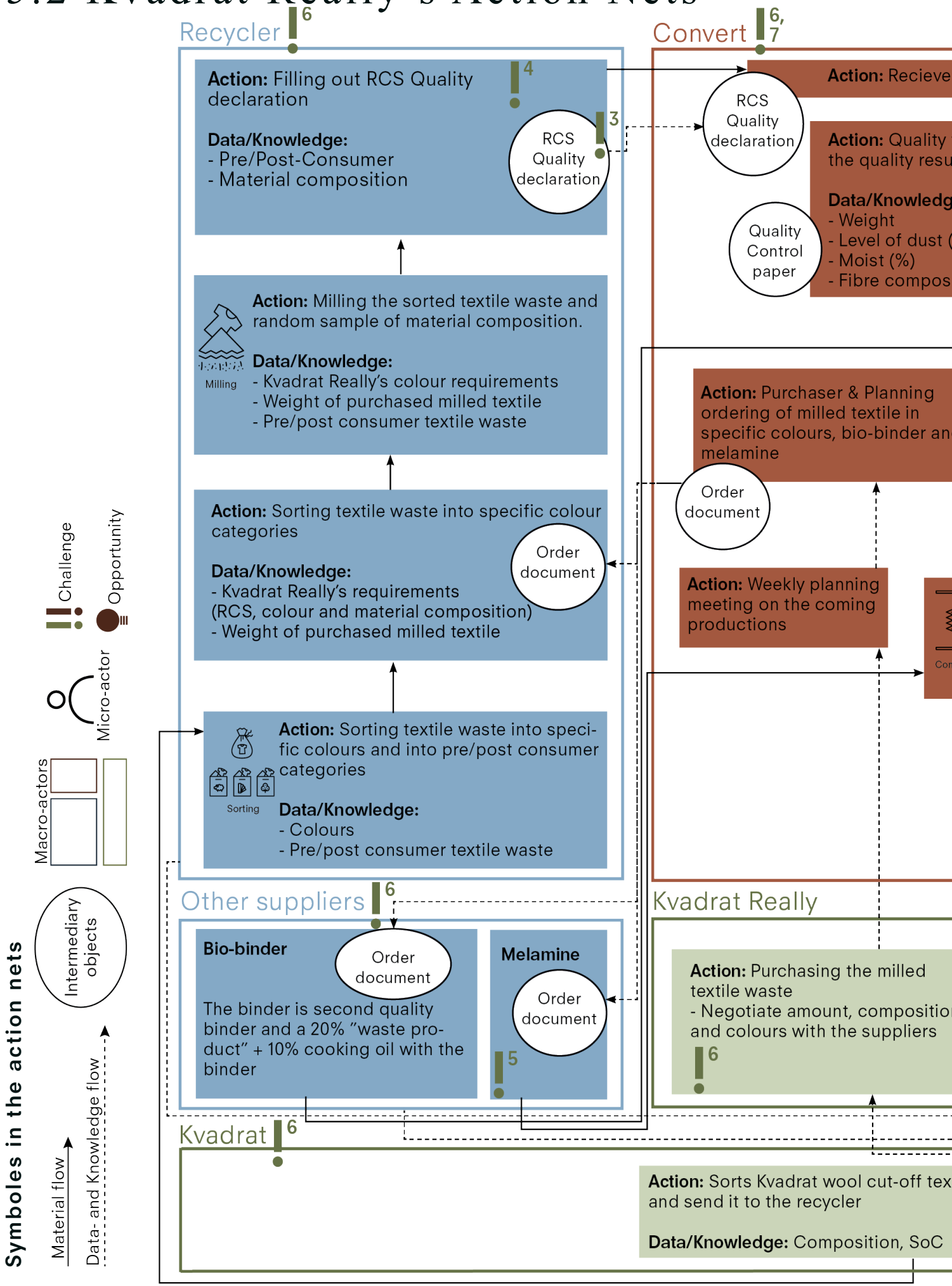
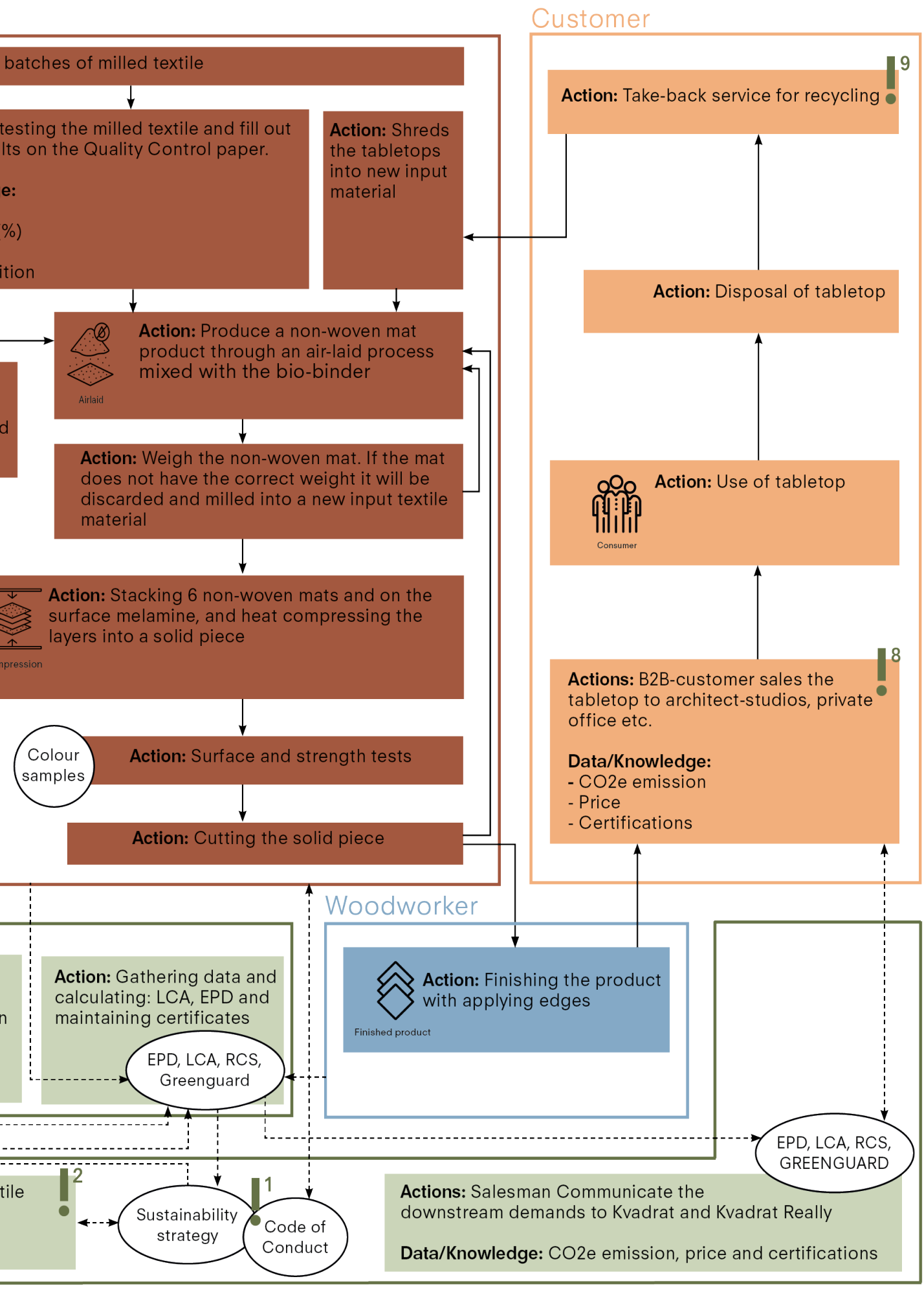


Figure 13 - Th


Customer
batches of milled textile
testing the milled textile and fill out
lts on the Quality Control paper.
e:
%)
ition
Action: Shreds the tabletops into new input material
Action: Take-back service for recycling
9
Action: Disposal of tabletop
Airlaid
Action: Produce a non-woven mat product through an air-laid process mixed with the bio-binder
Action: Weigh the non-woven mat. If the mat does not have the correct weight it will be discarded and milled into a new input textile material
Consumer
Action: Use of tabletop
Action: Stacking 6 non-woven mats and on the surface melamine, and heat compressing the layers into a solid piece
8
Actions: B2B-customer sales the tabletop to architect-studios, private office etc.
Data/Knowledge:
- CO2e emission
- Price
- Certifications
Colour samples
Action: Surface and strength tests
Action: Cutting the solid piece
Woodworker
Action: Finishing the product with applying edges
Finished product
Action: Gathering data and calculating: LCA, EPD and maintaining certificates
EPD, LCA, RCS, Greenguard
EPD, LCA, RCS, GREENGUARD
2
1
Sustainability strategy
Code of Conduct
Actions: Salesman Communicate the downstream demands to Kvadrat and Kvadrat Really
Data/Knowledge: CO2e emission, price and certifications

Upon visualising the action nets in Figure 13, the analysis divides them into smaller action nets and examines the political programs of the actors, how the actors build alliances, and how they translate intermediary objects.

5.2.1 The Narratives of Kvadrat and Really

When Kvadrat invested in the ownership of Really, Kvadrat's identity became part of Really. This was declared through the renaming to Kvadrat Really. The Founder and Director (F&D) of Kvadrat Really explains that they chose to fusion with Kvadrat because of its strong branding on quality and design (Appendix 2). Additionally, the purchaser states that after the fusion, the market perceived Kvadrat Really in the same way as Kvadrat, with identical expectations to quality. (Appendix 3).

In the interviews with the employees at Kvadrat Really and Kvadrat, the significance of the brands' storytelling was highlighted. Through the interviews, it became clear that Kvadrat has a strong narrative. In essence, Kvadrat's narrative is about innovation, collaboration, and a deep-rooted commitment to quality and sustainability. The company's ability to blend tradition with modern design and technology has positioned it as a pioneer in the textile industry, working in collaboration with artists, interior design and architecture on a global scale (Kvadrat, n.d.). The strong narrative reflects a political program where quality and sustainability is something that is seen as the core of its business and something that makes Kvadrat valuable. Likewise, Kvadrat Really has a strong narrative concerning the pioneering element of recycling textile waste into a valuable product by designing waste into aesthetic design products in high quality (Kvadrat Really, n.d.). The purchaser comments that Kvadrat Really is built on a good story, which is used by the salespeople when promoting the tabletops (Appendix 3).

From the interviews, it appears that Kvadrat and Kvadrat Really share a common narrative regarding their organisational identity. Dawson (2000) points out that *"In political processes, a rational narrative is constructed, revised and modified over time and sustained within the context of other competing voices and views"* (p. 39). Kvadrat, a textile company, and Kvadrat Really, a production and furniture company, have distinct profiles. However, they have build an alliance through a rational narrative that has successfully evolved in response to various internal and external factors. This narrative has allowed them to sustain a common political program focused on quality and sustainability (Kvadrat, 2024a).

5.2.2 Kvadrat's Sustainability Strategy

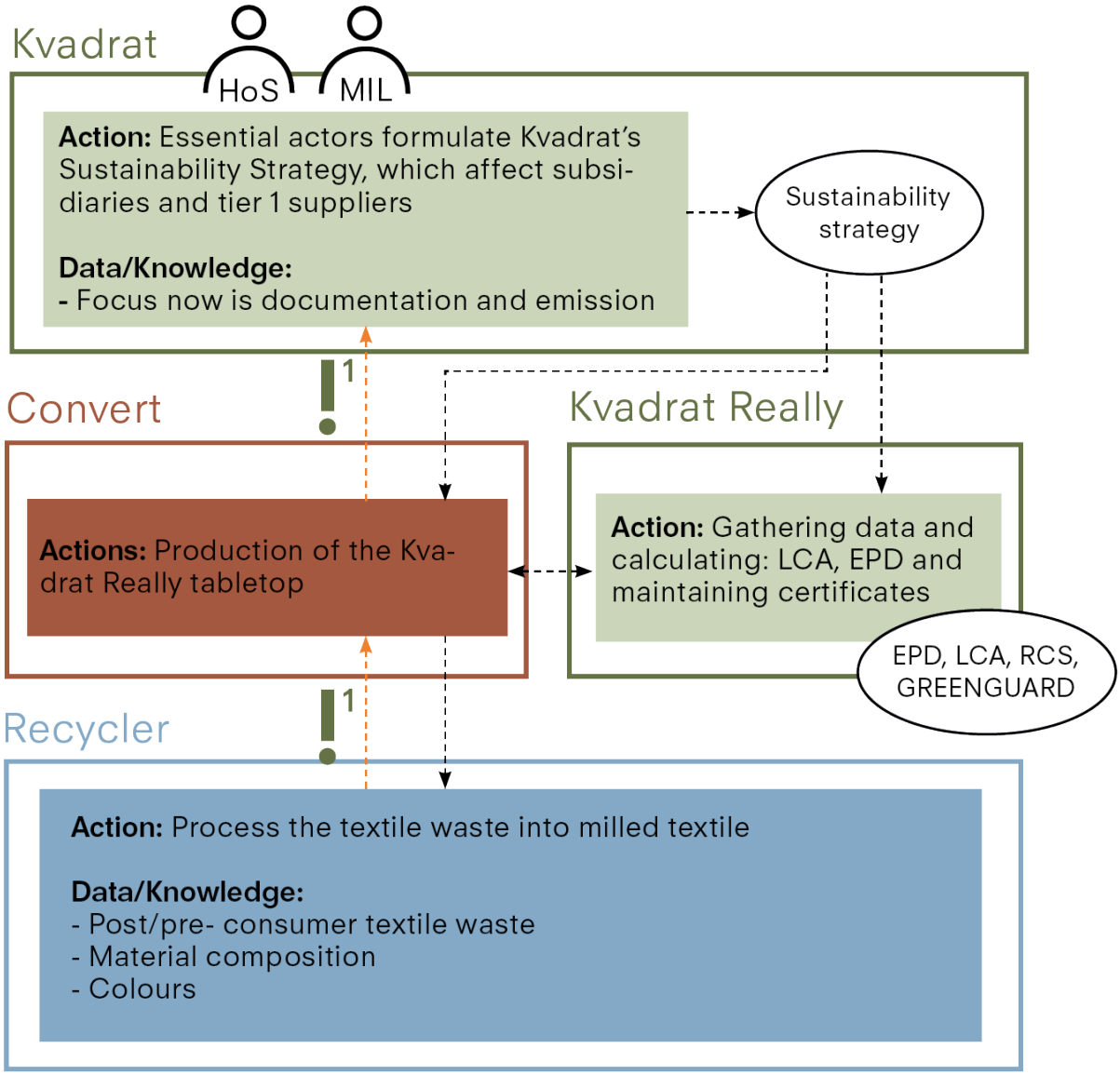


Figure 14 - Challenge 1

The interviews provided profound insight into the organisational culture, particularly highlighting Kvadrat's power position. The most prominent example is the implementation of the concept of a Sustainability Strategy, and its impact on Kvadrat Really's internal dynamics and alliances (Dawson, 2000). Figure 14 visualise that the strategy aims to ensure that the entire organisation adheres to specific sustainability requirements, making it an intermediary object, that establishes the framework and requirements as non-negotiable (see section 4.5.2). The strategy encompasses three pillars: environmental, social, and governance. In the context of this master's thesis, the environmental pillar is crucial, comprising two focus areas: Decarbonisation and Conscious Design, each with defined sustainability targets. Targets aim to reduce CO2e emissions, provide EPDs and certifications, emphasise the amount of recycled materials in products and provide circular services.

Power relations shape the conditions and opportunities for subsidiaries and tier 1 suppli-

ers, continually producing and reproducing political programs (Kamp, 2000). The Head of Sustainability (HoS) and the Material Innovation Lab Manager (MIL) facilitate this by educating employees and suppliers within a change-maker network (Appendix 4).

Documentation was not a priority until recently; however, the current focus of the HoS is gathering documentation from tier 1 suppliers and subsidiaries to calculate their Scope 3. This data-gathering process is challenging, with Kvadrat Really and Convert being no exceptions (Appendix 4). The challenge identified from the interview with the HoS was the difficulty of getting all the important data from the production facility Convert, which they need to make their scope 3 calculation (Appendix 4). Furthermore, a part of being Kvadrats' tier 1 supplier is the need to live up to their Code of Conduct (CoC) which states: *"The business partner should be aware of the origin of the raw materials and components used….Business partners are expected to exercise appropriate due diligence in their supply chain and work with their suppliers and subcontractors to ensure that they also conduct their operations in line with the principles of this Code of Conduct"* (Kvadrat, 2024b).

5.2.3 Internal Recycled Materials

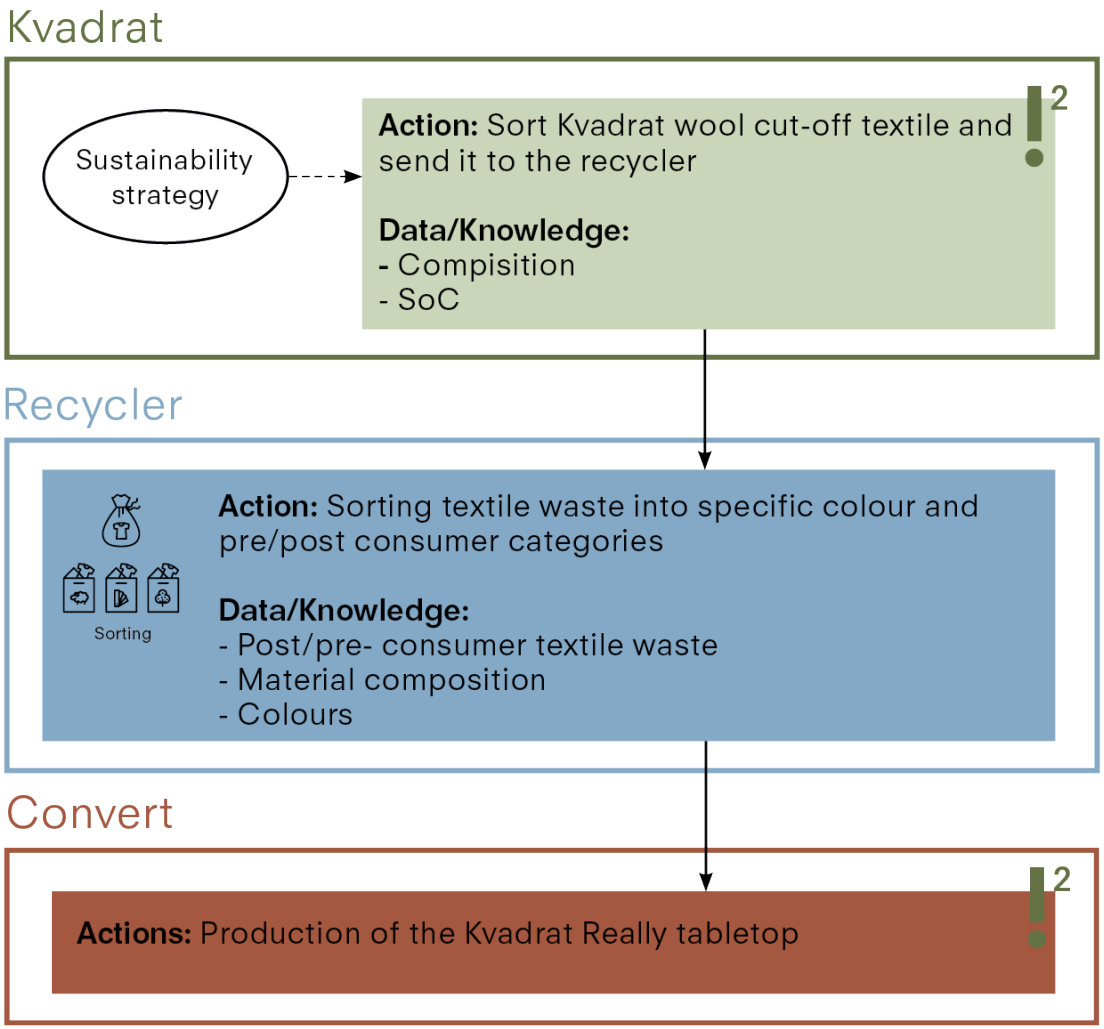


Figure 15 - Challenge 2

The strategy, visualised in Figure 15, Kvadrat focuses on Conscious Design, where recycling is included to reduce waste (Kvadrat, 2024). Kvadrat's CEO writes in the Sustainability Strategy Report from 2022 that: *"Really transformed 300 tons of textile waste into high-quality tabletops. And all Kvadrat brands incorporated the Kvadrat Conscious Design Principles into their specific design roadmaps"* (Kvadrat, 2023). Kvadrat has made a narrative of Kvadrat Really, that it is a successful example of recycling textile waste by upcycling cut-offs from Kvadrat's production and textile waste from their customers (ibid) (Appendix 2;3).

However, this initiative is not without its challenges. The R&D Manager, responsible for the development and technical properties of the tabletops, points out that using textile waste in tabletops is impractical due to its properties. Despite this, he acknowledges the significant global issue of textile waste and its potential interest to include and develop a high-quality product with textile waste. He further notes that some fibres possess better properties than others, making them more suitable for this application (Appendix 1). The wool cut-off from Kvadrat lowers the quality and makes the tabletop's core softer than using cotton, on account of that the wool input is only used in a small amount mixed with cotton in a composition of 15% wool, 85% cotton, as the base colour used in the cotton cream colour (Appendix 3). The F&D explains that the product's strength increases with the amount of cotton used. However, they recognise that pure cotton is attractive, as this is the main input for fibre-to-fibre recycling (Hedrich et al., 2022) (Appendix 2). Consequently, Kvadrat Really has designed the tabletop to be both robust and composed of mixed materials. Nonetheless, it is required to contain a minimum of 60% cotton and a maximum of 1% elastane.

These requirements do not speak to Kvadrat's advantages. In 2022 Kvadrat purchased 3 tons of cotton fibres and textiles compared with 1607 tons of wool (Kvadrat, 2023). The fact that Kvadrat Really is not seen as an integrated part of Kvadrats' material journey makes it challenging to create a closed-loop system of the materials. Additionally, Kvadrat's textiles are of very high quality. By adding the wool cut-offs into Kvadrat Really's tabletop, they are downcycling the fibres. In this situation, Kvadrat has decided to compromise the high quality and sustainability for a good CE story by using Kvadrat Really's narrative of recycling textiles into a new and valuable product.

5.2.4 Data Requirements Across Industries

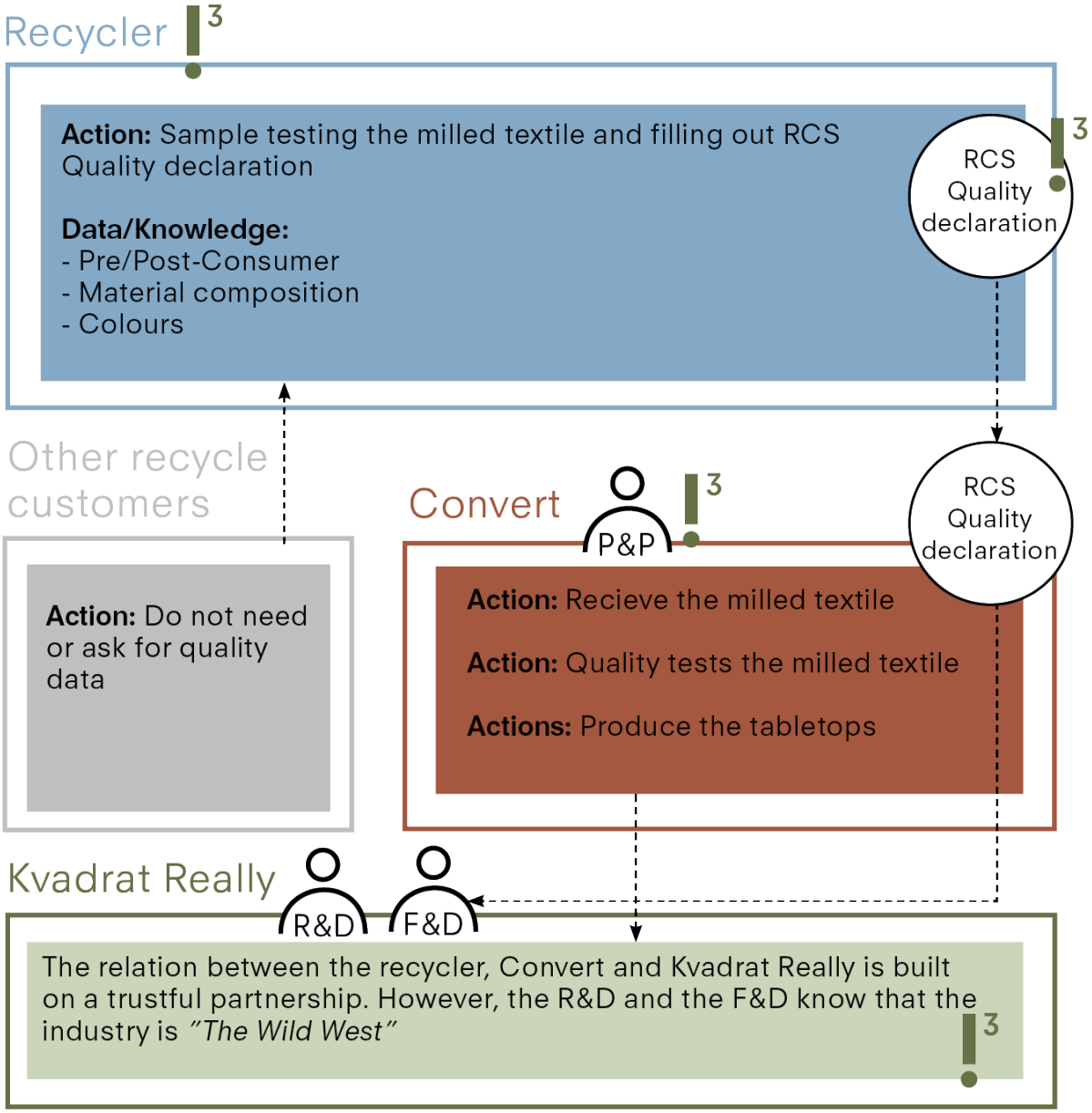


Figure 16 - Challenge 3

Figure 16 demonstrates how the purchaser and planner in Convert, Kvadrat Really's manufactory order the rest of the textile waste from the recycler. When the textile enters the Recycler it is seen as waste (Appendix 1). The textile waste goes through a process of tearing, shredding and milling processes. Afterwards, the recycler fills out the RCS declaration before it arrives at Convert. As Kvadrat Really's production scaled, the material amount needed meant they had to change from ordering textile waste from laundry services to recyclers because they could deliver the amount, reasonably material composition, inform if it is pre- or post-consumer textile waste and divide it into colours better (Appendix 3;4). This transformation gave new challenges in a lack of quality data as the recyclers are not used to having these questions asked of their other customers (Appendix 1).

The F&D and the R&D Manager know that even though the recycler fills out the RCS

declaration, the documentation and material can have some uncertainties. The F&D expresses in an interview that it should be noted that the recycling industry operates in a rather unregulated manner, akin to the Wild West, where people often lack complete control and knowledge, with the primary focus being on profit (Appendix 2). In another interview, the R&D Manager confirms this by saying that it is not everything the recycler can or will tell their customers (Appendix 5). However, the actors at Kvadrat Really, state that they have a close and trustful partnership with the recycler and that they only work with suppliers from the EU (Appendix 2). By that, they belive that the suppliers must live up to certain standards.

5.2.5 RCS Declaration to Document the Input Material

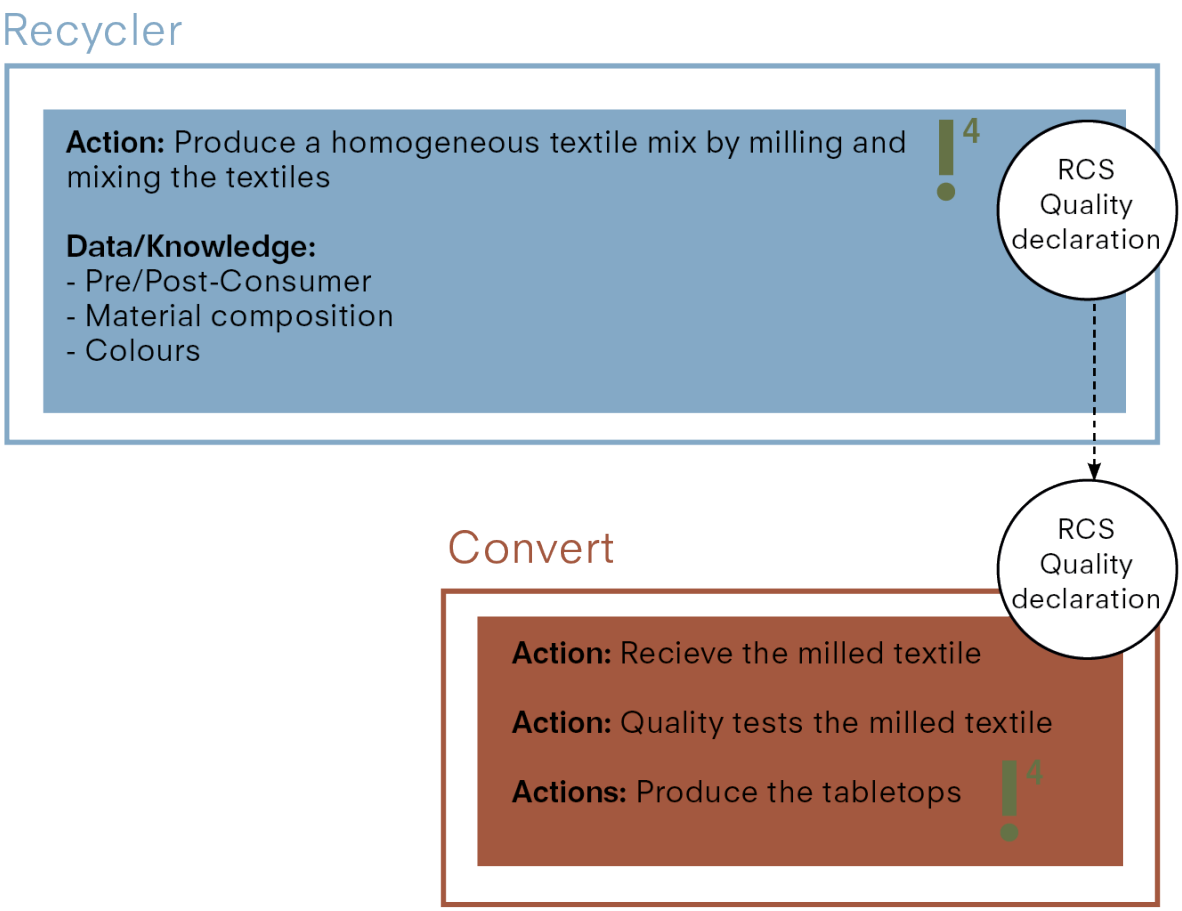


Figure 17 - Challenge 4

Figure 17 visualise how Kvadrat Really utilises recycling partners due to its advanced machinery, the capacity of materials and concerning separation of Convert's different types of input materials. The recycler employs machines to mill and shred textiles and remove most of the dust, ensuring that the milled textile output meets Really's stringent requirement concerning a maximum of 6-8% of dust. The other requirement is the composition, which stipulates at least 60% cotton and a maximum of 1% elastane, as well as distinguishing between post- and pre-consumer textiles.

One significant challenge is that the recyclers do not know the composition of the tex-

tile waste by 100 percentage and cannot test every batch of milled textiles. Despite this limitation, recyclers can produce a more homogeneous material by milling and mixing the textiles (Appendix 5;2).

A homogeneous material mix is crucial for Kvadrat Really, as inconsistency would result in products with an undesirable, uneven appearance. As the founder expressed, Kvadrat Really needs a supplier who can mix materials properly; otherwise, the mats will resemble a patchwork landscape (Appendix 2).

5.2.6 Substances of Concern

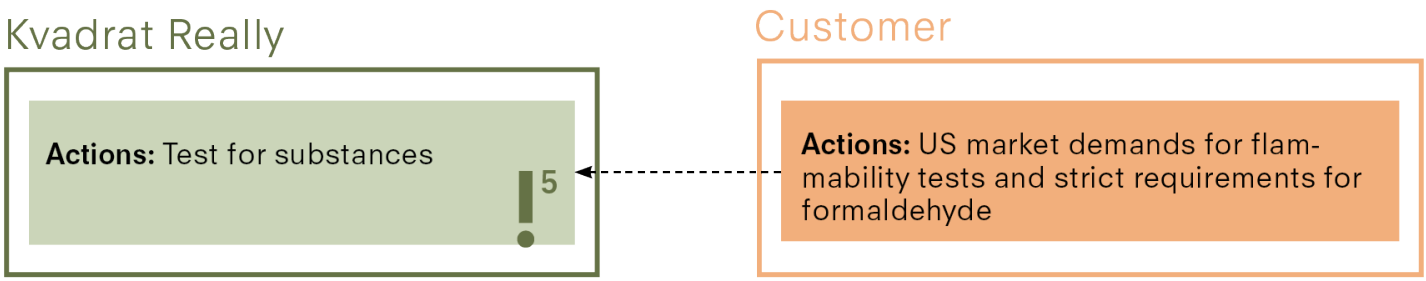


Figure 18 - Challenge 5

REACH has flagged melamine as a substance to be used sparingly, presenting a challenge as customers become more critical of its usage (Appendix 2). Additionally, Kvadrat Really aims to enter the US market, but as seen in Figure 18 the country requires greater transparency regarding the substances used in materials and production processes, as well as specific flammability tests. One challenging element is the melamine surface, as the US market has strict requirements for formaldehyde[11] use in melamine. This has led to instances where melamine has nearly failed or failed to meet these standards (Appendix 2).

To prevent the inclusion of substances of concern, the textile waste used in the tabletops must not come from outdoor, UV, or fire-retardant textiles (Bour et al., 2023). However, the current data from recyclers does not specify the categories of textiles used, forcing Kvadrat Really to rely on the recyclers' assurances. Additionally, there is no existing system for accurately testing large amounts of textile waste, making it difficult to control the chemical substances in the tabletops (Appendix 2;5). At this point, Kvadrat Really does not have comprehensive knowledge of the chemical composition of all produced tabletops. However, they annually do the VOC test for substances. The F&D ensures that the test results are consistently very low (Appendix 2).

11 Formaldehyde is a colourless, highly toxic, and flammable gas used in producing fertiliser, paper, plywood, and some resins. Exposure can irritate the skin, throat, lungs, and eyes, and repeated exposure may lead to cancer (The National Institute for Occupational Safety and Health, 2019).

5.2.7 Who is Responsible?

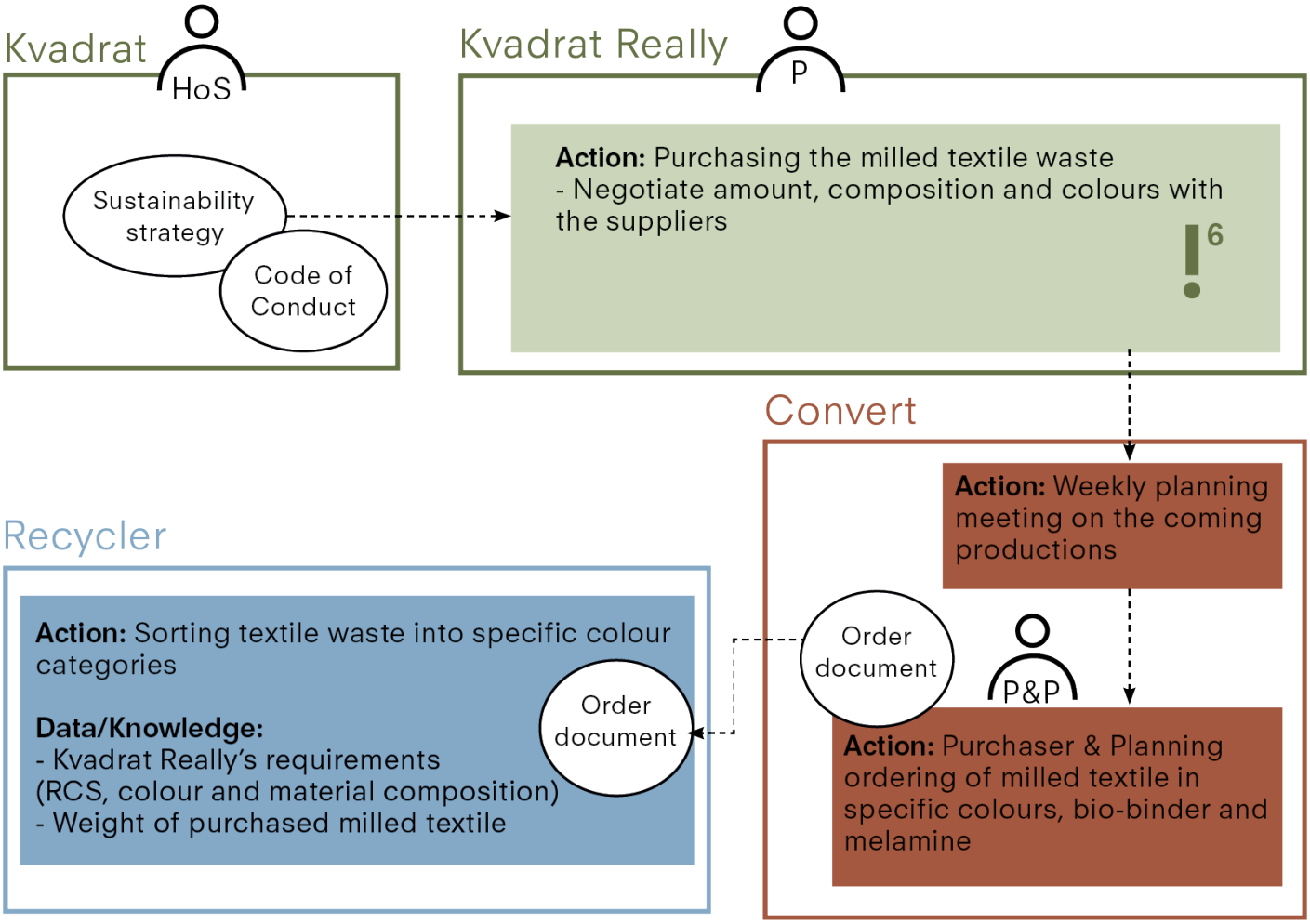


Figure 19 - Challenge 6

As addressed in section 5.4.2, Kvadrat's Sustainability Strategy shapes the conditions and opportunities for Really and Convert. Part of the strategy is a requirement to adhere to its CoC (Appendix 4). The HoS in Kvadrat highlights that most of the responsibility regarding supplying the information needed is located at the textile purchaser. As illustrated in Figure 19, the purchaser, in contrast to Kvadrat Really, expresses that each supplier in the chain are responsible for this information. Regarding the input material this is merly adressed by having the recycler sign the CoC. This document do not consist of specific data, but rather broad promisses that they need to live up to. If their is identified a lack in the production due to the input material, it can be tricky to hold the supplier accountable, if Kvadrat Really has not been transparent in which requirements and documentations they need from them recyclers. The manufacturer, Kvadrat Really, will allways be responsible for the products they put on he market including product data transparency through the supply chain.

The HoS is a change agent, by pushing the implementation of the strategy. A part of her political program is to shift the relevant actors towards greater understanding and transparency of responsibilities. The HoS stresses the importance of onboarding suppliers and educating them on working with Kvadrat's products, certifications, and data-gathering processes (Appendix 4).

5.2.8 Convert Produce for other Companies

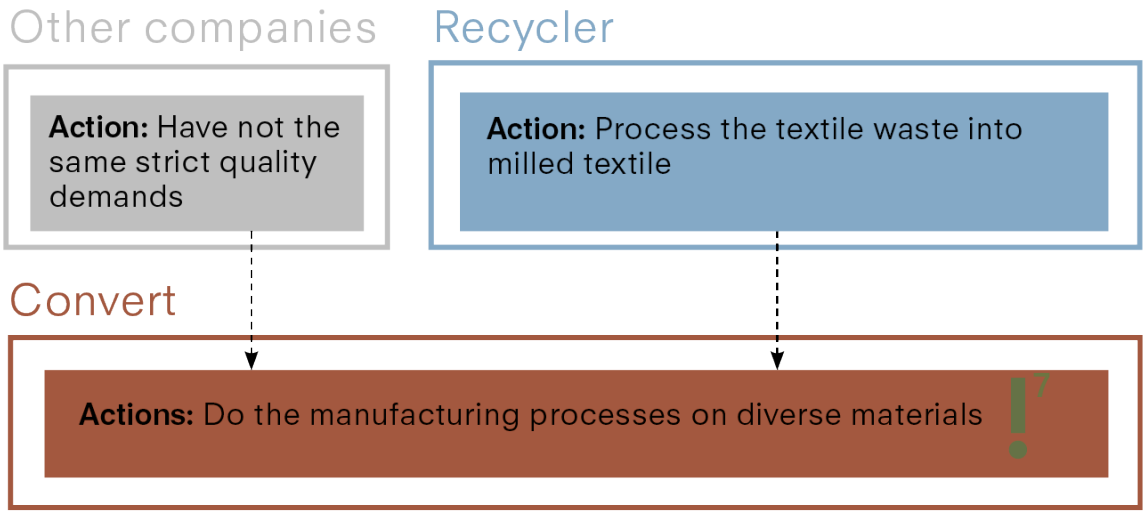


Figure 20 - Challenge 7

Convert specialises in the production of manufactured goods for various companies, employing a uniform manufacturing process that accommodates diverse materials, including seaweed and wood. Figure 20 visualises that presently, all materials produced by Convert are processed through the same machinery, which has led to a decline in quality for the textile waste input. The existing equipment is unable to manage the wide range of materials while simultaneously adhering to the requisite quality standards for textile waste fibres (Appendix 1;2).

5.2.9 B2B Customers' Demands

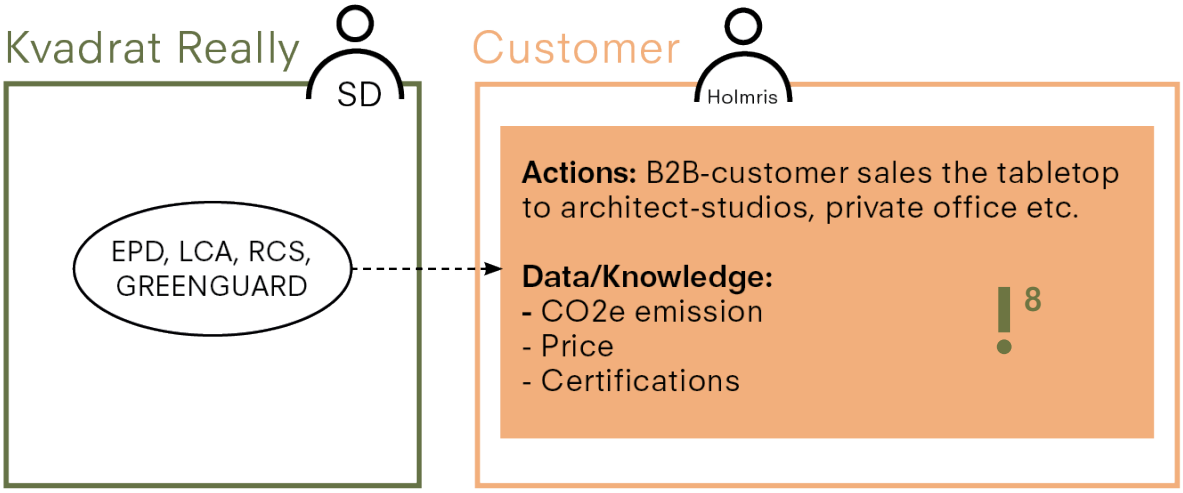


Figure 21 - Challenge 8

The main input material is classified as textile waste, produced without water usage, resulting in a carbon footprint of 13,4 kg. Pr. sqm, which is a 30% saving compaired tom a conventional MDF tabletop (Kvadrat, n.d.-b). The lower CO2e emission creates a stron-

ger position for Kvadrat Really in the furniture market as this is a crucial navigation tool for customers when deciding between tabletops. The furniture industry has a strong position on the agenda for what to prioritise, as the low CO2e calculation becomes more important than finding alternatives to composite material. The trade-off lies within the balance between keeping the low CO2e emission while using as much textile waste in the tabletop as possible, as this will be good for the storytelling of turning textile waste into a resource but more problematic in terms of the total calculation of the production process.

The SD has noticed that people are very enthusiastic about Kvadrat Really's narrative, of promoting sustainability through the use of waste textile materials that would otherwise be burned. He points out that customers appreciate the product for its looks and increased sustainability. However, he notes that the price of the tabletop is one of Kvadrat Really's challenges in the furniture market (Appendix 2). The Development Manager (DM) at Holmris which in Figure 21 and this case represents the customer, stresses that the Kvadrat Really tabletops are 20% more expensive than Holmris' most expensive linoleum tabletop (Appendix 7).

The SD further highlights the significance of certifications for the tabletop. Certifications are boundary objects which play a crucial role for customers, serving as a safeguard against greenwashing and to compare and negotiate which product to purchase. The certifications put Kvadrat Really in a powerful position in the market. The F&D points out that many, including furniture manufacturers, have a limited understanding of sustainability and rely primarily on EPDs and recycling labels without conducting further investigation (Appendix 2).

Regarding aesthetics, the SD mentions that customers need to get more used to the different looks of recycled products. One of Kvadrat Really's major B2B customers, Holmris, is fully committed to the tabletop and the recycled surface (Appendix 2). In addition to their commitment, the DM at Holmris expresses that Really needs to improve its processes to ensure that products are thoroughly completed before being released to the market. Hereby, he recommends establishing a clear limit on the number of permissible errors (Appendix 7).

5.2.10 Take-back system

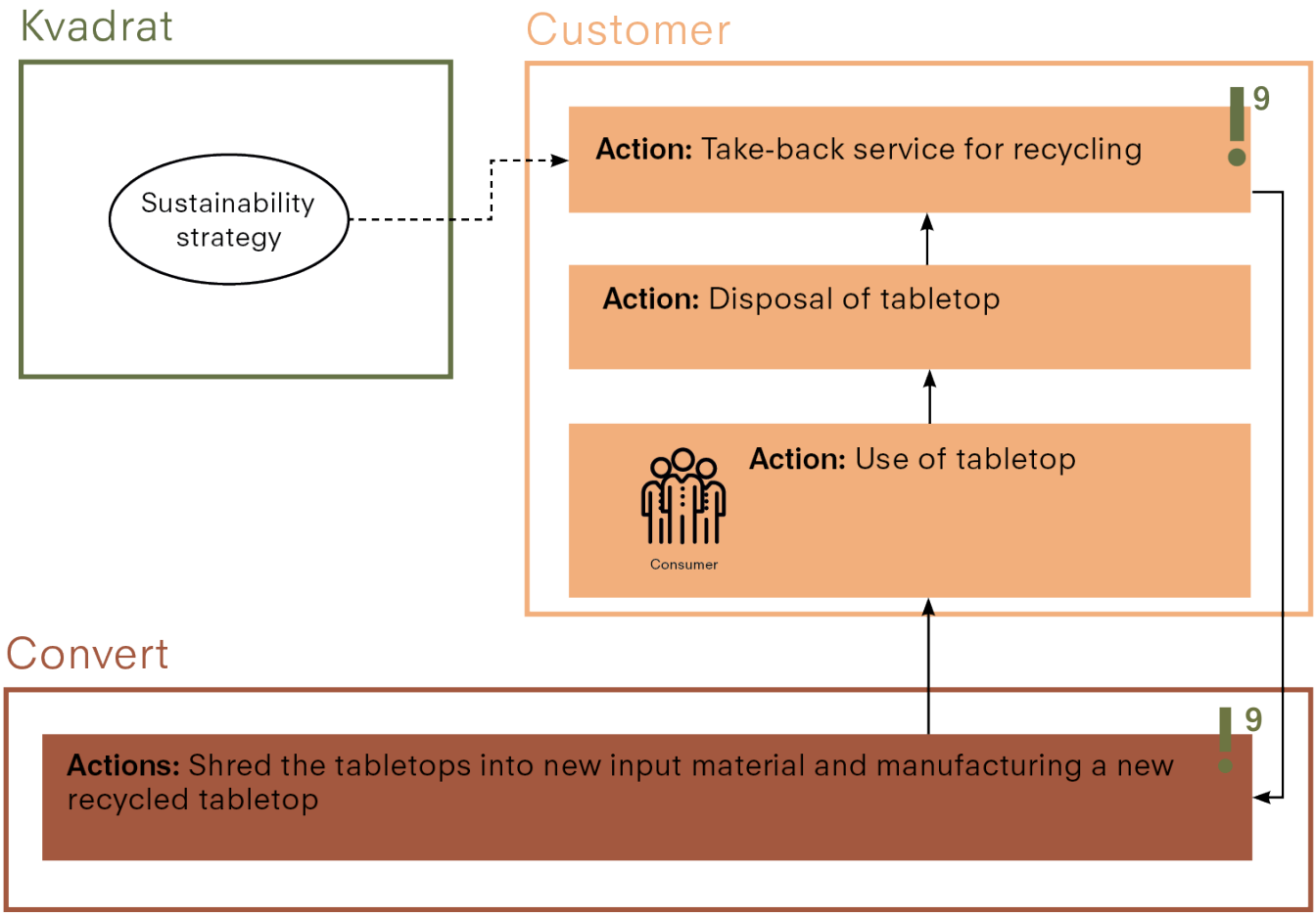


Figure 22 - Challenge 9

In the 2023 Sustainability Strategy report from Kvadrat, they emphasise the importance of minimising the use of virgin materials through the launch of a customer textile take-back concept in partnership with Kvadrat Really (Kvadrat, 2023). The report states that Kvadrat Really is the pioneer among brands in providing circular services. Whenever a Really product reaches the end of its life, customers have the option to return it to the company and receive reimbursement based on the composition of the returned material. The team at Really takes the responsibility of shredding the old product and repurposing it into a new one (ibid). The HoS has set ambitious targets for circularity, which include the development of new business models (Appendix 4). The F&D stresses that the take-back system is not settled yet as there needs to be developed a model which is economically sustainable as well (Appendix 2). While Kvadrat promotes in the Strategy the take-back system, Kvadrat Really rather want to focus on developing long-lasting quality products (Kvadrat, 2023) (Appendix 2;5).

As visualised in Figure 22, one of the challenges with establishing a take-back system is that Kvadrat Really primarily sells to B2B customers, such as Holmris, and therefore is not in direct contact with the end user. However, the company is willing to accept and recycle tabletops if contacted by someone with a large number to return (Appendix 2).

Another challenge is the difficulty of offering a take-back system in the US, where Kvadrat Really does not have a manufacturer to recycle the tables. This was highlighted by the experience of the sales platform Vitra, which found it challenging that Kvadrat Really could not offer recycling of the tabletops in the US (Appendix 2;6).

5.3 Sub-conclusion

The analysis reveals the current challenges involved with Kvadrat Really, which are summarised in Figure 23. Visualising the process from textile waste to disposal highlights how the parent company, Kvadrat, implements policies through intermediary objects like the CoC, impacting tier 1 suppliers. The far-reaching influence of Kvadrat's Sustainability Strategy, with its rigorous environmental targets and emphasis on Conscious Design, is evident in Kvadrat Really's operations and partnerships. However, persistent challenges such as decentralised data, textile waste recycling difficulties, and quality control issues continue to be addressed. Additionally, the recycling industry's lack of stringent data requirements and the challenge of ensuring consistent material composition pose significant obstacles. Finally, the take-back system and its alignment with sustainability goals present further hurdles, especially in managing customer returns and recycling logistics and the use of materials with toxic substances, such as melamine. Despite these challenges, Kvadrat Really continues to navigate its sustainability journey, striving to balance quality, environmental impact, and economic viability.

No.	Challenges (!)
1	Kvadrat Really and Convert can not fill out the needed data and documentation Kvadrat demands.
2	The tabletop requires at least 60% cotton, conflicting with Kvadrat's primarily wool materials.
3	Missing data from the recycler means a lack of control over the quality of the product.
4	Recyclers determine composition by testing once and assuming the rest of the textile waste matches.
5	Kvadrat Really lacks knowledge and tools about SoC, including the input material and its high formaldehyde content in the melamine.
6	The different roles and responsibilities in the supply chain and K.R. need to be more transparent.
7	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
8	More customers are focusing on sustainability, but they expect a recycled product to be the same quality as a virgin one.
9	Kvadrat Really's business model could expand to include a take-back system, but it requires logistic and systemic scalability.

Figure 23 - Table of identified challenges at Kvadrat Really

Source: Kvadrat Really

6. Analysis 2

In this analysis, the vertical dimension will also be examined in detail. Furthermore, the analysis investigates ESPR with the identified challenges from analysis 1, highlighting the ones which encompass the concepts of CE and transparency, trust and traceability (European Commission, 2023). This Chapter explores the implications of these concepts for Kvadrat Really, focusing on political negotiations, alliance formation, conflict resolution, and compromises among actors. The research group will investigate the context of the existing action nets and how this might affect the identified challenges from Chapter 5. Furthermore, the action net is used to visualise and understand the challenges and opportunities within and through the supply chain of Kvadrat Really to navigate the strategies needed for meeting the ESPR requirements by understanding the involved actors' power positions and who has the "driving roles" for acting upon the strategies toward implementing the concept, ESPR.

SUB-Q 2: *How might ESPR cultivate the challenges and opportunities that already exist within and around Kvadrat Really?*

6.1 Empirical Knowledge

To gain insight into the current state of the ESPR and its regulatory requirements, the research group conducted extensive research, delving into grey literature such as Commission proposals, webinars, and reports from various stakeholders (see section 2.2). To understand how the ESPR focus areas will affect Kvadrat Really, the research group conducted semi-structured interviews with the R&D Manager, the F&D and the SD with questions developed based on the focus areas illustrated in Figure 24. Here it demonstrates the interviews conducted through a design game illustrating the network by which Kvadrat Really is influenced. The visualisation is used to navigate the ESPR's effects on the existing action nets.

Figure 24 - Interview through a visualisation of the Action Nets

6.2 ESPR Focus Areas

CE is a core concept of ESPR's political program, which is built on the idea of improving the environmental sustainability of products by setting requirements that products need to fulfil to be placed on the EU internal market (European Commission, 2023). The requirements aim to be used as a basis for improving the product aspects (European Commission, 2022). To reach this goal the ESPR focus on gaining more transparency in the supply chain, trust in the collaboration between actors within and traceability through following the materials journeys (European Parlement and of the Council, 2022). Even though the requirements are not fully elaborated yet, however, they will concern the following areas:

Ecodesign Requirements/ESPR		
No.	**Focus Areas**	**Definition**
FA1	Product durability and reliability	Refers to its ability to function as required under specified conditions and for a given duration, without interruption or failure.
FA2	Product reusability	Refers to the capacity of a product to be used repeatedly for its original purpose or other purposes, either through its design, material composition, or ease of refurbishment.
FA3	Product upgradability, reparability and maintenance	Repair involves fixing defects or damage to restore a product's functionality. Upgrading enhances a product's features or capabilities. Maintenance encompasses actions to keep a product in working condition.
FA4	The presence of substances of concern in products	Identifying hazardous substances within products poses risks to human health or the environment. This includes substances subject to restrictions or bans under EU regulations, such as REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals), as well as those posing risks in specific product categories.
FA5	Product energy and resource efficiency	To optimise the utilisation of energy and resources throughout a product's lifecycle. This involves minimising energy consumption and resource depletion during the production, distribution, use, and disposal phases.
FA6	Recycled content in products	Refers to the amount of materials from recycled sources added into a product composition. This includes materials recovered from post-consumer waste or industrial by-products.
FA7	Product remanufacturing, refurbishment and recycling	Remanufacturing and refurbishment refer to restoring used products to a like-new condition, preserving their functionality and value. Recycling involves recovering materials from end-of-life products to create new products or components.
FA8	Products' carbon and environmental footprints	Encompass the total greenhouse gas emissions and broader environmental impacts associated with the entire lifecycle of a product, including production, distribution, use, and disposal.
FA9	Products' expected generation of waste materials	Refers to the estimation of the amount and types of waste generated throughout a product's lifecycle, including manufacturing, use, and disposal stages.
FA10	Available information on the product	General information requirements include the implementation of digital product passports and green claims, all of which pertain to the value chain (Arne Remmen, 2024; European Commission, 2022).

Figure 25 - Overview of ESPR requirements (European Commission, 2024).

6.3 How ESPR Focus Areas Affect Kvadrat Really's Action Nets

From the identified challenges in the first analysis, the theme of data and knowledge plays a crucial role. This current challenge of lack of knowledge on the quality of the tabletop in the production process will further be challenging in meeting the focus areas of ESPR as data and knowledge through the supply chain will become essential in the coming years (Challenge 3 & 4).

The disagreement of the purchaser's role and responsibilities creates conflict in developing and pushing for the required data from the recyclers, as this actor needs to understand and agree with the requirements of negotiating. The requirements of more transparency and knowledge about the material journey are challenging to live up to if the purchaser disagrees with their role as a communicator of these requirements down through the supply chain (Challenge 6). This will influence the actors and their political process, which helps describe organisational change processes (Dawson, 2000; Hvid et al., 2003; Kamp, 2000; McLoughlin et al., 2000). In this case study, the change processes are driven by ESPR activities in the European market and the internal history and culture of Kvadrat Really (Dawson, 2000; European Commission, 2024) (Appendix 2;4). The Action Nets affected by ESPR requirements are visualised in Figure 26:

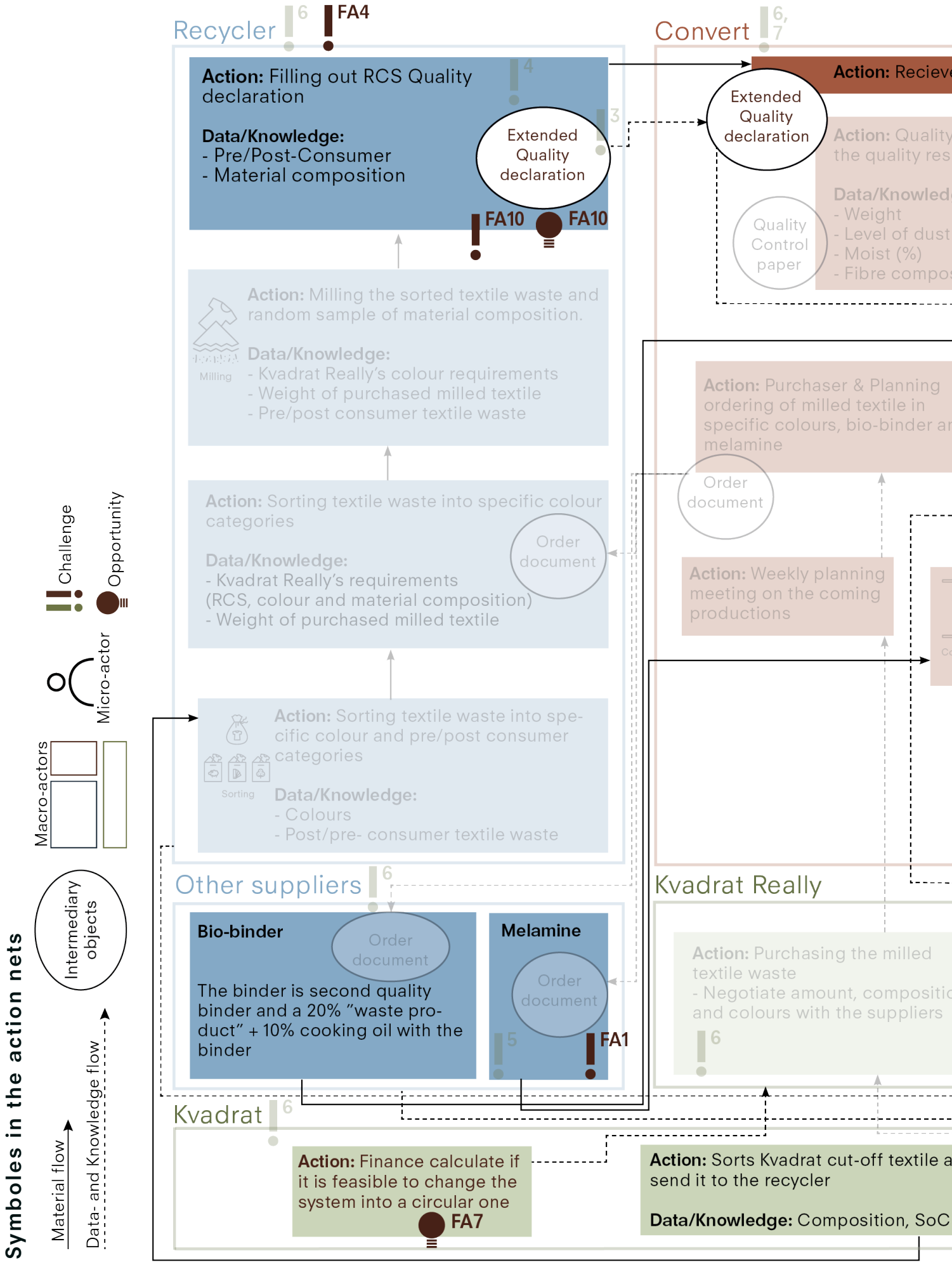
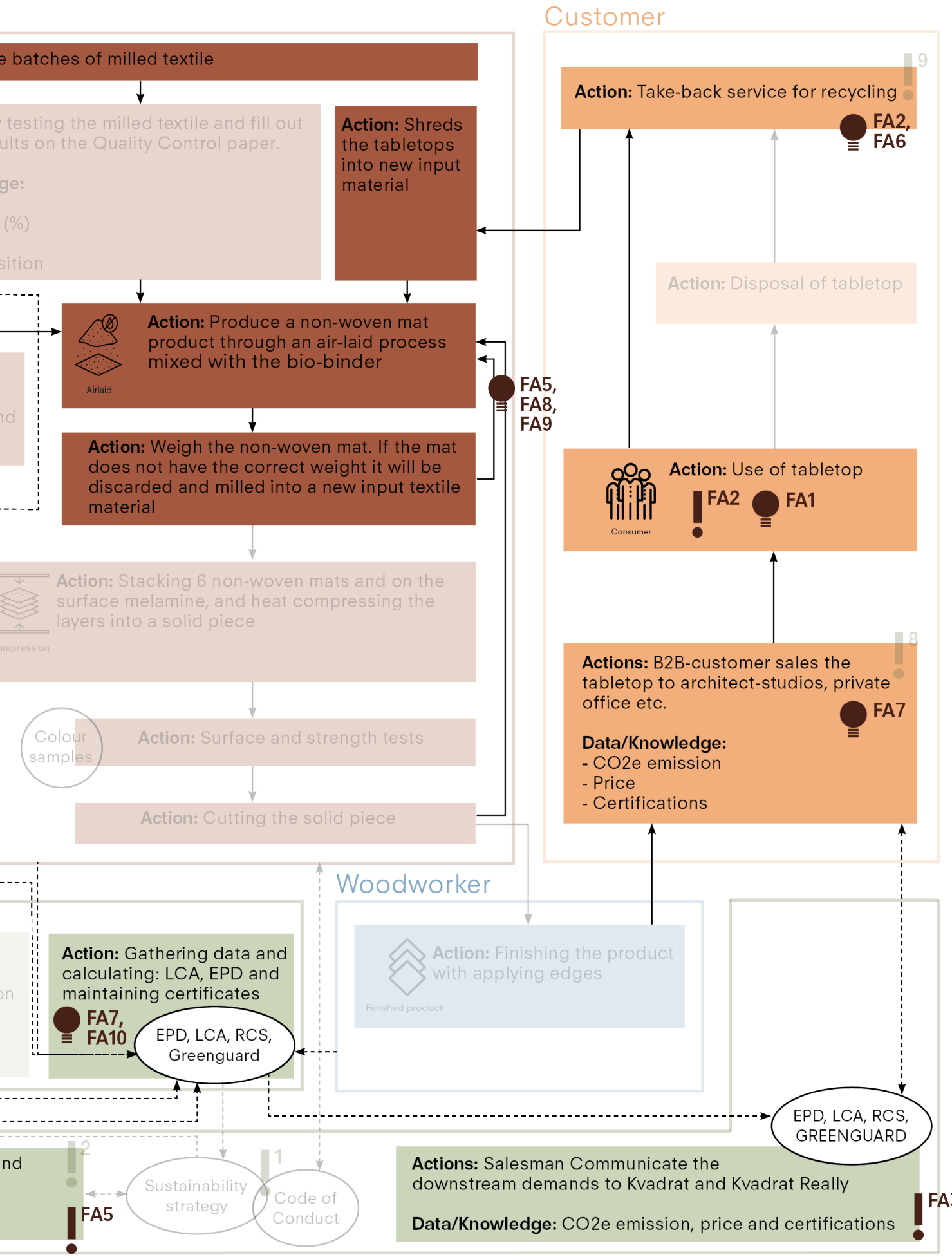


Figure 26 - Visualisation



of the Action Nets with ESPR.

To understand the power of the ESPR in context to Kvadrat Really, this analysis will describe how each Focus Area affects the Action nets by zooming in on the translations appearing where the challenges and opportunities have been identified.

6.3.1 Product Durability and Reliability

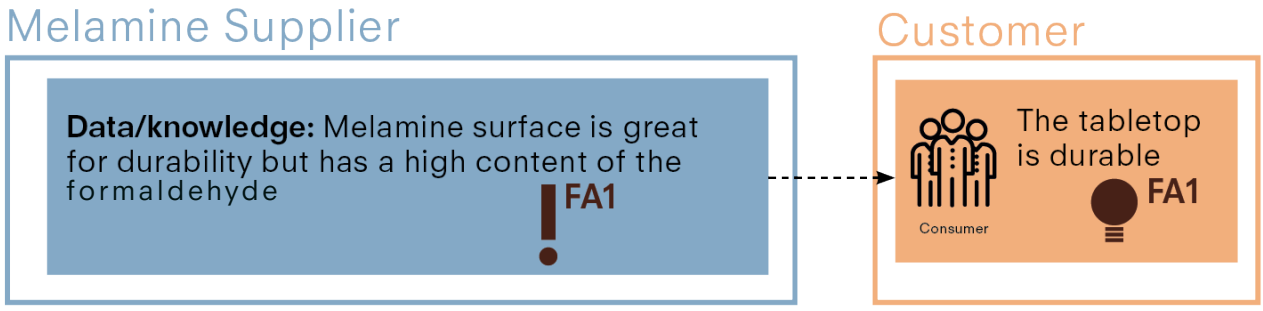


Figure 27 - Challenges and opportunities in FA1.

The outer layers of the tabletops are coated with a melamine surface, enhancing the product's durability. However, from a CE perspective, this poses a challenge to recyclability, as the melamine must be removed from the textile fibres to enable reuse in production. Currently, the melamine surface represents the best option for Kvadrat Really to maintain the aesthetic appearance of visual textile fibres on the surface while ensuring a long-lasting product. According to the ESPR, durability should be prioritised over recycling (European Commission, 2024). Consequently, the research group recommends further exploration into design for durability by reconsidering the separation of material components from the outset. Additionally, product-service systems, such as the one mentioned in section 2.2.4 of Holmris, which involves passing used furniture to institutions in need of functional but not necessarily new tables, warrant further investigation.

6.3.2 Product Reusability

For Kvadrat Really to include more reusability of their tabletops a scalable service system is needed. One thing is the product parts' reusability another is the logistic need for taking back the tabletops for this purpose, as visualised in Figure 28. The question is if this is something that needs to be solved internally in the organisation or if collaboration with actors in the supply chain is preferred (see section 7.1.1).

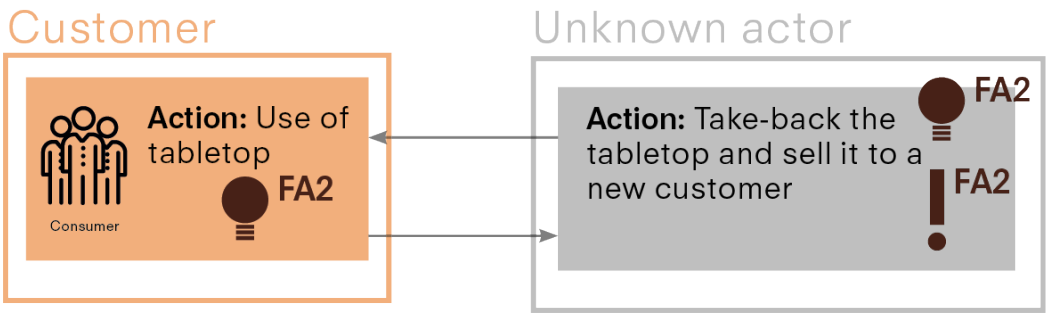


Figure 28 - Challenges and opportunities in FA2.

6.3.3 Product Upgradability, Reparability, Maintenance and Refurbishment

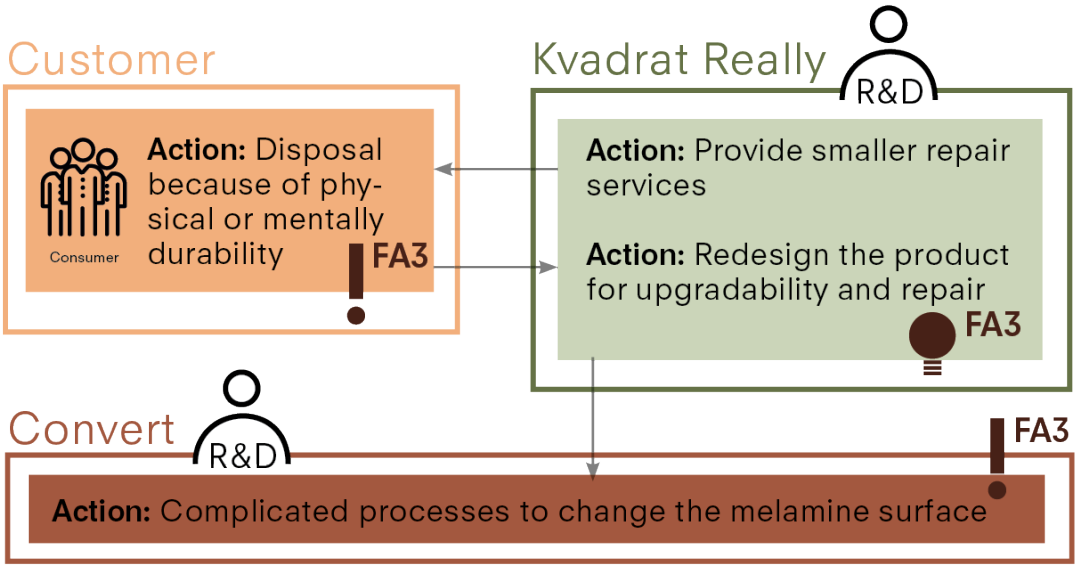


Figure 29 - Challenges and opportunities in FA3.

The product must be designed for upgradability, allowing for repairs or enhancements if it fails or is damaged. This requirement is possible as the melamine surface can be removed and exchanged with a new one (Appendix 5). However, the current challenge lies within the time it will take to perform the upgrade, as the R&D Manager believes that most customers prefer a new tabletop (ibid). The DM from Holmris thinks changing the melamine surface is too complicated and expensive due to the mechanical processes, and many things can go wrong (Appendix 7).

The interview with the SD mentioned how customers ask for more flexibility in reparation services, e.g. a scratch or failure on the surface. As visualised in Figure 29, the Kvadrat Really is currently looking into the possibility of fluent melamine which could repair more minor damages and prevent the need for a whole new surface or a new tabletop (Appendix 2;5). The focus on finding a solution for more minor scratches speaks to the previously mentioned time issue where the R&D Manager said it is possible to change the top of the tabletop. However, the time it will take means that most customers will ask for a completely new table instead (Appendix 5).

This negotiation between the customers and the sales team is affecting the focus of repairability solutions. Even though one solution already exists, the organisation needs to look into solutions that better suit their customers. Change agency is determined by one's normative values and attitudes (Somekh & Thaler, 1997). In this case; time is a value for customers, which this solution demonstrates. A challenge in adopting more repairability services is that this function has not been incorporated from the initial design phase, making it more difficult to develop a solution that can be integrated into the product. (Appendix 1).

6.3.4 The Presence of Substances of Concern in Products

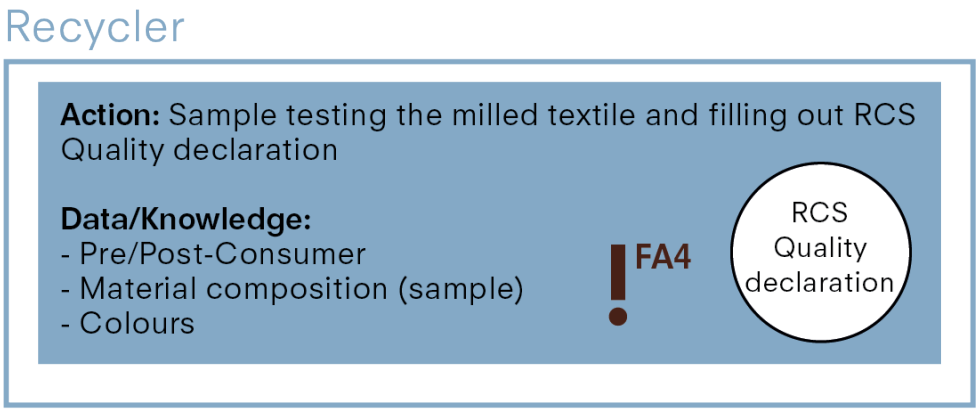


Figure 30 - Challenges and opportunities in FA4.

A key focus within ESPR and the material information required is the focus on more transparency in the presence of SoC as well as the more strict requirements when entering the US market (Challenge 5). The F&D explains how the recycling industry works like "*Cowboys and Indians"* (see section 5.4.4) (Appendix 2). The Key Account Manager at NewRetex has a similar description, referring to the industry as "*a mafia*" (Appendix 8). In the transition toward more CE, a main challenge will be the transitioning period, as the textiles produced for the last ten years have not met the exact requirements in terms of chemical usage (Appendix 5). As visualised in Figure 30, Convert currently demands the recycler for the RCS declaration to document the input material. Besides the existing challenges, this standard does not state anything about the chemical usage or content within the textiles.

6.3.5 Product Energy and Resource Efficiency

Kvadrat Really exclusively uses 100% renewable energy in its production processes, as documented by green energy certifications stamped by Rambøll (Kvadrat, n.d.-b). Given that the input materials for their products consist entirely of waste textiles, the organisation has achieved a prominent position in terms of resource efficiency.

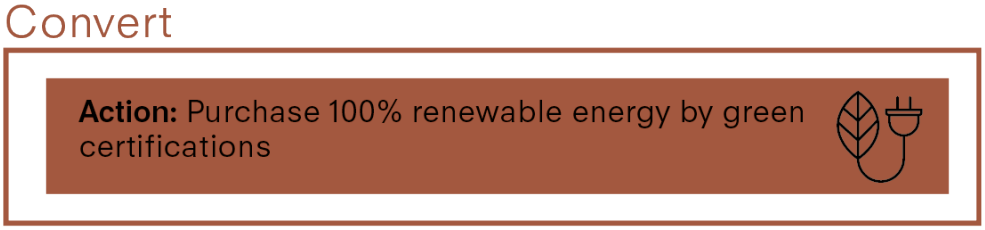


Figure 31 - Challenges and opportunities in FA5.

6.3.6 Recycled Content in Products

From the interview with the R&D Manager recyclability opportunities is stated in the translation of textile waste into tabletops, which creates the opportunity to meet the requirements of the ESPR in terms of recyclability as an integrated part of their business model (Appendix 1).

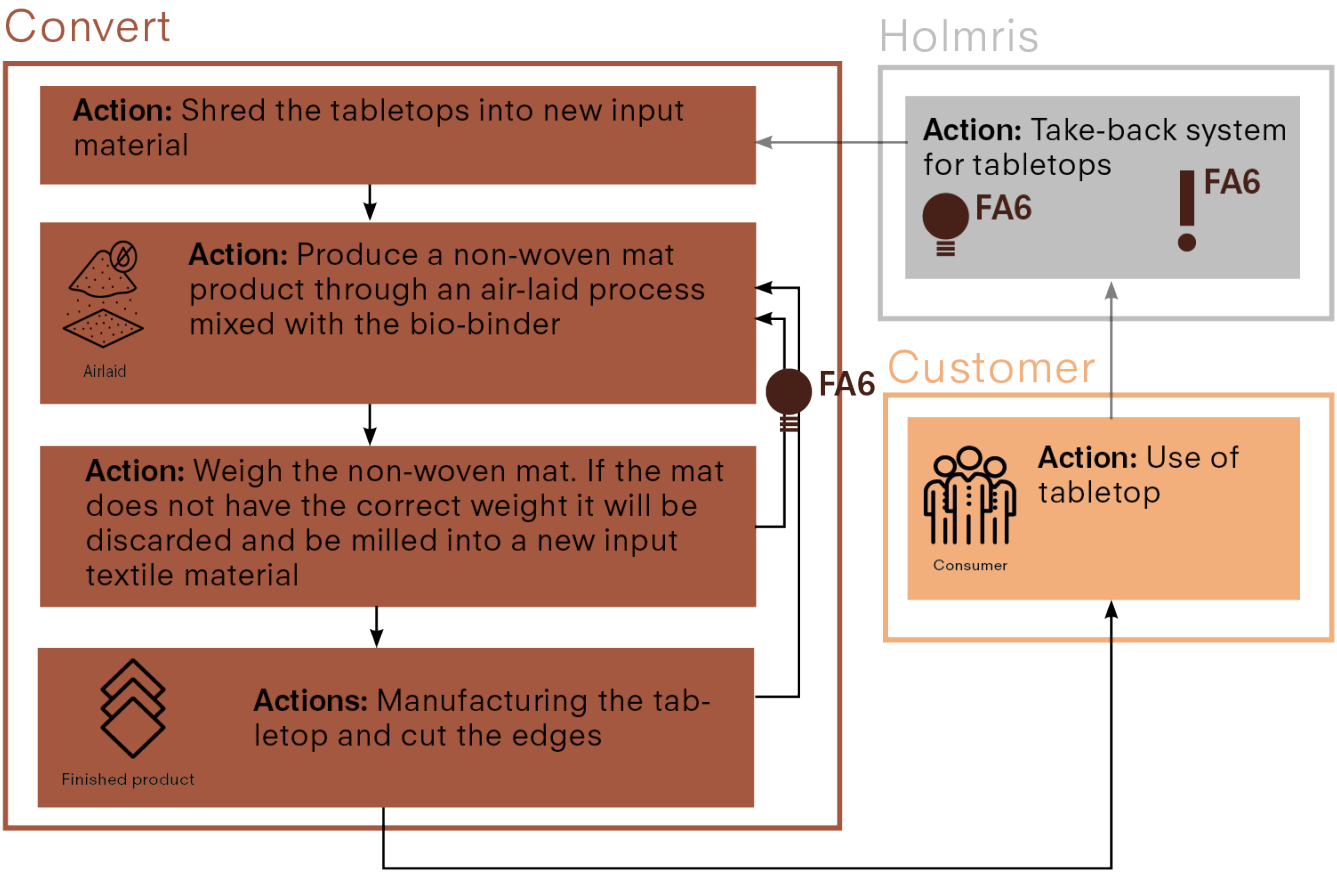


Figure 32 - Challenges and opportunities in FA6.

The tabletop cut-offs from the air-layed production step can be recycled directly into the machine again, which means less resource use and more value gained from the production. According to the R&D Manager, the processes are developed to recycling the cut-offs repeatedly (Appendix 5). Having said that, Figure 32 visualise that the system for recycling the tabletops has not been implemented into the production system yet, this would need a broader collaboration with their customer Holmris, as they already have developed take-back service systems in larger amounts which would be required (Appendix 7). From the interviews, it is clear that the lack of knowledge concerning how the infrastructure should work to recycle at a larger scale while meeting the requirements of more material knowledge is challenging.

The binder used in the tabletop lowers the product's CO2 emissions but makes it difficult to recycle when mixed with textile fibres (see section 6.3.8). According to the F&D, their reflections on this matter are rather pragmatic, as this is how the industry looks

currently, and as long as there are no better solutions for binders, they will stick to this (Appendix 2).

The leftover yarns from Kvadrats' production, which are recycled in Kvadrat Reallys' tabletops, speak to the ESPR focus areas of recycling and circulating materials. The challenge is that the main material used at Kvadrat is wool, it is only a small amount which can be circulated into the tabletops as they need a minimum of 60% cotton. The fact that Kvadrat Really is not seen as an integrated part of Kvadrats' material journey makes it challenging to create a closed-loop system of the materials which has the consequence of Kvadrat Really needing to look in the direction of recyclers to provide the qualities needed (CHALLENGE 2).

6.3.7 Product Remanufacturing and Recycling

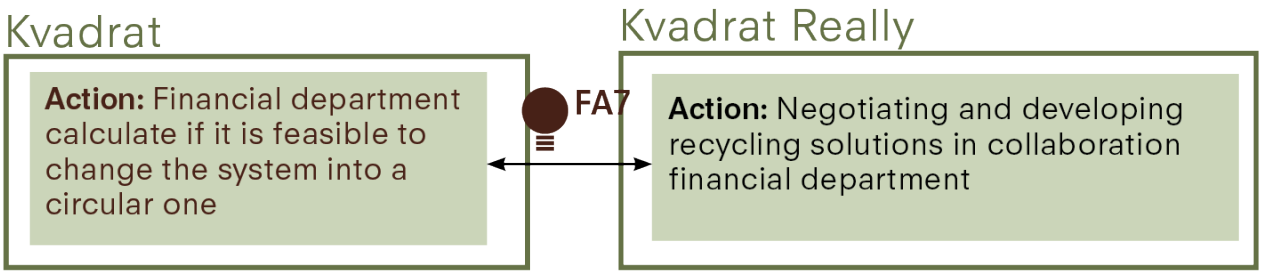


Figure 33 - Challenges and opportunities in FA7.

The F&D highlights the importance of implementing more circular business models across Kvadrat and Kvadrat Really, where the Financial Department has a crucial role in taking part in and navigating the opportunities within the innovating environment (Appendix 2). The Financial Department becomes a crucial element for negotiating a more circular economy as the industry is built upon an economic evaluation of strategies to define if they make sense in environmental and branding aspects. This gives the financial department a position of agency as they calculate if it is economically feasible to change the system into a circular one. Another aspect is valuing data and knowledge collection more consistently, as this is currently lacking. As the ESPR requirements are being settled in the coming years, a focus on more data will be required. According to the R&D Manager, this will be essential in pushing the motivation toward valuing the data-collecting process (Appendix 5).

6.3.8 Products' Carbon and Environmental Footprint

As mentioned in the first analysis (5.4.9) customers increasingly prioritise a lower CO2e emission when selecting tabletops. The furniture industry plays an important role in clarifying potential trade-offs by prioritising low CO2e emissions above recycling. In the case of Kvadrat Really adding a bio-binder makes the tabletop a composite material which can be more challenging to recycle in an open-loop system.

6.3.9 Products' Expected Generation of Waste Materials

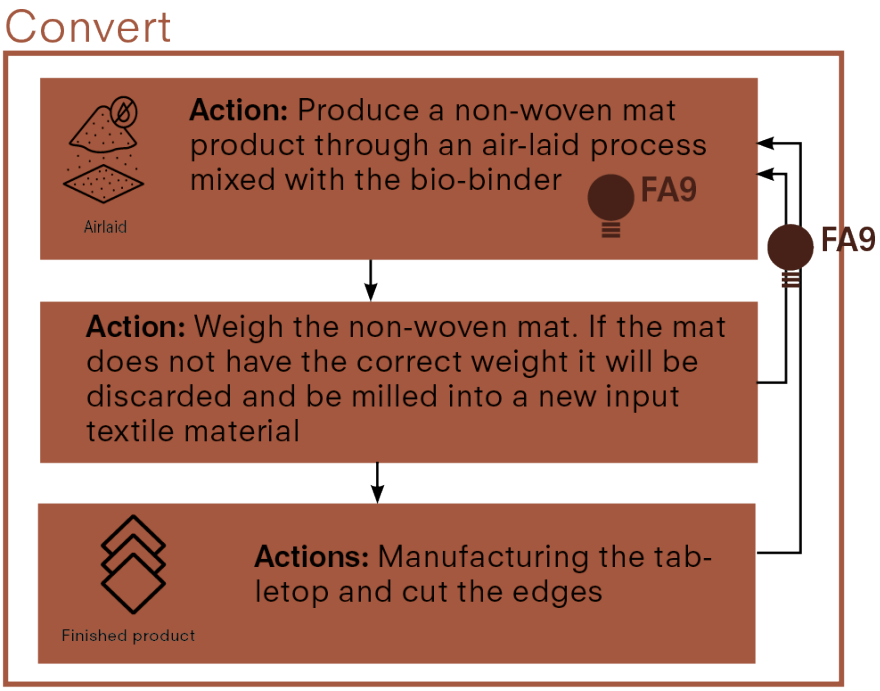


Figure 34 - Challenges and opportunities in FA9.

Before producing the final tabletops, the step involves making felted mats, which as elaborated in section 6.3.6, can be directly recycled back into the machinery, resulting in minimal waste. The main source of waste in the organisation's production process is dust from the textile fibres, which accounts for about 10-15% of the total production (Appendix 1).

6.3.10 Available Information on The Product

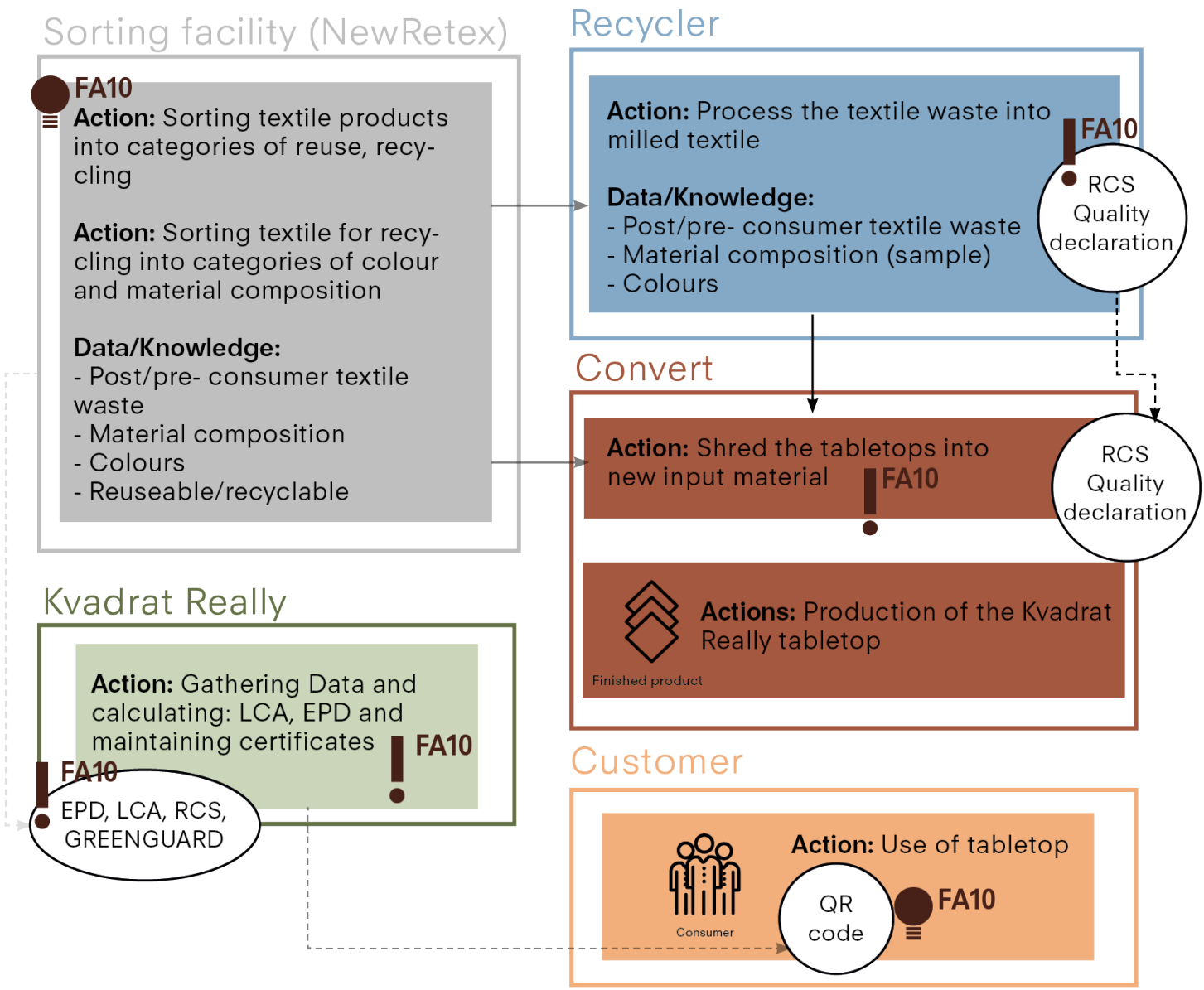


Figure 35 - Challenges and opportunities in FA10.

Part of the ESPR focus areas is to use more recycled content in products. This creates an opportunity for Kvadrat Really to position itself better as the product only consists of recycled content. On the other hand, the requirement will also need more information on the recycled content, such as chemical content and processes and the origin of the material. The current material declaration between the recyclers and Convert is based on RCS requirements (see section 5.4.5). The F&D elaborates that it has been difficult to get any information from the recyclers concerning how they quality tests the textiles or where they come from (Appendix 2).

The R&D Manager highlights that the recycler's composition often is incorrect. Knowing the exact composition of the textile waste requires new technology, e.g. the one used at the sorting facility NewRetex where the garment is scanned and analysed for the exact

data composition and colour group (Riba et al., 2020, 2022). The challenge of working with a sorting facility is that Kvadrat Really requires a certain amount of input textiles in specific colours to produce the amount and scale required, which they currently need to determine if the sorting facilities can provide. When visiting NewRetex they informed the research group how they deliver textiles sorted into specific composition because of the AI-controlled system they have developed for sorting textiles, e.g. into colour groups (Appendix 8).

According to the F&D, the supply chain needs to be as simple as possible, as adding a sorting facility between the recycling facility and Convert would be more costly and complex (Appendix 2). One option would be to focus on the relationship between the sorting and recycling facilities and how they can collaborate to meet the requirements for more data on the materials and the amount of textiles available.

From the interview with the F&D, the price when collaborating with a sorting facility is 2 kr. and 12 kr. for a recycling facility, making it easier to shift a partnership with a sorting facility instead of a recycler. In the end, the requirement for more exact composition data on recycled content will push for a need for change in the current supply chain collaborations which will depend on who takes on the “driving role” in being fastest in adapting to the new regulatory requirements while meeting the scale and price demands.

Another opportunity illustrated in Figure 35 is if Convert decides to invest in a new shredding machine only for the textiles. This would mean better control in lowering the waste amount generated in the production (see section 6.3.9). This would also mean a cost saving, as Convert is currently only paying for the process at the recycler and not the material (Appendix 5). To invest in a shredding machine only for the textile fibres would need an approvement from the CEO and Kvadrat, as it will be expensive. This requires the Kvadrat Really team to develop the narrative concerning reuse and recycling regarding transparency to convince the CEO and Finance department of more production control at Convert.

As Figure 35 highlights certifications have a crucial role in demonstrating how well the product lives up to certain environmental requirements. A current discussion and criticism of these is how little CE is included in the criteria for the different certifications (Dansk Erhverv, 2022; Appendix 2). This is a crucial action to push the furniture industry towards developing more circular business models including the ESPR requirements.

The felted mats and tabletops come with a QR code tag that links to a maintenance guide. This system is a good foundation for further development in terms of implementing a DPP to meet the ESPR requirements. The ESPR focus areas include the substances that negatively affect the re-use and recycling of materials, which is a crucial element to make available in the DPP (Bour et al., 2023).

6.4 Navigating Challenges into Strategies

CE involves incorporating new sectors, such as recyclers and sorters, into the textile and furniture material journey. The dependency between Kvadrat Really, Convert, and the recycling facility is crucial for expanding data and transparency about the tabletops' production process. This dependency requires detailed information on production steps, material compositions, and processes (European Commission, 2023). Addressing these challenges must be reflected in their political programs to ensure agreement on their importance. Combining Kvadrat's and Kvadrat Really's material journeys could enhance supply chain transparency by better documenting and controlling material input from internal processes. However, it is unclear if Kvadrat Really aims for this or if it focuses on circulating textile waste in an open-loop rather than a closed-loop system. Furthermore, the organisation has the foundation for a Take-back system based on circular economy principles (see section 7.2). The question is whether they prioritise this over other strategies.

Figures 36a,-b & -c lists how the challenges from analyses one and two relate to the ESPR focus areas. Grey indicates challenges from analysis one, red from analysis two, and green highlights opportunities in each focus area.

Challenges and opportunities to ESPR	
ESPR Focus Area	**Challenge/Opportunity**
Durability	Textile input material is not the optimal choice for tabletops
	Certifications lack a focus on CE practices (durability is a part of CE)
	The melamine surface supports durability as it makes the tabletops more resitance.
Reusability	The different roles and responsibilities in the supply chain and K.R. need to be more transparent.
	Kvadrat Really's business model could expand to include a take-back system, but it requires logistic and systemic scalability.
	Certifications lack a focus on CE practices.
	Making a take-back system would require collaboration with Holmris who has already established a system for this.
Upgradability, Repairability/ Possibility of Maintenance and Refurbishment	Kvadrat Really lacks knowledge and tools about SoC, including the input material and its high formaldehyde content in the melamine.
	More customers are focusing on sustainability, but they expect a recycled product to be the same quality as a virgin one.
	Certifications lack a focus on CE practices.
	The melamine surface can be refurbished.
Presence of Substances of Concern	Recyclers determine composition by testing once and assuming the rest of the textile waste matches.
	Missing data from the recycler means a lack of control over the quality of the product.
	Kvadrat Really lacks knowledge and tools about SoC, including the input material and its high formaldehyde content in the melamine.
	The different roles and responsibilities in the supply chain and K.R. need to be more transparent.
	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
	Certifications are used as a tool for preventing greenwashing.
	The collaboration between K.R and the recycler is based on trust.
	There does not exist a standard, system or technology, that can test textile waste in scale.
Environmental Impacts, including Carbon and Environmental Footprint	The bio-binder consists of 20% industrial PET waste and 10% used cooking oil.
	The felted mats can go directly into the machine again.
	Kvadrat Really currently lacks knowledge of their energy use in production.

Figure 36a - Overview of the challenges and opportunities to ESPR.

ESPR and challenges/opportunities	
ESPR Focus area	**Challenge/opportunity**
Energy and Resource Use or Energy and Resource Efficiency	Kvadrat Really and Convert can not fill out the needed data and documentation Kvadrat demands.
	The felted mats can go directly into the machine again.
	Kvadrat Really's production is entirely powered by green energy and biogas, resulting in lower CO2 emissions.
	Certifications lack a focus on CE practices.
Recycled content	Recyclers determine composition by testing once and assuming the rest of the textile waste matches.
	The tabletop requires at least 60% cotton, conflicting with Kvadrat's primarily wool materials.
	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
	Missing data from the recycler means a lack of control over the quality of the product.
	Certifications are used as a tool for preventing greenwashing.
	The felted mats can go directly into the machine again.
	Adding NewRetex to the supply chain.
	New technology, such as NewRetex, is needed to determine the exact composition.
	The RCS declaration is not detailed enough.
	It is challenging to get any data from the recyclers concerning the composition, and origin of the textiles.
Remanufacturing and Recycling	Kvadrat Really lacks knowledge and tools about SoC, including the input material and its high formaldehyde content in the melamine.
	The different roles and responsibilities in the supply chain and K.R. need to be more transparent.
	The bio-binder consists of 20% industrial PET waste and 10% used cooking oil.
	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
	Certifications lack a focus on CE practices.
	The melamine surface is problematic in terms of recycling.
	The felted mats can go directly into the machine again.
	Adding NewRetex to the supply chain.
	Supply chain innovation depends on who quickly adapts to regulatory data requirements and meets quantity and price demands.
	The core concept of K.R is built on recyclability.

Figure 36b - Overview of the challenges and opportunities to ESPR.

ESPR and challenges/opportunities	
ESPR Focus area	**Challenge/opportunity**
Expected Generation of Waste Materials	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
	Kvadrat Really and Convert can not fill out the needed data and documentation Kvadrat demands.
	Certifications are used as a tool for preventing greenwashing.
	The felted mats can go directly into the machine again.
Available Information on the Product	The different roles and responsibilities in the supply chain and K.R. need to be more transparent.
	Recyclers determine composition by testing once and assuming the rest of the textile waste matches.
	Convert's machinery uses diverse materials, preventing textile input from being used in their screeding machine.
	Missing data from the recycler means a lack of control over the quality of the product.
	Certifications are used as a tool for preventing greenwashing.
	QR Code on the felted mats and tabletops.
	Adding NewRetex to the supply chain.
	Supply chain innovation depends on who quickly adapts to regulatory data requirements and meets quantity and price demands.

Figure 36c - Overview of the challenges and opportunities to ESPR.

7. Analysis 3

In Analysis 1, the existing challenges in Kvadrat Really were identified. In Analysis 2, these challenges were linked to ESPR, and potential solutions for both current organisational - and future ESPR-related challenges were identified. Both analyses addressed the challenges by investigating how the actors engage in interactions across various political programs and actions in a vertical dimension (Bødker et al., 2017). The third analysis aims to translate the challenges into opportunities that Kvadrat Really can implement in a strategy for accommodating the future market regulation of ESPR. This will be done through an online questionnaire followed by a meeting, where selected actors of the organisation participate in a discussion of data on the input materials, take-back systems, expansion of markets, collaborations, and their roles in the value chain. In this process, political programs will become visible, and knots are starting to be tied. In conclusion, this section will present a draft of the action plan.

SubQ-3: *Which actions can Kvadrat Really implement to strengthen its position in the textile waste- and furniture markets affected by ESPR in the future?*

Source: Kvadrat Really

7.1 The Questionnaire

The questionnaire was made for the actors to reflect individually on the identified challenges from Chapters 5 and 6 before the workshop discussion. The questionnaire consisted of eight questions, which the actors, on a scale from one to five had to rate, based on how much value they believed solving the challenge would bring to the organisation. One being of no value, and five being the most valuable. Additionally, two qualitative questions were posed: "What will it take?" and "Who will it need?" to solve these challenges. The purpose of combining quantitative and qualitative data was to investigate whether there was a specific tendency in the respondents and to capture the context combined with potentially diverse interpretations of the questions (Singleton & Straits, 1993). The following section will elaborate on how the questions are related to the empirical findings from the past two analyses and how they are translated into a boundary object for negotiations in the workshop.

7.1.1 Preliminary Work for the Questionnaire

The questionnaire was formulated based on an amalgamation process of the organisational challenges identified in the first analysis combined with the findings from analysis two concerning the ESPR challenges and opportunities identified (see Figure 36a, -b & -c).

Despite identifying the challenges through interviews with the actors, the research group prioritised ensuring that the subsequent amalgamation process did not compromise the actors' political agendas. The actors within Kvadrat Really need to be the primary agents responsible for implementing and maintaining the strategy by driving value chain transformations. Based on this process, a value-creating question representing each challenge and relevant ESPR topic was formulated. By allowing selected participants to evaluate and identify the challenges most valuable for the organisation, they become engaged in a participatory design process that gradually shapes the organisation's strategy.

In Figure 37, the value-creating questions, the ESPR focus and the rationale behind the question are presented:

Value-creating Questions			
No.	**Question**	**ESPR focus area**	**Explanation**
1	How valuable would complete data and knowledge about chemistry be for Kvadrat Really (and Kvadrat)?	**FA4:** Presence of Substances of Concern	This speaks to their current problem concerning a lack of data from their recyclers on which chemicals are used in recycling.
2	How valuable would complete data and knowledge about the composition and quality of input materials be?	**FA1:** Durability **FA10**: Available Information on the Product:	The composition needs to be of a minimum of 60% cotton to keep the quality of the product, another aspect is the level of dust, which can't be more than 6-8% before resulting in a less good quality.
3	How valuable would complete data and knowledge about the origin of the textiles be for Kvadrat Really?	**FA10**: Available Information on the Product	The processes and what to expect concerning chemical usage and working conditions have a lot to say depending on the origin of the textile. More transparency would mean K.R could be more critical towards the input material sourcing.
4	How valuable would a fully functional take-back system be for Kvadrat Really?	**FA2:** Reusability **FA7:** Remanufacturing and Recycling	Their business model is built to make the system, but they would need a collaboration with Holmris for logistics.
5	What level of value would be achieved if Kvadrat Really could enter the American market?	**FA4:** Presence of Substances of Concern	This could improve their sales by attracting more customers. However, this market has stricter regulations regarding chemicals and melamine, which are currently used to make the tabletop surfaces more resistant to scratches and stains (durable)
6	How valuable would it be for Kvadrat Really if Kvadrat more extensively incorporated Kvadrat Really into a circular system and thus better supported and understood Kvadrat Really?	**FA6**: Recycled content **FA10:** Available Information on the Product	This would mean better control over the input material, as there would be more available data from the suppliers and on the material level.
7	How valuable would it be for Kvadrat Really if the recycling sector met the same requirements as the product and textile industries?	-General ESPR	It would make it easier to scale their business as the current barrier is the lack of streamlining requirements between the sectors.
8	How valuable would a position that fully understands quality requirements and market regulations be?	-General ESPR	This could potentially mean a better and faster process of integrating ESPR into the organisation, as there would be a shorter distance between the daily tasks and negotiations.

Figure 37 - The Value-Creating Questions: ESPR Focus and Rationale Explained.

The following ESPR focus areas were not included in the questionnaire: *FA3-Upgradability, Repairability/Possibility of Maintenance, FA5-Energy and Resource Use, FA8-Environmental Impacts, and FA9-Expected Generation of Waste Materials* (see *Figure 25*). Questions were not formulated for FA5, FA8 and FA9 because these areas are already being effectively addressed by Kvadrat Really and were not mentioned frequently enough by the actors in the initial analyses. As stated in analysis two, the production facility is certified with a green energy certifications. The main input material is classified as textile waste, produced without water usage, resulting in a lower CO2e emission. Pr. sqm, which is a 30% saving compaired to a conventional MDF tabletop (Kvadrat, n.d.-b). A question specifically for upgradability and maintenance would have been relevant to include as it is a product-specific attribute for product longevity (Arne Remmen, 2024). However, it was addressed in the discussion with the actors in the workshop under the theme of a take-back system (see section 7.3.3).

7.1.2 The Parameters

Valuing in an organisation can be interpreted in various ways, therefore the research group decided on the following parameters for the actor to evaluate from:

- The cost of the product
- Saving time and reducing the workload
- The quality of the product
- Meeting customer demands

The parameters are based on our empirical findings from interviews, field trips and insights from the literature review. The parameters focus on economic, social and environmental sustainability combined with the main drivers for including Eco-design considerations in organisations by Salo et al. (2020) (see section 2.1.2).

The top four motivations in the textile industry are “general willingness”, “increasing the value of products”, “quality of products” and “requested by customers” (ibid). The interviewed actors also mentioned some of these parameters which reflect their political programs. Both the SD, the DM and the R&D Manager have expressed that Kvadrat Really’s tabletops are expensive compared to other office furniture on the market (Appendix 2;7). It is important, that the product’s price does not increase further. Following this; *The cost of the product* is added as a parameter. The F&D also expressed that the financial aspect is important and that the finance department should be more involved (Appendix 2). The R&D Manager also stressed that “*saving time and reducing the workload*” creates value (Appendix 1). This is connected to the financial aspect of manufacturing the tabletops in terms of payment to employees and the operations of machines. In interviews with Kvadrat employees (Appendix 3), maintaining the narrative of creating quality products was emphasised as important and something to be maintained. Durabil-

ity which relates to quality, is an important product attribute in ESPR and CE regarding product longevity, and “quality” is therefore relevant to include. According to the article by Salo et al., (2020), eco-design tools and considerations to meet customer demands is not highlighted as a value-creating factor to include. Despite this, the empirical data from the interviews with the actors stressed the importance of meeting the customer’s demands and was therefore included (Appendix 2;5).

The purpose of relating the ESPR questions into parameters was to materialise the actors’ agendas into numbers through which competing agendas could become visible, making strategic negotiations regarding change in the action nets easier.

7.2 Selection of Actors

To enable a change in the action nets, it is essential to strategically foster the necessary negotiations among relevant actors. The research group involved a diverse array of actors from various horisontal levels. Forming alliances with powerful actors is important, as their support will increase the chances of more actors in the net willingly tying the necessary knots supporting the change program. The research group has gradually built trust with the actors through visits to Convert and Kvadrat, interviews, design games, informal lunch conversations, and an internship before the start of this master thesis. The insights from the meetings have formed the research groups’ understanding of their different political programmes which has been the guideline for selecting participants in the final workshop where the strategies are negotiated. The selected actors are illustrated in Figure 38.

Source: Kvadrat Really

Title: **Founder and Director (F&D)**

The research group has met her several times (Appendix 1). It is perceived that she share
teaching, designing, and guiding the industry, and as the founder of an organisation com
related interests in meeting ESPR. She supports a potential change program and strategi
negotiations is valuable due to her comprehensive understanding of the product chain, p
operations.

Title:**Research and Development Manager (R&D)**

He oversees research and design to ensure continued improvement of the tabletop, alig
times during the project. His main focus is on the product's technical aspects and he is i
are market demands. The project group views him as a supporter of an ESPR-related cha

Title: **Purchaser and Planner (P&P)**

The project group meet him on the visit to the production facility (Appendix 1). The P&P
raw materials are ordered according to the production schedule and verifying that the co
input material which includes, planning, ensuring compliance documentation and the eva
participate. Instead, he answered the questionnaire. He is identified as an actor who pos
related to data. Currently, he does not seem to directly have an agenda for meeting ESPR
to ESPR, he will hopefully become interested.

Title:**Senior Vice President of Supply Chain & Operations (SVP of SC&O)**

The project group meet him at the workshop. As a new actor in the business of Kvadrat R
for overseeing the end-to-end supply chain and operational activities of the organisation
efficient, cost-effective, and reliable operations. He has a background in Kvadrat and is t

Title:**Sales Director (SD)**

He is focusing on achieving sales objectives and driving revenue growth. The research gr
issues (Appendix 1). It became clear that he is the main contact with future customers, bu
refurbishment potential. His focus is on "selling the good story" of Kvadrat Really (Append
the master's thesis, benefiting Kvadrat Really's customers. He did not answer the questio

Figure 38 - Overview of

Company: **Kvadrat Really**

s alliance and common agendas with the group. With extensive experience in
nmitted to sustainability (Kvadrat, n.d.-a), she has both personal and business-
cally uses her influence to engage others in the project. Including the F&D in
procedures, involved actors, and her significant power to influence business

Company: **50% Kvadrat Really, 50% Convert**

ning with market demands and business objectives. The group met him several
nterested in ESPR themes like durability, refurbishment, and recycling, as these
nge program.

Company: **Convert**

plays a crucial role between the suppliers and the production team, ensuring that
orrect materials are delivered. His responsibilities are a blend of purchasing the
aluation of the supplier. He was invited to the workshop, but could not
ssesses an important role in terms of accommodating ESPR-related challenges
R, but by seeing the organisational possibility of solving problematisation related

Company: **Kvadrat**

eally, he was urged by the F&D to participate in the workshop. He is responsible
, and his role involves strategic planning, leadership, and management to ensure
herefore seen as an interesting actor in the link between Kvadrat and Kvadrat Really.

Company: **Kvadrat Really**

oup met him alongside the F&D to discuss the product chain and ESPR-related
t he lacks knowledge of the product's technical aspects, such as composition and
dix 1). His customer interactions provide valuable input for evaluating challenges in
nnaire but participated in the first part of the workshop

chosen actors.

7.3 The Workshop

The workshop took place online on the 21st of May. The research group, the F&D, the SD, the R&D Manager and the SC&O were present. The presentation was structured around the results of the questionnaire. At the beginning of the workshop, it was stressed that the aim was to put the actors' opinions in focus and that the research group's role was to facilitate and keep the structure.

7.3.1 The Result of the Questionnaire

Four out of five of the chosen actors answered the questionnaire. The total results are shown in Figure 39:

	Questionnaire scoring result					
No.	Value-creating Question's topics (see Figure 37)	Meeting customer demands	Saving time and workload	Quality of the product	The price of the product	**Total score**
1	Precise data on material composition and quality	15	14	19	14	**62**
2	Precise data on chemical content	16	14	18	12	**60**
3	Ressources to requirements and market regulation understanding	16	15	17	12	**60**
4	Kvadrat and Kvadrat Really strengthen cooperation	17	14	14	14	**59**
5	Recycling sector standards	17	14	15	11	**57**
6	Take-back system	16	11	14	14	**55**
7	Data on the origin of the material	14	12	15	12	**53**
8	The American market	17	9	15	11	**52**

Figure 39 - The questionnaire scoring result.

The scoring table functions as a boundary object to provide valuable insights into the participants' daily actions and the current challenges within and surrounding Kvadrat Really. In that way, the scoring table functions as a communication tool for the actors to use as a starting point for their negotiations (see section 4.5.1). Following this, the results from the questionnaire also identified which areas to further negotiate.

7.3.3 Results from the Workshop

In the workshop, the participants were urged to react to the scoring (see Figure 39), by negotiating the prioritied order of the challenges. The result of the negotiation will be used by the research group to formulate the final design contribution. The results are visualised in Figure 40:

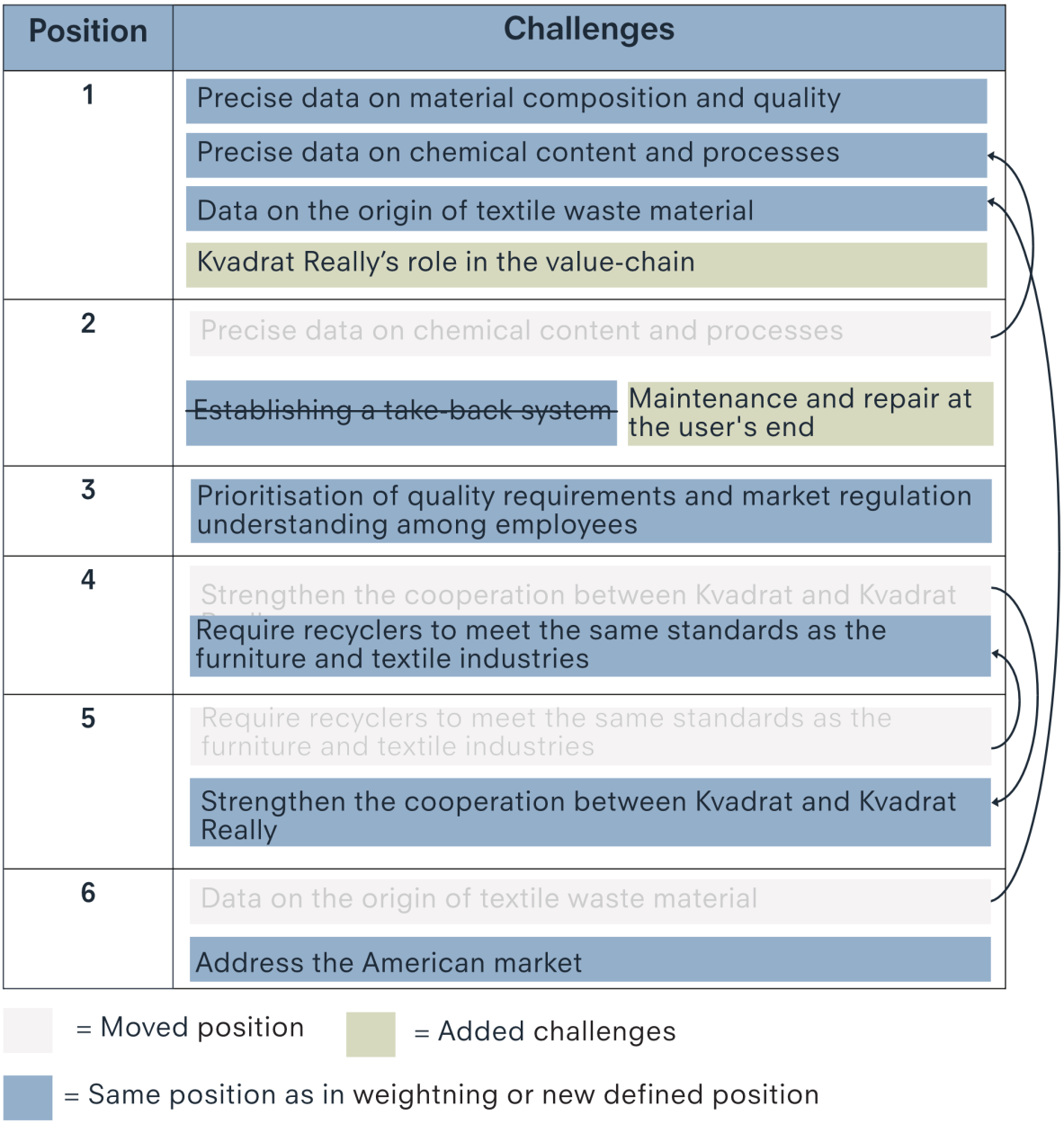


Figure 40 - Results from the workshop.

The R&D Manager and the F&D agreed that "Data on Composition and Quality", should be ranked highest. The F&D stated: *"The composition of materials and their declaration is extremely important, for example, with RCS and other certificates. This will continue to be crucial to a future material passport, where the accurate declaration is essential"* (Appendix 6). In this statement, the F&D stresses her support for the ESPR when referring to the material passport, a policy instrument presented in the regulation. Her support was stated through her reflection regarding a Take-back system, where she high-

lighted the longevity of the product as more important: *"As a starting point, one should not focus on a take-back system, but rather on prevention and maintenance. Develop some tools for maintenance or repair. For example, a kit for consumers is sent with the purchase. Take-back is fine, but it is better to repair"* (Appendix 6). The overall feedback on a take-back system indicates that it is not considered highly meaningful by the actors to prioritise due to the heavy infrastructure requirements and significant related CO2e emission. The aspects of a repair kit for the customers would be more relevant to prioritise regarding meeting the maintenance and repair requirements of the ESPR (Appendix 6).

The R&D Manager argued that the need to discard materials due to undesirable chemicals should be given an equally high rating as *Data on Composition and Quality* (See Figure 39). He also noted that it is crucial to present data on origin, and it therefore makes sense to prioritise it. Furthermore, the F&D and the SC&O agreed on lowering the *The American Market* in the table. The F&D stated: *"Meeting the needs of the USA should be the lowest priority. It is a very different and far too complex market for us to enter."* The SC&O who is new in Kvadrat Really with the agenda of ensuring efficient, cost-effective, and reliable operations, added a new challenge: *Kvadrat Reallys role in the value-chain* (see Figure 39). He followed up on this by asking: *"What is Really's role compared to Convert's in terms of sourcing? Or should it be outsourced, for example, to Altex? Are we good at this, or are there others who would be better at sourcing for Kvadrat Really and thus ensuring the data?"* This reflection is threefold. Firstly he questions the distribution of the roles in the value chain, second, he suggests new collaborations in the supply chain and lastly, he asks for a new knowledge flow regarding data in the action nets indicating that Altex or another recycler should provide this.

All actors are engaged in the discussion related to defining responsibilities in the value chain, which is seen in the discussion related to the aspects regarding; *Prioritisation of Puality Requirements* and *market regulation understanding among employees* and *require recyclers to meet the same standards as the furniture and textile industries*. In the discussion, different roles in the value chain and technologies that provide the data needed are mentioned. The F&D stated: "*Really is both a product and a brand – Convert should be the ones handling sourcing. It should be Convert that collaborates with a recycler. They should know what their machines can work with and how this changes over time"*. The R&D Manager agreed but emphasised that the recycler has an important role in making the sourcing role easy for Convert: "*There needs to be a collaboration with the recyclers, as they have the most knowledge about this. It is difficult for Convert to control quality because the system does not currently exist, so it makes sense for this responsibility to lie externally – with the recycler"*. The SC&O agreed on outsourcing some of the data responsibility to the recycler but emphasised that each link in the product chain has a responsibility: "*It is better to buy this capacity in the market, where others also place demands on them. Therefore, the recyclers must be able to meet the common requirements. Kvadrat has procurement requirements, just as Kvadrat Really has require-*

ments for Convert regarding documentation, which they then pass down to the recycler. Each link in the chain is responsible for providing the correct documentation. Convert has a significant task in ensuring accurate documentation". In the workshop, the negotiation regarding responsibilities in the value chain stands as an example of mimetic connection through the participants observing and learning from stories shared by the other participants. These connections involved translating the participants' experiences and perspectives into forming and strengthening connections. On the other hand, these negotiations regarding data responsibility in the value chain indicate that there are some uncertainties and unstable knots, which have to be tightened in the negotiations between Kvadrat, Kvadrat Really, Convert and the Recycler.

The insights from the negotiations formed the foundation for the research group to develop a draft for a co-created strategy for Kvadrat Really. As mentioned in section 7.3.3, the goal is to motivate the actors to take ownership of the strategy and develop it to their needs, implement it, and by doing so support the political program of ESPR.

7.4 The Strategy

Based on the empirical findings and analyses, the project group proposes a sequence for addressing organisational ESPR-related issues in Kvadrat Really. This proposal is not a final solution but a prototype and a boundary object that the actors can negotiate around. In prototyping, it is strategically, meaningful not to present it as a defined action plan, as this will encourage empathy-building, activate the actors and make them take ownership of the strategy (Carlgren et al., 2016). The purpose is to form the strategy and, to align with the political agendas described. To make the action plan more tangible, the research group urges the actors to specify and further formulate the following: 1) The relevant actors and their positions within the value chain, 2) The necessary data and knowledge of materials, the actions to be taken, and the collaborations to be established. The essential components of the action plan are outlined in the following section. They are depicted as individual bubbles that merge as they are addressed, eventually forming a single subject, whereas the ESPR and Kvadrat Really are seen as a unified entity (see Figure 41).

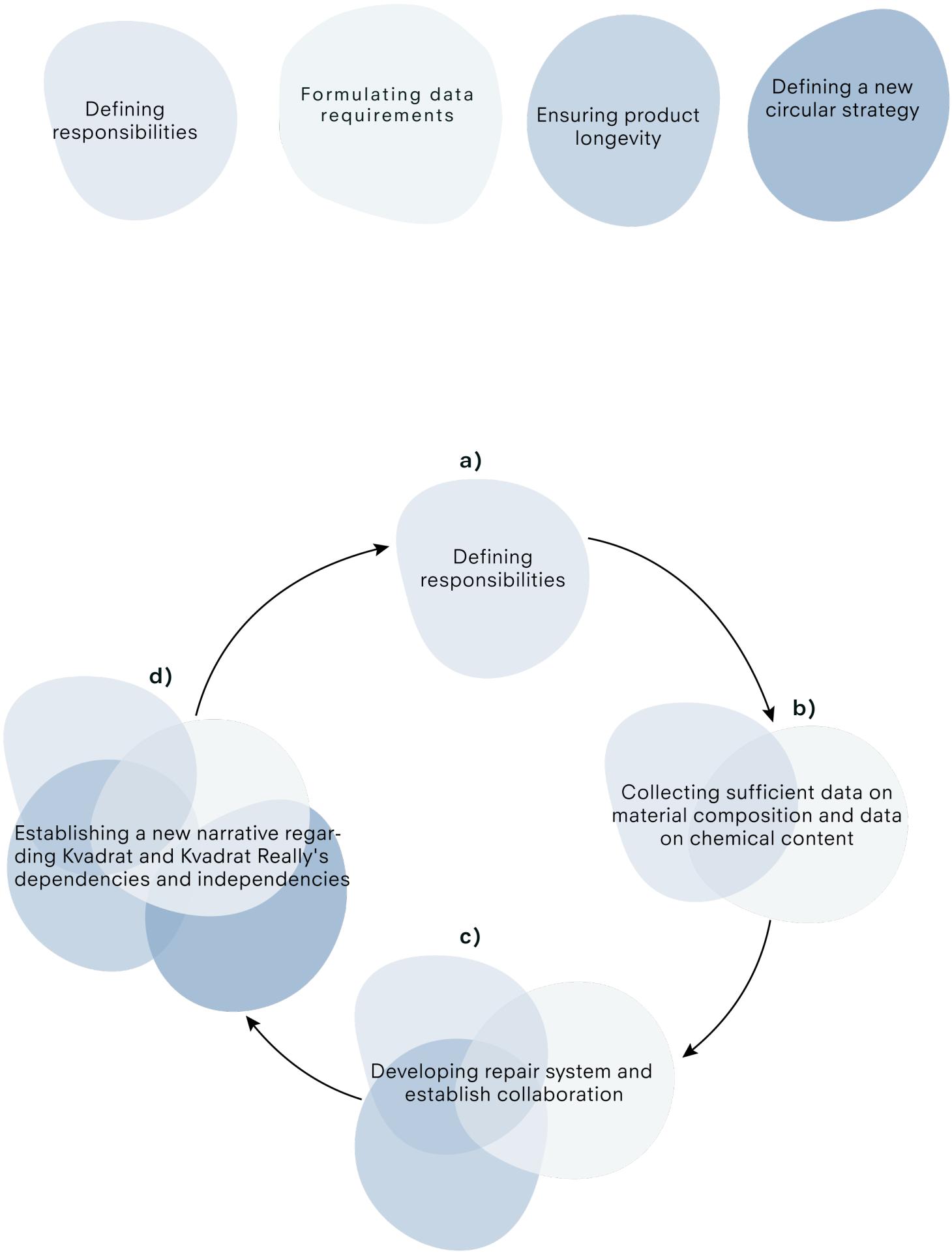


Figure 41 - Proposal of the action plan.

a) Define the different actors' roles in the value chain:
This area concerns the importance of relevant actors in the organisation establishing a clearer definition of each individual's responsibility for providing data on the input material and the final product. To address this issue, it is recommended to organise negotiations involving the relevant actors from Kvadrat, Kvadrat Really and Convert together with the recycler. It is proposed to invite the recycler(s) Altex and NewRetex, both of whom are frequently mentioned by the actors in Kvadrat Really. Inviting actors already familiar with each other increases the possibility of establishing negotiations and tying knots. Both recyclers have different strengths and weaknesses (see section 5.4.4). These aspects should collectively be negotiated, to identify which actions, objects and knowledge flows could accommodate weakness and instead establish strong alliances. This area is closely intertwined with the next area concerning the collection of sufficient data (b) and therefore lays a crucial basis for moving further.

b) Collect sufficient data on material composition and data on chemical content: Once the areas of responsibility are defined, it will become simpler to direct data requests and assign accountability to the appropriate actors in the value chain. This area creates an opportunity for solving organisational challenges regarding data collection and reducing future product defects (Figure 23, challenges 1, 2 and 3), simultaneously engaging in ESPR-related topics regarding transparency, waste generation, product information (DPP) and recycling. Currently, Kvadrat Really has encountered difficulties demanding detailed data from Altex (see section 5.4.5). NewRetex, known for offering more detailed and specific information on their materials, could perhaps take on a more prominent role in the network, as either a new provider of input materials or as a collaborator in the supply chain. Therefore, it is recommended that a representative responsible for sourcing from Kvadrat Really, together with representatives from both recycling companies is invited to negotiate these opportunities.

c) Establishing a repair and maintenance service: This aspect should be a part of Kvadrat Really's program since it creates value in terms of complying with the ESPR regarding prolonging the product lifetime via; product upgradability, reparability, maintenance and refurbishment (FA3, FA7), combined with organisational interest in meeting the customer segment that draws on the market concept of CE. Furthermore, it has the potential to solve the organisational challenges of a take-back system (see section 5.4.10). If customers can take care of their repairs and maintenance, or if Kvadrat Really can send a representative to help customers with these tasks, the need for a take-back system becomes less relevant. Additional resources should be allocated to developing such systems to address this area effectively. This includes the technical aspects of repair and maintenance and communicating these solutions to customers. It is recommended that the R&D Manager

take a leading role in this development. Additionally, the expansion of information provided via the current product QR code, should be further developed. For effective communication of this solution, it is meaningful to include Holmris in the negotiations, given their extensive contact with the end users.

d) Establishing a new narrative regarding Kvadrat and Kvadrat Really's dependencies and independencies: Currently, Kvadrat's sustainability strategy includes a narrative where Kvadrat Really plays a crucial role in ensuring that certain aspects of the company's operations are circular. (see section 5.4.1). The research group has recognised the necessity for Kvadrat to build another narrative, by establishing a new connection through new more sustainable activities between Kvadrat and Kvadrat Really. The change-maker network, as mentioned by the HoS in section 5.4.2, could be an opportunity space for developing the relationship between Kvadrat Really and Kvadrat. To foster the implementation of CE- and ESPR practices, the identified change agents would be valuable to include, as they are more proactive in driving the changes needed.

In the current system, Kvadrat sends wool material to Really to minimise waste and support circular initiatives internally. While this practice aligns with circular principles and waste reduction, it is still problematic as mentioned in Chapters 5 and 6. Rethinking Really's role in Kvadrat's Sustainability Strategy could foster innovation in their current system. The research group recommends that this re-evaluation is crucial for a stronger sustainability strategy to be developed. A reevaluation of the relationship between Kvadrat and Really through negotiations could enhance ESPR strategies across their shared value chains.

Expanding into the American market is currently not estimated as beneficial for Kvadrat Really and is therefore not included in the strategy. As the SC&O pointed out, *"Why not concentrate on all markets within the EU?"* (Appendix 6). Numerous challenges associated with the American market do not justify immediate attention. While obtaining more chemical data may facilitate Kvadrat Really's entry into the market, it introduces new challenges related to their use of melamine in the outer layers of the tabletops. Melamine currently serves as the outer layer surface, ensuring appropriate surface durability, and compromising durability is not a viable option.

Figure 40 illustrates the process of integrating ESPR-related- and organisation focus areas through new actions and collaborations within the action nets. The subsequent step involves negotiating the content of the model and considering its potential implementation.

Source: Kvadrat Really

Discussion, Conclusion & Reflection


Source: Kvadrat Really

8. Discussion

This chapter examines the principal findings derived from the preceding chapter's results. It is organised into three subsections corresponding to the research questions outlined in the research design chapter.

Sub-Question 1 - Challenges in Kvadrat Reallys Action Nets

A key focus within the ESPR is to create durable products, which requires a system and clear guidance for which kind of data is crucial affecting the starting point of creating textile products with reuse and recycling in mind. But what about the tons of textiles produced without considering CE principles? In the interviews with the R&D Manager, he states that the main challenge will be the transitioning period as the textiles have been produced for the last ten years before CE requirements were defined (Appendix 5). The mindset of designing and building a system for CE is crucial. But even more present, is finding solutions for how to use the textile resources that are already produced which cannot necessarily live up to the data requirements needed for recyclability (Bour et al., 2023). The research group questions if this is reflected enough in the ESPR and whether the timeframe for adjusting the textile- and furniture sectors to the ESPR has thought of which kind of challenges might appear from the tons of already produced textile products.

The certification systems in the sector of textile- and furniture products have a lot of agency as these *objects* have become guidelines for the industry to avoid greenwashing. Focusing on voiding greenwashing is important, but the certifications need to include more CE perspectives in the certification criteria as well. In the literature review, the Joint Research Center supports this by proposing simplifications of the EU Ecolabel criteria specifically focusing on including more recyclability aligning with the ESPR standards (Joint Research Centre (JRC) Day 2, 2024). The research group argues for enhancing certification criteria to encompass circular practices. With this focus, transitioning to a circular system will be easier for organisations, as the current criteria reflect the complexities of operating within such a system.

Kvadrat Really is an organisation that has based its business model on practising circularity, a challenging task demonstrated by their years of development into their current tabletops. By using textile waste as the primary material for their tabletops, the organisation operates within an open-loop system. One might question whether the textile waste would be better utilised in a closed-loop system for fibre-to-fibre products. Additionally, does establishing a business case like Kvadrat Really's make sense if it does not lead to radical changes, such as reduced consumption and the adoption of closed-loop systems? The research group argues that to find solutions for transitioning to circular systems, the industry needs to explore and test how this can be done to understand and identify the

challenges and opportunities within the current practices for transitioning toward radical changes. Kvadrat Really exemplifies an organisation that continually tests and improves its products. Their progress is evident in their development from initially producing 10 mm boards to now manufacturing tabletops with a thickness of up to 22 mm.

Sub-Question 2 - ESPR and Kvadrat Really

According to the literature review, barriers like organisational culture and establishing ecosystem partnerships can hinder circular advances (European Environment Agency, 2021; SITRA, 2019). The challenges lie in establishing narratives supporting circular advances through the supply chain. The transition toward CE systems needs to include sectors that have not been operating in this way before, such as recycling and waste. To create a successful system that aligns with ESPR practices, it is essential to identify and develop a common narrative on valuing resources from a circular perspective at each phase of the supply chain. The existing literature, as well as the ESPR guidelines, do not support how to solve this issue or specify the tools required to integrate the various sectors. It simply agrees with the EU's focus on supply chain traceability in the textile sector, highlighting the challenge of translating this into actionable practices (Trads et al., 2024).

The Political Process Theory involves observing and participating in actors' narratives by engaging in their daily routines. Due to the limited time and resources of this project, such a detailed investigation was not feasible. However, the research group relied on findings from a previous internship by one of the members, which involved participating in the daily dynamics of the organisation in both the office and production facility. Emphasising this back stage work could have further supported the quality of assumptions about the actors' political programs and strategic considerations in facilitating negotiations.

From the analyses, it appears that recycling industries operate rather unregulated with a main focus on profit before CE concepts. Trust is a core concept of CE, which conflicts with the impression of the recycling sector as more unregulated and difficult to get data from. According to Agrawal et al. (2018), traceability facilitates the tracking of products along the chain and transparency is to make information visible and accessible (Ahmed and MacCarthy, 2021). The research group argues that to develop a CE system one needs to look into how the current textile waste is traceable and where the system lacks transparency regarding the input materials. To identify the challenges of traceability and transparency the understanding of the dynamics within the organisation is essential. The conflict between designing for durability or recycling appears in the choice of using melamine in the outer layers of the tabletops. The melamine is great for product durability but becomes a problem when recycling the product because of the mix of materials needed to be separated. From the perspective of the ESPR durability needs to be prioritised before recycling, as one of the aims of CE is slowing the products, by keeping them as products for as long as possible, before recycling them.

Sub-Question 3 - Kvadrat Reallys Action Plan to Accommodate the ESPR

The research group argue for the importance of Kvadrat Really settling on what kind of role they want to have in the supply chain. Currently, they have been involved with all steps of the supply chain, which has led to misunderstanding of where the responsibility lies and challenges regarding navigating which strategies to prioritise. From the 6.4.1 section, it is clear that the collaboration between Kvadrat and Kvadrat Really is based on how to combine the two strong narratives being told (Kvadrat: innovation, collaboration, and a deep-rooted commitment to quality and sustainability and Kvadrat Really: innovative and CE practising) and less on establishing a closed-loop system. As mentioned in section 7.4 the compromising of quality and durability of the tabletops would be a wrong prioritising in the context of the ESPR and a closed-loop system is therefore not an option.

Another aspect is the challenge of working cross-sectionally between the textile recycling and furniture sectors, as new considerations arise that conflict with the ESPR's emphasis on reuse over recycling. In Kvadrat Really, recycling is the core of their identity, highlighting the importance of including such insights in the ESPR to ensure all textile company scenarios are considered when establishing requirements. The review of the literature revealed a gap in the integration of ESPR into organisational practices (see section 2). The case study presented in this master's thesis demonstrates the complexity of aligning all aspects of the ESPR with the textile and furniture sectors, as each organisation faces existing challenges that the ESPR might further complicate. In the case of Kvadrat Really, these complexities are even more pronounced since their business operates across sectors, where challenges in the textile, recycling, and furniture industries all have an impact.

The case focus has been shaped by the current challenges highlighted by the actors within Kvadrat Really and throughout their supply chain (see Chapter 5). This has necessitated a primary focus on data and knowledge, rather than on durability and longevity, as these elements are crucial for understanding the challenges that arise in the action nets between actors. The selection of this case study has therefore driven the emphasis towards data and knowledge. Consequently, the prioritisation of focus areas in this master's thesis is intricately connected to the organisation's challenges, aiming to understand how ESPR is integrated and navigated within these challenges. This approach ensures a comprehensive examination of the interplay between data, knowledge, and the operational realities faced by Kvadrat Really. From this, it appeared that focusing on the steps before the finished tabletop (from recycler to product) was important to solve firstly to make a product which can be more durable. The research group argues for the necessity of focusing on a more traceable product development process before focusing on durability and reuse specifically in the case of Kvadrat Really. This case is more complex as it needs to meet the ESPR requirements, but also struggles to find its place

in a supply chain with actors from different sectors such as recycling, sorting, and the textile- and furniture industries. The complexity of meeting the expectations of the sectors while pushing the agenda of more CE practices gives another layer of reflection on what is possible and where gaps are still to be filled with solutions within the regulatory landscape. This master's thesis aims to expose future developments of the ESPR requirements to establish a successful transition of the industries.

Source: Kvadrat Really

9. Conclusion

The ESPR aims to improve circularity, energy efficiency, and environmental sustainability of products in the EU, emphasising product information through the DPP. The textile industry has significant potential for enhancing reuse and recycling efforts and reducing textile waste.

A literature review reveals gaps in academic and grey literature, highlights the necessity of innovative recycling and upcycling technologies, and underscores the need for robust logistical support and actor collaboration across sectors for scalability. It also identifies a gap in academic research on the impact of political regulations on industries like textile recycling, indicating the need for more case studies with practical implications. Furthermore, it stresses the need to shift from a linear to a circular business model in the textile industry, incorporating reuse and recycling (Ellen MacArthur Foundation, 2023; European Environment Agency, 2021). Technological development is crucial for establishing circular systems and reducing environmental impacts (Turnbull et al., 2020), requiring circular strategies and practices at each step of the textile life cycle. This master's thesis identifies challenges in data flow between the recycler and Convert, where the RCS declaration lacks crucial data on dust levels, chemical substances, and material composition, affecting the quality and durability of the tabletops.

This master's thesis provides a comprehensive examination of the furniture brand, Kvadrat Really, which recycles textile waste into tabletops. Using the participatory infrastructure approach, the research group investigates how Kvadrat Really can comply with upcoming ESPR requirements and improve CE practices.

Action Nets Theory traces the dynamics of actions among actors and entities, focusing on how stable action nets are established and how data and knowledge travel through integrated objects. Political Process Theory examines the diversification and evolution of actions, including actors' political programs, negotiations, and alliances. Additionally, the knotworking method creates a cohesive action net encompassing the entire product chain and internal operations of Kvadrat Really, addressing challenges and establishing foundational actions for transitioning towards enhanced transparency.

The master's thesis focuses on identifying current challenges and opportunities within an organisation working with reuse and recycling across sectors, the impact of ESPR, and strategies for transition. Kvadrat Really lacks knowledge on infrastructure to meet ESPR requirements, highlighting the need for negotiation spaces across the supply chain. An interview with the R&D Manager reveals the addition of QR code tags on products for maintenance information, indicating an opportunity for developing repairability services and production transparency.

This in-depth case study highlights the critical needs through the formulation of a strategy consisting of four areas for development to incorporate into Kvadrat Really business operations: *a) Define the different actors' roles in the value chain, b) Collect sufficient data on material composition and data on chemical content, c) Establishing a repair and maintenance service* and *d) Establishing a new narrative regarding Kvadrat and Kvadrat Really's dependencies and independencies.* Defining roles and responsibilities within Kvadrat Really and its supply chain is crucial for meeting ESPR requirements. Existing challenges focus on recycling and quality processes, with less emphasis on durability and repairability, aligning with Kvadrat Really's current stage towards ESPR compliance. Negotiating roles and responsibilities is the first step before implementing other strategic actions.

10. Reflection

Concluding this report it is relevant to address several key reflections such as what contributions the master thesis has made to the field of Sustainable Design Engineering (SDE) and which role SDEs have in solving sustainable challenges in society. Following, what are the limitations of this thesis, what other theories could have been applied, and what are the scalability and prospects for this project?

The study of Sustainable Design Engineering (SDE) addresses the challenges posed by modern consumption, production, and unsustainable technologies by being critical of the differences between change and radical changes when problematising (Aalborg University, 2022). The perspective of SDE is largely aligned with the radical humanist paradigm within the social sciences. This alignment shapes the problem-solving methodologies employed and determines the direction explored for potential solutions. Transitioning the textile- and furniture industries towards more sustainable practices needs change agents who can provide a more holistic approach, where conflict is not seen as a barrier but rather the crucial element for creating radical changes. In the master thesis, the challenges have a central role through the thesis, which relates to the research group's perspective that conflict is interesting because it allows for reevaluation and new perspectives on each other's understandings.

The proposed action plan's goal is not merely to comply with the ESPR but for Kvadrat Really to become a front-runner in transitioning toward more CE and transparency through the ESPR. Participatory infrastructuring has been essential in achieving this aim by emphasising the actors' roles. It supports their perspectives by establishing negotiation spaces, such as the workshop analysed in Chapter 7, allowing them to understand their responsibilities in this transition and aiding in the further development of the strategy themselves.

The choice of methods and theories is reflected in the research group's political programme of highlighting social dynamics as a key focus when understanding the complex-

ity involving humans and their assumptions of this world. It is these theoretical glasses that make the project relevant for the organisation. They are the experts on the actual dynamics, but the research group collect and organises this knowledge through the methods applied making them visible for the actors to understand and negotiate around.

Instead of using Action Nets Theory, this master's thesis could have delved into the original theory; Actor-Network Theory (ANT) (Callon, 2001). ANT describe the complex and heterogeneous network of human and non-human actors, in which the tabletop is in. While Action Net Theory emphasises the actions that connect actors, ANT focuses on the objects and actors themselves. Although ANT is praised for its ability to describe networks, its practical implications are limited. The research group believes that concentrating on the actions between the actors, rather than the actors themself, makes it easier to translate theoretical findings into practical applications, such as action in a strategy for Kvadrat Really. Nonetheless, the importance of social dynamics and power struggles is acknowledged, which is why the theory of political processes is included.

Another more distinct theory that could have been applied is the Multi-Level Perspective (MLP) (Geels, 2005). This theory offers a framework for analysing Kvadrat Really within the context of socio-technical transitions towards sustainability (ibid). Here, ESPR represents a new element in the socio-technical landscape, pressuring the existing textile regime to adopt more sustainable practices, including CE practices and greater supply chain transparency. This pressure creates a *window of opportunities* for niche companies like Kvadrat Really and NewRetex to meet the new demands, ultimately leading to adjustments in the existing regime.

Another topic, that could have been relevant to add as it also supports more traceability, transparency, and general ESPR principles could be to look into the present method of calculating and reducing businesses' Scope 3 emissions. The Scope 3 standard is the only internationally accepted method for companies to account for value chain emissions (GHG Protocol, 2013). It could be interesting to look into how the ESPR focus areas are aligned with the requirements of the Scope 3 calculations to support the integration of ESPR into the organisation. Given the growing focus on Scope 3 emissions among organisations, incorporating this perspective could significantly enhance the project's scalability and relevance.

From the development of the strategy presented in this master thesis, the natural objective would be to initiate a meaningful implementation phase by diving into the first area in the strategy: "Value Chain Roles" (see section 7.4). In this process, key actors should be engaged in a political process to negotiate their responsibilities within the value chain. It is anticipated that this process will lead to relevant connections by tying knots that promote more sustainable value chain collaborations, thereby supporting the objectives of the ESPR.

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